REAL CORP 2016

Manfred SCHRENK, Vasily V. POPOVICH, Peter ZEILE, Pietro ELISEI, Clemens BEYER (Eds.)

SMART ME UP!

HOW TO BECOME AND HOW TO STAY A SMART CITY, AND DOES THIS IMPROVE QUALITY OF LIFE?

22-24 JUNE 2016, HAMBURG, GERMANY

PROCEEDINGS

of the 21st International Conference on Urban Planning, Regional Development and Information Society

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Edited by

Manfred SCHRENK, Vasily V. POPOVICH, Peter ZEILE, Pietro ELISEI, Clemens BEYER

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PREFACE

Manfred SCHRENK,

Conference Director,
President CORP – Competence Center of Urban and Regional Planning

WELCOME to REAL CORP 2016, the

21st International Conference on Urban Planning, Regional Development, Information Society and Urban, Transport, and Environmental Technologies!

Smart cities go hand in hand with evolvement and improvement of digital technology. They are a post-industrial reaction to the economic, social and political changes and challenges the world has been facing throughout the last decade – like the demographic change, the financial crisis or scarcity of resources.

In cities there are plenty of players with very different tasks and interests. Many of them are trying to own the term „Smart city". It is somehow fascinating to compare the different interpretations of this label – from a geographic point of view (for example in Europe, USA, China, ...), through its perspective (humans and quality of life or technology and efficieny as centre point?), or generally from an economic position (potential savings on the one hand, rapidly growing business field on the other hand) and via approaches to standardisation of the city and its services.

There are lots of methods to achieve smartness, and there are lots of approaches to define proper smart indicators that tell us something about the smartness of a city. What are their advantages or disadvantages, which approach may claim to be the right one – and why? What can the planning community do to benefit from smart technologies developments while creating the cities for today's and following generations? During the international conference REAL CORP 2016 some 250 experts coming from 50 countries all over the world are exchanging their knowledge and discussing how to become and stay a Smart City.

What are the most important key factors of Smart Cities: energy, mobility, logistics, housing, security? Which role do other parts play, like environment, disaster management, leisure, research and development? These fields of expertise will be the leading topics of REAL CORP 2016 under the motto "Smart Me Up!". The proceedings comprise about 1,000 pages of hand-picked and mainly double-stage peer reviewed knowledge for planners and for cities.

More than 100 expert presentations and keynote speeches, several workshops on different topics as well as excursions to historic and future development sites of Hamburg complete the programme of this year's conference.

What makes REAL CORP unique is the interdisciplinary and highly international approach of our partners, speakers and participants. Welcome to three days of world-wide networking, sharing of thoughts and development of project ideas in the wonderful Free and Hanseatic City of Hamburg.

Welcome to Hamburg! Have a great conference!

Manfred SCHRENK, Clemens BEYER & the REAL CORP Team

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Table of contents – Inhaltsverzeichnis:

PREFACE **5**
Manfred Schrenk

(Un)Plugging Smart Cities with Urban Transformations **15**
Igor Calzada

A Pilot Experiment on Affective Multiple Biosensory Mapping for Possible Application to Visual Resource Analysis and Smart Urban Landscape Design **29**
Zheng Chen, Sebastian Schulz, Xiaofan He, Yifan Chen

A Spatial Microsimulation Model for the Estimation of Heat Demand in Hamburg **39**
M. Esteban Muñoz H.

A Study on the Lifestyles and Daily Activities of Informal Settlers in Inner Kabul City **47**
Sofia Sahab, Toshiyuki Kaneda

A Suite of Novel EO-Based Products in Support of Urban Green Planning **57**
Mattia Marconcini, Annekatrin Metz

Air-Based Mobile Urban Sensing – Copters as Sensor Carriers in Smart Cities **67**
Benjamin Allbach, Patrick Leiner

Altern im urbanen Umfeld dargestellt an ausgewählten Beispielgebieten von Graz **79**
Josef Gspurning, Julia Kügele

An Approach to Adapt the Paradigm of Integral Planning to Urban Development **99**
Karsten Rexroth, Petra von Both

Behaviour Analysis of Interdependent Critical Infrastructure Components upon Failure **107**
Pradeep Burla, Christine Lindner, Dirk Vallée

Belgrade: Smart Solutions for the Climate Change Challenges? **117**
Aleksandra Stupar, Aleksandra Djukic, Jelena Maric

Brownfields Information Brocker **125**
Karel Charvat, Sarmite Barvika,Tomas Mildorf

Can the Integration of Environmental Dimension Make Smart a Metropolitan Context? An Argument about Planning in the Recently Established Metropolitan City of Cagliari and Natura 2000 Network **137**
Ignazio Cannas, Daniela Ruggeri

City Lab Lisbon – Development of a Smart Roadmap for the City of the Future **151**
Marielisa Padilla, Tom Hawxwell, Willi Wendt

Communal Companies Merging as Smart Approach: Kikinda Town in Serbia Case Study **161**
Danilo S. Furundžić, Dijana Jakšić-Kiurski, Ivana Petrović

Comparing Automated Methods for Identifying Areas of Critical Heat Demand in Urban Space **171**
Hannes Seller

Computing Residential Heat Demand in Urban Space using QGIS. A Case Study for Shumen, Bulgaria **179**
Ivan Dochev

Creative Capital for Smart Solutions: Toward a Liveable City **189**
Sanja Simeunčević Radulović, Aleksandra Stupar

Crowd Delivery als neues Lieferkonzept zur Stärkung des „Lokalen Marktplatzes“ **197**
Linda Dörrzapf, Martin Berger, Gert Breitfuss, Elias Remele

Das Konzept der quattromodalen Knoten **207**
Georg Hauger, Monika Wanjek, Claudia Berkowitsch, Sarah Pfoser, Oliver Schauer, Lisa-Maria Putz, Reinhold Schodl, Sandra Eitler, Matthias Prandtstetter, Karin Markvica

Defining Smart Cities: a Relative and Dynamic Approach **213**
Luigi Mundula, Sabrina Auci, Donatella Vignani

Die smarte Vision auf den Boden bringen **223**
Ernst Rainer, Martin Grabner, Oliver Konrad

EmoCyclingConcept – Smart and Safe Mobility – Workshop **237**
Dennis J. Groß, Peter Zeile

Enriching the 3D City Model for the Simulation of Urban Heat Demand **243**
M. Esteban Muñoz H., Ivan Dochev, Hannes Seller, Irene Peters

Environment and Social Audit for Smart City Planning Perspective in India **249**
Bikram Kumar Dutta, Sanhita Bandyopadhyay

ISBN 978-3-9504173-0-2 (CD), 978-3-9504173-1-9 (print)
Editors: Manfred SCHRENK, Vasily V. POPOVICH, Peter ZEILE, Pietro ELISEI, Clemens BEYER

Experiences from a Living Lab Trialling a Mobile Participation Platform 263
Sarah-Kristin Thiel, Peter Fröhlich, Andreas Sackl

Fernerkundungsgestütze Wärmeverlustdetektion von Dachflächen als Beitrag zur Energieeffizienzsteigerung von Stadträumen – Ergebnisse einer Fallstudie in Graz/Österreich 273
Wolfgang Sulzer, Katharina Kern, Christian Bauer, Reinhold Lazar, Martin Mudri, Winfried Ganster

Floating Architecture and Structures – an Answer to the Global Changes....................287
Horst Stopp, Peter Strangfeld, Anna Malakhova

Fühl die Stadt – Methoden zur Erfassung subjektiver Wahrnehmung 295
Linda Dörrzapf, Martin Berger, Fabian Dorner, Hartmut Dumke, Lisa Reinhart, Gloria Watzinger, Stefan Leichtfried

GIS Application for Improving Housing Conditions in Substandard Roma Settlements in Serbia 305
Ljiljana Živković

Hiking Trip Selection Based On Reachability By Public Transport 317
Stefan Wagner, Gerhard Navratil, Hans Fiby

How to stay a Smart City? Inspiration from a Place-Based Spatial Policy in Ghent – Working Together with Local, Smart Citizens 333
Ann Pisman, Peter Vervoort

Human's Digital Space in a Digital City 343
Vasily Popovich, Leonid Borodkin, Manfred Schrenk

Identifikation geschlechterspezifischer Mobilitätsbarrieren anhand einer drittvariablengestützten Mobilitätsverhaltensanalyse 349
Christine Lindner, Daniel Horn, Conny Louen

Informationstechnologie unter Erreichbarkeit – intelligentes Transportsystem: eine Studie für den Stadtverkehr in Istanbul....................369
Bilge Ulusay Alpay

Innovative Approaches to Urban Data Management using Emerging Technologies....................375
Jens Dambruch, Andreas Stein, Veneta Ivanova

Integrative Secondary Education Programmes and Research in Smart Cities Context....................385
Momir Tabakovic, Darya Bululukova, Harald Wahl

Intelligent Development Research on Job-Housing Space in Chinese Metropolitan Area under the Background of Rapid Urbanization 391
Sicheng Wang, Yingxia Yun, Zhong Sun

Interaction with Interconnected Data in Participatory Processes 401
Lars Schütz, Dirk Helbig, Korinna Bade, Matthias Pietsch, Andreas Nürnberger, Andreas Richter

Korneuburg 2036 – eine Stadt plant sich selbst. Die Frage nach Langfristigkeit und Verlässlichkeit in der kooperativen Stadtentwicklung 411
Elisabeth Schauppenlehner-Kloyber, Johannes Huemer

Local Agenda 21 Plus Josefstadt: Smart Projects to Share Space, Talents, Knowledge, Objects and much more 423
Petra Hirschler, Sibylla Zech

Low Tech Solution for Smart Cities – Optimization Tool CityCalc for Solar Urban Design....................431
Roman Smutny, Doris Österreicher, Stefan Sattler, Martin Treberspurg, Kurt Battisti, Markus Gratzl, Ernst Rainer, Heimo Staller

Mapping Conflicts in the Development of Smart Cities: the Experience of Using Q Methodology for Smart Gusu Project, Suzhou, China 437
Joon Sik Kim

Mischung: Possible! Impulses for Mixed Use and Flexible Capacities in Contemprary Densely Built Urban Areas 447
Silvia Forlati, Christian Peer

Mit Potenzialanalysen die richtigen Verwaltungsdienstleistungen digitalisieren....................455
Fais Al-Anbari, Sven Hauenstein

Model-based Planning for a Sustainable Urban Development 463
Sebastian Ebertshäuser, Petra von Both

Modelling Microclimates in the Smart City: a Campus Case Study on Natural Ventilation....................473
Olaf Schroth, Quan Ju

Modernisierung im sozialen Wohnbau – wie dabei Smart Mobility unterstützt wird....................481
Eva Favry

Open-Innovation- und Living-Lab-Ansätze in der Praxis der Stadtentwicklung – Herausforderungen, Dilemmas und Chancen....................491
Barbara Hammerl, Remko Berkhout, Elisabeth Oswald

Participative Foresight for Smarter Cities: From Vision Seeds to the Development of Scenarios 501
Vicente Carabias-Hütter, Tobias Kuehn, Alexander Sokolov, Harry Spiess

Planning of Smart Government of Belgrade 509
Eva Vaništa Lazarević, Marija Cvetković, Uroš Stojadinović

Portable Streets: Smart Urban Solution 515
Rania El Messeidy

Putting Life to Smart City Project Portfolios (The Role of Innovation in Smart Cities) 521
Stefan Fazekas

Rationale of Smart High-rise Regulations 531
Hao Zhang

Raumerfassung und Raumwahrnehmung – aktuelle Techniken und potenzielle Einsatzgebiete in der Raumplanung 541
Steffen Folz, Daniel Broschart, Peter Zeile

Semantic Medical Care in Smart Cities 551
Alexander Vodyaho, Nataly Zhukova, Maxim Lapaev, Andrey Koltavskiy

Semantic Platform for Building Coherent Net of Smart Services 561
Alexander Vodyaho, Nataly Zhukova, Maxim Kolchin, Maxim Lapaev

"Sidewalk" as a Realm of Users' Interactions: Simulating Pedestrians' Densities at a Commercial Street in Cairo City 569
Hussam E. M. Magdy, Masahiro Shohmitsu, Toshiyuki Kaneda

Smart Cities or Smart About Cities 579
Judith Ryser

Smart Cities: a Policy Tool for City Efficiency? 589
Luigi Mundula, Sabrina Auci

Smart City – Smart Design? Die Auswirkung digitaler Medien auf die Stadtgestalt 599
Philipp Strohm

Smart Data for Smart Government – a Show Case from Abu Dhabi Distribution Company 609
Rim Meziani

Smart Energy Supply Conception for the Urban Development Area of Aspern Seestadt (Vienna) 615
Ursula Mollay, Barbara Saringer-Bory, Christof Schremmer, Sebastian Möller

Smart Governance, the Backbone of Smart Planning. A new Strategic Plan for the Cluj-Napoca Metropolitan Area 625
Pietro Elisei, Sabina-Maria Dimitriu, Radu-Matei Cocheci

Smart Government in Wien 633
Gerhard Hartmann

Smart Planning: Different Participation Methods for Evaluating Spatial Attractiveness 643
Christian Mueller, Ulrike Klein, Angela Hof

Smart Sustainable E-Solutions for Implementation and Enforcement of Smart Cities in India 653
Sandeep Kumar Raut, Papiya Bandyopadhyay Raut

Smart Urban Simulation Tools for Planning Decision Support Need Smart Data and Smart Data Gathering Methods 659
Ernst Gebetsroither-Geringer, Wolfgang Loibl, Mario Köstl, Jan Peters-Anders

Stadtentwicklung im Untergrund. Skizzen aus der Schweiz 667
Alexander Ruch

Stand der Weiterentwicklung und Umsetzung des Standards XPlanung in Deutschland 679
Kai-Uwe Krause, Robert Krätschmer, Joachim Benner

Stresstest städtischer Infrastrukturen – ein Experiment zur Wahrnehmung des Alters im öffentlichen Raum 689
Sven Beyel, Johann Wilhelm, Christian Mueller, Peter Zeile, Ulrike Klein

Success Factors of Participatory Processes in Urban Development 699
Marianne Steiner

Technology-supported Citizens Participation in Taiwan 709
Ken-Ping Shen

The Concept of Situation Centers for Smart Cities 719
Oksana Smirnova, Tatiana Popovich

The Influences of User Generated "Big Data" on Urban Development 727
Mai Mahmoud, Dina Taha

The Pivotal Role of Public Transport in Designing the Integration of Mobility Services and in Operating MaaS Offer: the Concept of Shared Mobility Centre and the Experience of Arezzo 737
Giorgio Ambrosino, John D Nelson, Saverio Gini

Track me if you plan – Aufzeichnung urbaner Aktivitätsmuster mittels Smartphonetracking 749
Lisa Provo, Steffen Folz, Kerstin Kopal, Peter Zeile

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Editors: Manfred SCHRENK, Vasily V. POPOVICH, Peter ZEILE, Pietro ELISEI, Clemens BEYER

Unobtrusive, Seductive and Profound? The Silent Transformation of Mobility in the Region of Stuttgart..............................759
Manuel Heckel

URBIS Decision Support for Integrated Urban Governance..769
David Ludlow, Katerina Jupova

Virtual 3D City Model Support for Energy Demand Simulations on City Level – The CityGML Energy Extension.............777
Joachim Benner, Andreas Geiger, Karl-Heinz Häfele

Web Data Extraction Systems versus Research Collaboration in Sustainable Planning for Housing: Smart Governance Takes It All...787
Valerie Dewaelheyns, Isabelle Loris, Thérèse Steenberghen

Why Geospatial Linked Open Data for Smart Mobility? 803
Anuja Dangol; Valerie Dewaelheyns, Thérèse Steenberghen

Zusammenhänge zwischen der Basisinnovation der Informations- und Kommunikationstechnologien und der räumlich-funktionalen Entwicklung der europäischen Stadt..821
Juliane Ribbeck

A Critical Deconstruction of the Concept of Transit Oriented Development (TOD)..829
Dorina Pojani, Dominic Stead

Auf dem Weg zur digitalen Stadt – Aufbau der digitalen Planungsinfrastruktur Hamburg.....................................835
Birgit Augstein, Frank Raser

City Information Modelling – Potenziale für eine intelligente Stadtplanung 843
Mara Müller, Daniel Broschart, Peter Zeile

Deconstructing Economic, Ecologic and Social Urban Discourses for Innovation Policies..851
David Hamers

Envisioning Sustainable Lifestyles in Stockholm's Urban Development 857
Moa Tunström, Lukas Smas, Liisa Perjo

EO-based Smart City Decision Support Services for Integrated Urban Governance: the DECUMANUS Project.................863
David Ludlow, Maria Lemper, Mattia Marconcini, Philippe Malcorps, Annekatrin Metz

ERP hoch 3: Energieraumplanung entlang von ÖV-Achsen 869
Ernst Rainer, Michael Malderle, Michael Eder, Stephan Maier, Hartmut Dumke, Petra Hirschler, Pia Kronberger-Nabielek, Kurt Weninger, Johannes Fischbäck, Sibylla Zech, Rudolf Scheuvens, Michael Narodoslawsky, Hans Schnitzer, Johann Zancanella

Experimenting New Forms of Urban Governance in Vienna 875
Joanne Tordy, Max Kintisch, Christof Schremmer

How to become a Sustainable Smart City: the case of Al Quassim Eco-Neighborhood, Saudi Arabia 881
Al Jawhara Al Muhanna, Aida Nayer

Initiating a Smart Transportation System: Jeddah City..891
Manal Al Deweik, Aida Nayer

Interactive Visualisation of Statistical Data with the CentropeSTATISTICS Cross-Border Geoportal...................................899
Clemens Beyer, Manfred Schrenk

Monitoring von Smart-City-Strategien – Wiens Smart-City-Monitoring-Prozess...903
Clemens Rainer, Eva Pangerl, Pia Hlava, Ina Homeier

Öffentliche Verkehrsmanagement-Strategien und private Mobilitätsservices: Lösungsinseln in Konkurrenz oder Synergien durch Kollaboration? 909
Stefan Kollarits, Ulrike Brocza

Positioning Urban Labs – a New Form of Smart Governance?...919
Lukas Smas, Peter Schmitt, Liisa Perjo, Moa Tunström

Prioritization of Urban Green Infrastructures for Sustainable Urban Planning in Ploiesti, Romania.....................................925
Athanasios Alexandru Gavrilidis, Mihai Răzvan Niță, Diana Andreea Onose, Irina Iulia Năstase, Lavinia Denisa Badiu

Seniorengerechte Kommunikation von Geoinformationen in Nationalparks am Beispiel senTOUR 931
Wolfgang W. Wasserburger, Clemens Beyer, Sabine Hennig, Maria Wasserburger

Smart Cities and Standards – the Approach of the Horizon 2020 Project ESPRESSO 937
Jan-Philipp Exner, Pietro Elisei

Smart City for Smart People 945
Elisabeth Kerschbaum, Thomas Zelger, Hildegund Moetzl

Smart, Green and Inclusive Urban Growth: Visualising Recent Developments in European Cities 953
Kersten Nabielek, David Hamers, David Evers

Smart-City-Leitfaden für die Seestadt Aspern Wien..959
Clemens Rainer, Ina Homeier

Three Cities – Lyon, Munich, Vienna – will be SMARTER TOGETHER 965
Bruno Gaiddon, Julia Girardi, Hans-Martin Neumann, Korinna Thielen, Etienne Vignali, Willi Wendt

Three Decades of Transport Infrastructure Development and Travel Behaviour Change in the Netherlands 977
Dena Kasraian, Kees Maat, Bert van Wee

Towards Jeddah Smart City: Assessing People Perception Of Spacious Quality Indicators In Open Spaces 983
Aida Nayer, Dina Taha

Understanding Cities and Citizens: Developing Novel Participatory Development Methods and Public Service Concepts.... 991
Marek Vogt, Peter Fröhlich

URBAN LEARNING – Joint Learning towards Integrative Energy Planning in European Cities.................... 997
Herbert Hemis, Marko Matosović

Urban Planning through Exhibition and Experimentation in Stockholm.................... 1003
Peter Schmitt, Lukas Smas, Liisa Perjo, Moa Tunström

Visibility as a Stake for Cities.................... 1009
Olivier Lefebvre

A Shift from 2D Design Paradigm of the 19th Century to 3D/CityGML, BIM, 3D Printing and Some of Smarter Cities in Poland.................... 1015
Robert Lach, Krzysztof Nawrocki, Boguslaw Zbyszewski, Stasislaw Lessaer, Jan Lessaer, Leszek Sobieraj, Artur Jach

Mobility Patterns and Lifestyles in Vienna – Case Study Liesing.................... 1029
Jiannis Kaucic, Stephanie Kirchmayr-Novak, Wolfgang Neugebauer, Joanne Tordy, Christof Schremmer

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Keynote Speech

(Un)Plugging Smart Cities with Urban Transformations

Igor Calzada

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1 ABSTRACT

The trouble with modern theories of behaviourism, is not that they are wrong but that they could become true. (Arendt)

We may wish for easier, all-purpose analyses, and for simpler, magical, all-purpose cures, but wishing cannot change these problems into simpler matters than organised complexity, no matter how much we try to evade the realities and to handle them as something different. (Jacobs)

In this paper, the author argues that the development of the so-called smart city concept and its use in planning inner cities are intimately bound up with required current urban transformations. In particular, regarding the notion of urban governance, which encompasses economic transformations, big data, social innovation and urban living labs as some timely key ingredients that should be addressed in contemporary cities (Urban Transformations ESRC portfolio, 2016). By contrast, it is noteworthy that although smart cities are already being built around us, they differ considerably from the simplistic, one-size-fits-all, smart-city-in-the-box mainstream approach (Townsend et al., 2011) that has been hegemonic so far. This idea mostly hearkens back to basic notions of deconstructing the governance interactions that actively require a holistic approach considering urban transformation trends occurring in our cities in a different manner. Based on a previously published Journal of Urban Technology paper entitled 'Unplugging: Deconstructing the Smart City', the authors argue that such reimagining and repositioning need to occur across smart city technologies by avoiding pragmatic approaches that wrongly are assumed to be non-ideological and commonsensical. Hence, the paper is structured in five sections. First, the concept of the smart city as both a buzzword and a fetish term will be presented. Second, the author shows how smart city policy agendas should be unpacked and plugged in again in a wider and inclusive perspective by suggesting the Unplugging framework, which consists of 10 transitions. Third, based on on-going, EU-funded smart city project's interventions, the author underlines the importance of integrating urban transformations and research findings as a strategy that would enable more emancipatory and empowering visions of smart cities beyond simplistic market ambitions of companies or the control desires of states (Kitchin 2015: 30). Finally, five final remarks are presented as the future research agenda of (un)plugging smart cities with urban transformations: urban governance interdependencies, data to decide, metropolitan and regional scaling-up, city-to-city learning and comparing smartness (benchmarking, dashboards and rankings).

Keywords: Smart City, Urban Planning, Transformation, Transition, Buzzwords

2 CONTEXT

'Smart city' (Hollands 2008, Kitchin 2014, Albino 2015, and Batty 2015) has already become a 'fetish' term to simplify complex urban debates in an uneven techno-deterministically-driven, hyper-connected society. Therefore, a mainstream wave of urban standardisation concerning the one-size-fits-all, smart-city-in-the-box paradigm has been dominating policy agendas. Yet, this movement has failed to offer alternative, efficient policy tools to understand better and intervene in our daily urban realities while considering the whole range of stakeholders that determine whether or not a common solution is a 'smart' one for the city. Moreover, it is arguable that the smart city is already happening around us, but not in the way anticipated. Furthermore, the 'smart city' discourse has been shifted by academics in order to make proposals that produce realistic transitions in cities and to avoid a narrowly portrayed approach to governance and urbanisation processes.

Regarding the uneven techno-deterministically-driven society, surprisingly, it's a society that seems to embrace information and communication technologies (ICTs) enthusiastically as the key component of the infrastructure of modern cities and their internal governance strategies.

In academia, urban studies have a long tradition of critically examining the interface between space and digital technologies, and information studies have targeted the city as one of its principal domains of research. However, narratives and practices around notions of smartness have been largely absent.

Having said that, some could argue that the smart city exists (or is already happening around us), but not in the way it was anticipated. Two deeply researched main paradigmatic examples illustrate the way this trend has been orchestrated as a mainstream wave of urban standardisation: Masdar (Cugurullo 2013) in Abu Dhabi and Songdo (Shwayri 2012) in South Korea.

On the one hand, according to Cugurullo, behind the Masdar City project, there is a much bigger project aimed at capital accumulation, and little attention is paid to what is unrelated to the business plan. At the core of Masdar City lies a powerful mechanism fuelled by technology-driven capital flows pumped directly into the development to become part of it. Thus, there is little space for the social aspects of sustainable development and the social dimension of the city (2013: 34). To sum up, Masdar City is what Augé (2008) calls a non-place: a non-anthropological spatial entity bereft of an organic society.

On the other hand, according to Shwayri, Songdo is a clear case of building cities from scratch as a result of a persistent belief by governments that newly constructed cities can set their nations on a fast path to the future. Songdo, however, is built on inherent contradictions (2013: 52): the making of Songdo as eco-city has seen adverse effects by producing significant price contrasts that in effect only allow the affluent class to avail themselves of the newly emerging city.

2.1 Urban buzzwords in the last 30 years

The smart city seems to be the urban buzzword for the 2010s. However, as Jong et al. (2015) suggested in the graph shown in Fig. 1, over the last three decades, metropolitan areas around the world have been engaged in a multitude of initiatives aimed at upgrading urban infrastructure and services, with a view to creating better environmental, social and economic conditions and enhancing cities' attractiveness and competitiveness. As depicted in the graph, many new categories of cities have entered the policy discourse: sustainable cities, green cities, digital cities, smart cities, intelligent cities, information cities, knowledge cities, resilient cities, eco-cities, low carbon cities, liveable cities and even combinations, such as low carbon eco-cities and ubiquitous eco cities. The point is these terms often appear to be used interchangeably by policy makers, planners and developers. However, the question arises whether these categories nevertheless each embody distinct conceptual perspectives, which would have implications for how they are applied in policy.

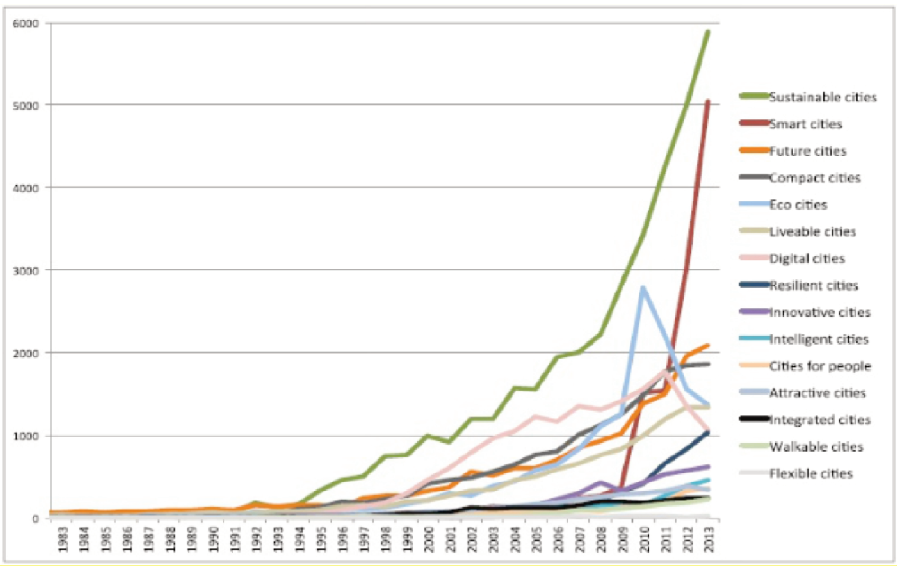

Fig. 1: Urban buzzwords in the last 30 years. Source: De Jong, M., et al., (2015) Sustainable-smart-resilient-low carbon-eco-knowledge cities; making sense of a multitude of concepts promoting sustainable urbanization, Journal of Cleaner Production (2015), http://dx.doi.org/10.1016/j.jclepro.2015.02.004

2.2 Evolution of the Smart City term

Hence, we could argue that this mainstream wave of urban standardisation concerning the smart city paradigm has so far been dominating policy agendas since the mid-1990s:

- As shown in Fig. 2, initially, since the 1960s, the different terms were used as described before.
- Actually, it was in the mid-1990s, when the smart city term emerged in newspapers and media.

- It was just after the recession boosted in 2008 when corporations begin to stake their claims. Back in 2008, when the smart city movement was taking its first steps, Robert G. Hollands (2008) asked for the real smart city to stand up. Since then, there has been an intense debate, as well as a number of projects self-proclaiming their smartness. It should also be said, great steps have been taken in some leading cities to explore how we turn digital innovation into public service improvements and entrepreneurial activities. However, comparative and city-to-city learning urban transformation applied research is required, as this paper will suggest in sections 4 and 5.
- Since 2011, a critical discourse has gained momentum.

Yet, it should be said, this paradigm has failed to offer alternative and efficient policy tools to understand better and intervene in our daily urban realities, while also considering the whole range of stakeholders.

Particularly in the European Commission H2020 Framework Programme, the urban smartness is simplified, assuming that the technical system is an efficient interdependent bubble made up of three factors: mobility, energy, and ICTs.

As it has been pointed out before, this approach is known as the one-size-fits-all, smart-city-in-the-box paradigm. This paradigm is creating a new lexicon through which the development of cities is being forged with elements like urban apps, big data, intelligent infrastructure, city sensors, urban dashboards, Internet of Things (IoT), connected homes, smart meters, smart buildings and smart grids (Calzada 2016).

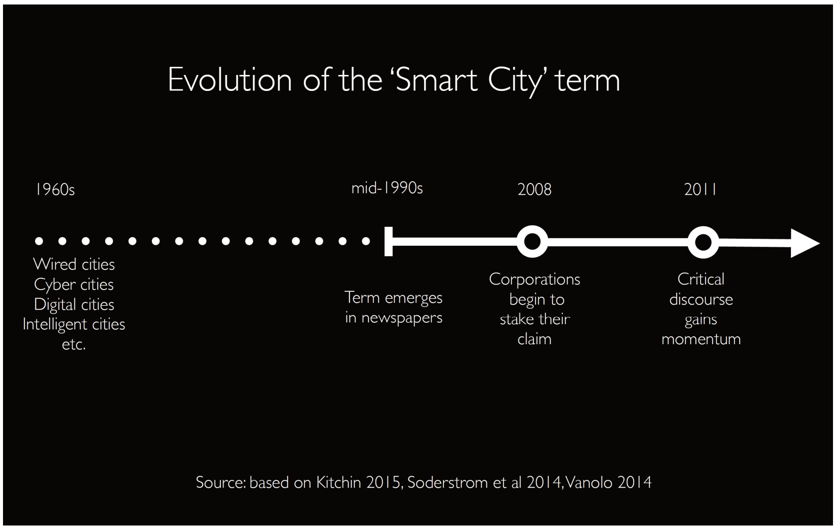

Fig. 2: Evolution of the 'Smart City' term. Source: Karvonen, A. (2016), From the Sustainable to the Smart City: Complementary or Contradictory Urban Visions? Paper given in April 2016 at VuB.

The world's 100 economies

Nevertheless, in this paper, a less dystopic and rather more constructive perspective will be provided in order to strike a balance between self-promotional examples by stressing the underlying pro-business bias and those biases underpinning sustainability and social innovation in a more democratic way. Actually, there is a wrong assumption that the smart city's economy should be increasingly driven by technology-inspired innovation and entrepreneurship that, in turn, will attract businesses and jobs, create efficiencies and save and raise the productivity and competitiveness of government and businesses (Caragliu 2009).

In a broader picture, nonetheless, we are aware that at the moment, cities generate 80% of the world's GDP. As shown in Table 1, according to the World Bank, the World's Top 100 Economies are represented not only by countries and companies but also by cities. Thus, the way smart cities are designed and implemented will mean having more efficient but also more sustainable urban settlements by reaching economic and social prosperity.

Smartness that is just in line with techno-economic growth will not develop further itself, provoking potential boomerang side-effect to the cause that has not been systemically anticipated before 2008 crisis (Calzada 2013). According to the Urban Transformations research portfolio funded by the ESRC (2016), the changing geographies of urban studies reflect the reordering of the global economy. The sheer scale of urbanisation in the global south, the tiger economy's maturity in Asia and the growth of the BRICs undermines a conventional urban studies narrative that focuses on the metropolitan experiences of the global north. Thus, geo-economics is already requiring a systemically smart response to the geo-politics and geo-democratics. Considering cities as isolated technical systems is clearly insufficient for the urban challenges that they are already facing. Cities are complex adaptive systems, combining spatiotemporal and behavioural structures that are affected by and affect individual and collective agents.

The World's Top 100 Economies

	Country/City/Company	GDP/Revenues		Country/City/Company	GDP/Revenues		Country/City/Company	GDP/Revenues
1	United States	14,204	35	ExxonMobil	426	69	Chevron	255
2	China	7,903	36	Osaka/Kobe, Japan	417	70	Toronto, Canada	253
3	Japan	4,354	37	Wal-Mart Stores	406	71	Detroit, USA	253
4	India	3,388	38	Colombia	395	72	Peru	245
5	Germany	2,925	39	Mexico City, Mexico	390	73	Portugal	245
6	Russian Federation	2,288	40	Philadelphia, USA	388	74	Chile	242
7	United Kingdom	2,176	41	Sao Paulo, Brazil	388	75	Vietnam	240
8	France	2,112	42	Malaysia	383	76	Seattle, USA	235
9	Brazil	1,976	43	Washington, DC, USA	375	77	Shangai, China	233
10	Italy	1,840	44	Belgium	369	78	Madrid, Spain	230
11	Mexico	1,541	45	Boston, USA	363	79	Total	223
12	Tokyo, Japan	1,479	46	Buenos Aires, Argentina	362	80	Singapore, Singapore	215
13	Spain	1,456	47	BP	361	81	Sydney, Australia	213
14	New York, USA	1,406	48	Venezuela	357	82	Bangladesh	213
15	Korea, Republic of	1,358	49	Sweden	344	83	Mumbai, India	209
16	Canada	1,213	50	Dallas/Forth Worth, USA	338	84	Rio de Janeiro, Brazil	201
17	Turkey	1,028	51	Ukraine	336	85	Denmark	201
18	Indonesia	907	52	Greece	329	86	Israel	201
19	Iran, Islamic Rep	839	53	Switzerland	324	87	Ireland	197
20	Los Angeles, USA	792	54	Moscow, Russian Federation	321	88	Hungary	194
21	Australia	762	55	Hong Kong, China	320	89	Finland	188
22	Taiwan	710	56	Austria	318	90	General Electric	183
23	Netherlands	671	57	Philippines	317	91	Kazakhstan	177
24	Poland	671	58	Nigeria	315	92	Volkswagen Group	158
25	Saudi Arabia	589	59	Atlanta, USA	304	93	ENI	158
26	Chicago, USA	574	60	Romania	302	94	AXA Group	157
27	Argentina	571	61	San Francisco/Oakland, USA	301	95	Phoenix, USA	156
28	London, UK	565	62	Houston, USA	297	96	Minneapolis, USA	155
29	Paris, France	564	63	Miami, USA	292	97	Sinopec-China Petroleum	154
30	Thailand	519	64	Seoul, South Korea	291	98	San Diego, USA	153
31	South Africa	492	65	Norway	277	99	HSBC Holdings	142
32	Royal Dutch Shell	458	66	Algeria	276	100	Barcelona, Spain	140
33	Egypt, Arab Rep	441	67	Toyota Motor	263			
34	Pakistan	439	68	Czech Republic	257			

Country City Company

GDP/Revenues in $ billions PPP, 2008

Data sources: Country data: GDP-PPP from the Development Data Platform time series, World Bank; City data: PricewaterhouseCoopers (PwC). 2009. *Which are the largest city economies in the world and how might this change by 2025?* Economic Outlook; Companies: Data retrieved from http://www.forbes.com/lists/2008/18/biz_2000global08_The-Global-2000_Rank.html (accessed November, 2009)

Cite as: Hoornweg, D., P. Bhada, M. Freire, C.L. Trejos Gómez, R. Dave. 2010. *Cities and Climate Change: An Urgent Agenda.* World Bank.

Table 1: The World's Top 100 Economies (World Bank 2010).

3 (UN)PLUGGING THE SMART CITY

Thus, this paper goes beyond the trend of hyper-connected societies. As such, while the creation of smart cities has many supporters, most notably governments that hope to address and manage the many issues cities face using ICT-based solutions and businesses that seek to profit from selling new smart city technologies and services, smart urbanism has not been universally welcomed (Kitchin 2015). As Vanolo (2016) argued recently, the reasons why the smart city is so popular in Europe are based mainly on a mix of various forces, to be found, first, in the availability of substantial European financial resources to fund the eco-restructuring of cities; second, in the tendency of the major private companies to invest in urban digitisation projects; third, in the construction of a persuasive rhetoric including salvation visions of technology; and finally, in the image of clean, liveable, technologically advanced cities far removed from the economic crisis.

3.1 Beyond hyper-connected socities

There is a wrong belief that complex open systems can be disassembled into neatly defined problems that can be solved or optimised through computation. This is what Morozov calls solutionism as the expansion of technological development, which includes reductions in the cost of connectivity, has increased the deployment of information-centric schemes (Ahlgren et al. 2012). Thus, smart cities represent a set of hyper-connected societies that enthusiastically embrace ICTs as a key component of the infrastructure of modern cities. However, the social adoption of technology and technological evolution occur at highly dissimilar rates, suggesting significant socio-technical misalignment (Calzada 2015).

3.2 Being digitally connected/plugged in is no guarantee of being smart

Albeit, the notion of unplugging lies in two notions:

- The first notion means the fact of being digitally connected or plugged in is no guarantee of being smart as Evans suggested in 2002 (Calzada 2015: 36). In urban planning, there is a well-established notion of wicked problems. They aren't solvable due to technical limits or a lack of data; rather, they aren't solvable because they are big and complex and so wracked with political conflicts that stakeholders can't even agree what success looks like or how to measure it. Yet the smart city promised that, given enough data and enough processing power, we could directly compute solutions to any problem (Rae 2015). This shows a lack of understanding of how cities work, and, at worst, it was a disaster in the making.
- The second notion is a consequence of the first one; as Williams noted in 1983, technology is never neutral, and it has the potential and capacity to be used socially and politically for quite different purposes. This idea is explicitly advocated by Kitchin when he refers to data (2015: 17) by arguing that the data within these systems are not neutral and objective in nature. Instead, they are situated, contingent and relational, framed by the ideas, techniques, technologies, people and contexts that conceive, produce, process, manage, analyse and store them.

3.3 (Un)plugging the Smart City: 10 transitions

In order to overcome the reductionist mainstream smart city direction from a critical urban transformational perspective, the author of this paper suggested in an previous article, which ranks as the seventh most-read article in the Journal of Urban Technology, to use of a 10-transition-based framework entitled Unplugging. With Unplugging, instead of merely accepting the technology or refusing it totally, it suggests implementing a transition in 10 different dimensions, as shown in Table 2.

	1 WHO	2 HOW	3 SYSTEMS	4 GOVERNANCE	5 INFORMATION	6 FOCUS	7 SPACE	8 DESIGN	9 SOCIO-POLITICAL PROCESSES	10 POLITICAL ECONOMY
UNPLUGGING the SMART CITY	Social & Digital Divide	Individualism vs Collectivism	Socio-Technical Systems	Master Planning vs Emergent Plan and Top Down vs Bottom Up	Overload vs Scarcity	Social Netting vs Social Capital	Context Collapse	Ambient Commons	Control & Normative vs Free & Emergent	Profitable vs Non-Profitable

Table 2: Unplugging: Deconstructing the Smart City. 10 Transitions/Dimensions

Unplugging is defined (Calzada et al. 2015) as a subtle notion of contestation of the dominant mode of urban governance that demands some transitions to overcome the social tensions and misalignments caused by hyper-connected societies. Nevertheless, this methodological proposal presents another virtuality: instead of aligning with dystopian and techno-sceptic pure visions of the smart cities, it lies in the constructive notion of the social innovation by identifying real cases that firmly embrace this novel trend—a novel trend that offers a corrective to the smart city mainstream in favour of a transition towards the judicious use of digital technologies, thus enabling the construction of a more economically and socially sustainable democratic citizenship. Here in a nutshell are the 10 transitions/dimensions that could be foreseen regarding the smart city projects:

(1) [The Who Dimension] Will the smart city evolve into an urban sphere in which dwellers have the right to decide whether to be connected? Will unplugging be a right or a privilege? To what extent is it possible to foresee a transition of smart cities from the high to the low social and digital divides towards more democratic, participatory and equal smart cities?

(2) [The How Dimension] How will the transition between individual and collective entities be organised? Will we witness new hybrid configurations by experimenting with unplugging? Can the function of the smart city be understood as a proxy for a community? Is the city a social interface in which the citizens will be able to self-design their social, everyday, life needs?

(3) [The System Dimension] To what extent is it possible that dwellers can be less passive in deciding the role of urban technology systems? Will these devices serve the citizens more than the citizens serve the devices? Will the transition from an artificial system to an embedded system be understood as an opportunity for adding value to citizens' experiences?

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Editors: Manfred SCHRENK, Vasily V. POPOVICH, Peter ZEILE, Pietro ELISEI, Clemens BEYER

(4) [The Governance Dimension] How will the smart city avoid technocratic, dominant, top-down governance? Are there experimental governance schemes that embrace bottom-up, emergent strategic planning and are considered to be real possibilities? Is the bottom-up innovation perspective simply wishful thinking?

(5) [The Information Dimension] How realistic is it to combine open access, civilian, deliberative systems within a confidential, espionage-obsessed paradigm? In the big data era, is it possible to transition from controlled to open data-driven models?

(6) [The Focus Dimension] Are open, democratic communities of individuals facing a transition from a business-led and techno-deterministic approach to socially innovative, community-driven cities? Do we notice the difference between simple social interactions and trusting human ties?

(7) [The Space Dimension] Will we observe changes in which context-collapsed information will be contextualized to enhance social interactions? To what extent can context collapse enable new opportunities for social capital?

(8) [The Design Dimension] Will technological devices be designed based on people's needs rather than on corporate or infrastructure interests? How can design and user interactions be improved to anticipate an ambient commons for citizens?

(9) [The Socio-Political Processes Dimension] Will the socio-political establishment experience a shift towards free and community-driven processes? What are the boundaries for establishing these processes in the urban arena?

(10) [The Political Economy Dimension] Finally, will the political economy of the smart city be altered as a consequence of changes in stakeholder power relationships?

The main aim of the paper is to present a way in which we could unfold the real practices and consequences of the smart city initiatives (Calzada et al. 2015) rather than providing a taxonomy of definitions (Albino et al. 2015, Caragliu et al. 2009, ARUP 2011 and 2014). According to some widely spread critical perspective about smart cities (Buck & While 2015, Campbell 2012, Gabrys 2014, Glasmeier & Christopherson 2015, Greenfield 2013, Hajer & Dassen 2014, Hollands 2008 and 2014, Kitchin 2015, Luque-Ayala and Marvin 2015, Marvin et al. 2015, Shelton et al. 2015, Soderström et al. 2014, Townsend 2015, Vanolo 2014, and Vitanen et al. 2014), despite the significant political, economic and social consequences, research on smart technologies to date has focused on their technical components. Albeit, there has been limited discussions of the social and geographical dimensions of urban processes.

In this context, smart city discourse, at least in the EU (Caragliu 2011 and European Parliament 2014), has changed for the better since 2008. City leaders around the world have a much more informed understanding of what smart technologies can do. But little can be said about smart interventions by considering holistic frameworks. It is why this paper advocates deconstructing, from the policy perspective, which are the interactions among stakeholders while unpacking processes driven by smart technologies. It is just after unplugging when we could certainly build the smartness in cities—not just by adding another layer more by adapting the hardware to the software (Calzada et al. 2016), rather than vice versa. It is after that when joint smart and sustainable policy agendas could make complete sense of the particular smart urban challenges with relevant transformative consequences.

In the next section, an analysis of the on-going smart city EU projects in which the author is already or has been involved will be presented. The author's participation has proceeded in different levels: as a member of advisory boards, lecturer, WP leader and PI.

4 PRELIMINARY FINDINGS FROM ON-GOING SMART CITY EU PROJECTS

Here some findings after working in the projects detailed in Table 3:

- It is obvious that the smart city concept has rapidly risen to prominence within the policy and governance discourses of urban development and is on its way to becoming the leading driver of urban sustainability and regeneration initiatives (de Jong et al. 2014: 12).
- However, as we have seen in the so-called one-size-fits-all, smart-city-in-the-box paradigm with Masdar and Songdo, rather than being constructed on tabula rasa according to the centralised plans of multinational technology corporations, smart city interventions are always the outcomes of, and

awkwardly integrated into, the existing social and spatial constellations of urban governance and the built environment (Shelton et al. 2015: 14).

- In the case of the two projects funded by the European Commission 7th FP, STEEP and STEP UP, interdependencies have been the unresolved issue so far.
  - In the case of STEEP (Systems Thinking for Efficient Energy Planning), partners spent months utilising the STEEP open-source methodology. As part of this process, a list of 50 KPIs was identified, against which the plan will be measured. Nonetheless, along the development of the Energy Master Plan for districts for the three partner cities, St Sebastián (Spain), Florence (Italy) and Bristol (UK), the adoption of the system-thinking methodology in combination with open-data sourcing to achieve carbon reduction targets and overcome the barriers to energy efficiency has shown the lack of vision and the urgent requirement for further interdependent actions among the stakeholders. This fact should remind us that the actions of citizens have less to do with individuals exercising rights and responsibilities and more to do with operationalizing the cybernetic functions of the smart city (Gabrys 2014:38).
  - In the case of STEP UP, a number of projects have been developed in each partner city. In Glasgow, the Commonwealth Games Athletes' Village and the Future City Glasgow programme awarded by Innovate UK and Clyde Waterfront as the biggest regeneration project ever undertaken in Scotland were developed. In Ghent, two initiatives were developed: a Car Free City Centre of approximately 35 hectares and a renewal project called Ledeberg Alive. In Gothenburg, a new sustainable urban district called Kvillebäcken was established, and two initiatives were implemented in parallel: Congestion Charge and New Travel Habits. Finally, in Riga, two interventions were undertaken: a smart card as a transport, social and education policy instrument and a new building complex in the Torknakalns district.
  - Regarding SMART CITY REGION, this project understands 'smart cities' as, in essence, entrepreneurial cities that respond immediately and efficiently—in imaginative, novel ways—to continuous, complex, socio-technical changes caused externally by global market dynamics and internally by unequal stakeholders' power relations. Indeed, this project compares strategically and ethnographically four specific city-region cases located in two European nation-states: Bristol and Glasgow in the UK and Bilbao and Barcelona in Spain. This project focuses initially on how each case study has produced a particular discourse of 'smartness'. Through this analysis, a stakeholder analysis and its unique configuration are provided. Thus, a comparative analysis will proceed with multilevel governance and stakeholder analysis. It is noteworthy that scales of multilevel governance pluralise with intensifying patterns of European connectivity and accelerating economic restructuring. This gives rise to the notion of city-regional governance in nation-states. This may involve new concepts and narratives, mobilisation of different knowledge, and imaginative thinking about new governance strategies and use of institutions while employing more informal collaborative networks among regional stakeholders. Thus, in this paper, smart city-regional governance entails opening up and pressing for significant new ideas about democratic legitimacy and political inclusion. Additionally, 'smartness' should be taken as an outcome of regional urban transformations in governance, reconciling seeming contradictions between established growth agendas and a rising concern with a broader range of qualitative parameters, such as societal and territorial cohesion. Nevertheless, considering the nation-state's limited capacity to manage conflicting patterns of urban growth and decline, political demands regarding devolution of metropolitan and regional powers should be smartly taken into account. This common trend remains crucial in four cases. While local governments increasingly are in charge of their own economic destiny, this paper compares city-regions to understand better stakeholders' dynamics in each socio-communitarian location. Socially and politically innovative processes are occurring at all scales, from neighbourhood participation interventions (micro) to city-regional strategic logics (macro). Hence, this paper establishes the 'smart city-region' term both as a unit of analysis and a mode of production among stakeholders. However, one must acknowledge the particular histories, unique geographies and diverse power relations among stakeholders in different city-

regions. This comparative analysis of the four cases will enhance two dimensions of the 'smartness' for each city-region. On the one hand, the focus will be on the metropolitan governance dynamics and the stakeholder interactions. On the other hand, it will tackle a special consideration for the devolution dynamics between the city-region and each referential nation-state. An analysis for the four cases follows:

- For a long time, Barcelona[1] has been investing and promoting itself as the first Spanish Smart City, the fourth in Europe and the 10th in the world. At present, due to a new city mayor—Ada Colau, who represents a radical new citizen platform called 'Barcelona in Common'—an initial smart city strategy has been shifted towards an 'open source' strategy.
- In 2013, Glasgow[2] won £24m of funding from the UK Technology Strategy Board (TSB) to explore ways to use technology and data. At present, the strategy is being reviewed based on the demonstrator project, which focuses on four main areas of urban infrastructure: health, energy, transport and public safety. The question here is whether the 'urban governance' model has integrated the city-regional scale as suggested by The Scottish City Alliance.
- By contrast, Bristol[3] received £3m from the UK TSB, but its approach has followed 'open innovation' principles by its flagship operational organisation called 'Bristol is Open'. The university is playing a remarkable role in engaging stakeholders at the metropolitan level. However, how the city-regional devolution affects Bristol's smart-city strategy remains uncertain.

o Finally, the recently launched lighthouse project called REPLICATE, funded by the European Union's Horizon 2020 Research and Innovation programme grant agreement No. 691735, shows the following challenge from the urban transformation perspective: the project advocates innovative approaches to citizenship, with the aim of involving citizens as stakeholders at all stages of the activities to co-create appropriate solutions and services which celebrate and work successfully with the characteristics and context of each metropolitan area in each lighthouse and follower city.

EU Project	Cities involved	Timeframe & Title	Funding Institution
EU-H2020-SCC- 1st Lighthouse: REPLICATE	Bristol (UK) St. Sebastian (ES) Florence (IT) Laussane (CH) Essen (DE) Nilüfer (TR) Bogotá (CO) Guangzhou (CN)	< 2015-2020 > REnaissance of PLaces with Innovative Citizenship And TEchnology	EU-H2020-SCC-Lighthouse www.replicate-project.com
EU-Marie Curie Actions-Cofund-Regional Programmes: SMART CITY-REGIONS	Bristol (UK) Glasgow (UK) Bilbao (ES) Barcelona (ES)	< 2015-2016 > Comparing Smart City-Regional Governance Strategies: Bilbao, Barcelona, Bristol & Glasgow	EU-FP7 Marie Curie Actions- Cofund BilbaoMetropoli-30/Bizkaia Province Council
EU-FP7-314679 STEP UP Smart City Plan	Glasgow (UK) Riga (LT) Gothenburg (SE) Ghent (BE)	< 2014-2015 > Energy Planning for Cities *MSc Master in Global Sustainable Cities	EU-FP7 www.stepupsmartcities.eu/
EU-FP7-314277- STEEP Smart City Plan	Bristol (UK) St. Sebastian (ES) Florence (IT)	< 2014-2015 > Systems Thinking for comprehensive city Efficient Energy Planning	EU-FP7 http://www.smartsteep.eu/

Table 3: Smart City EU Projects.

[1] http://smartcity.bcn.cat/en/smart-city-areas.html
[2] http://futurecity.glasgow.gov.uk
[3] http://www.bristolisopen.com

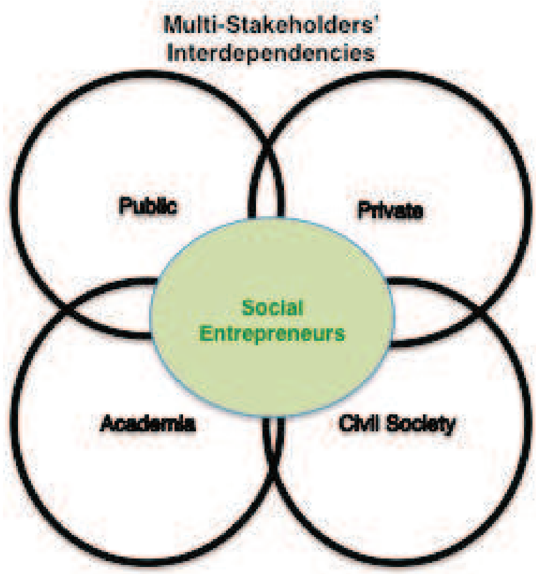
5 FINAL REMARKS

After presenting on-going EU projects, in this section, the paper concludes that despite the fact that smart city projects are indistinctively using the brand of the smartness, a deeper analysis is required by contrasting their findings with the cutting-edge research compiled by the ESRC Urban Transformations portfolio (ESRC 2016). In this portfolio, projects regarding specific interventions on big data (Bright 2016), economic evolution of the transformations in cities (Martin 2016), urban living labs (Bulkeley 2016), and neighbour and local development (Perry 2016) are showcased. Thus, in this last section, the author advocates that smartness in European cities should be critically complemented with an holistic urban transformation action research perspective (Calzada 2013, Evans 2014, Harvey 1997 and Sennett 2012).

In these final sections, the paper presents five intertwined research lines in order to leverage the transitions that smart cities require to align them with a systemic interpretation of the current urban challenges that are meant to be tackled in the upcoming years. The article is presented as a proposal for a further research agenda on smart urban transformations.

5.1 Multi-stakeholders' interdependencies: the hidden urban governance driver

If the crisis in 2008 underlined an evidence-based economic fact, it was that visions of smart cities are very diverse. Actually, how they dovetail with local and global economies, and how they unfold in practice, vary between places (Kitchin 2015:3). But who is benefitting from the smart city investments? (Glasmeier and Christopherson 2015). Who pays the bill at the end of the day? Some authors alert us to the fact that the design of an intervention has significant implications for its usability and accessibility and that each design gesture has an intended community. The assumption behind many smart city projects is that everyone owns a smart phone and knows how to operate it at maximum performance. Consequently, technology audits are necessary to reveal just how flexible, usable and accessible these technology designs are for different targeted stakeholders. So, to understand from smart city interventions, we need thoughtfully designed, rigorous comparative research by considering three main elements uniquely in each particular location: First, technology has reemerged as a prominent debate for urban development as long as we reconsider the different role of specific stakeholders in the given location. Second, around the power relations and topics of discussion, the dominance of green growth and ecological modernisation will be such a recurrent subject. Third, a total reconfiguration of urban partnerships should be encouraged in our cities.



According to some findings in the STEEP, STEP UP and SMARTCITYREGIONS, and by considering the results of the Urban Governance and Its Discontents International Conference organised by the Future of Cities Programme at the University of Oxford in 2016 (Oxford City Debates 2016), the potential, conflictive and deliberative stakeholders' interactions should be deeply considered before and during each smart city intervention. Actually, this is one of the main innovative aspects of the REPLICATE H2020 lighthouse project. As Harvey (1997) pointed out, the smart city and new urbanism movements build an image of the community and a rhetoric of place-based civic pride and conciousness for those who do not need it while abandoning those that do to their underclass fate. In order to overcome this gap in the smart city discourse,

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this paper suggests using the Penta Helix multistakeholder framework (Calzada 2013), which consists of the private sector, public sector, academia, civic society and social entrepreneurs. As has been said before, some signals show this direction. Especially, there are significant attempts (Saunders et al. 2015 and Smart Retro Project 2015) coming from the social innovation field to uncover the hidden urban governance engine that could be defined as the way multi-stakeholders' interdependencies operate in diverse smart cities.

5.2 Urban data to decide

The second remark is a concern. In the context of the smart city, the data that are generated are the products of choices and constraints shaped by a system of thought, technical know-how, public and political opinion, ethical considerations, the regulatory environment and funding and resourcing (Kitchin 2015: 21). Thus, how can a sensor, a smartphone or a commercial transaction have politics? The UrbanData2Decide project (Bright 2016) found that, in public decision-making processes, stakeholders have opposite positions and advocate different solutions but have difficulty providing details about what the different positions are based on and what the consequences can be.

According to Batty (2012: 18), there are some new functionalities for urban data to decide: the acquisition of data from multiple distributed sources, the management of data streams, the integration of heterogeneous data into a coherent database, data transformations, definition of new observables, methods for distributed data mining and network analytics, the management of extracted models, tools for evaluating the quality, visual analytics, simulation and prediction methods and finally, incremental and distributed strategies needed to overcome the scalability issues that emerge when dealing with big data. Regarding the last idea about big data, it should be completed with the statement made by Rae et al. (2015), when they argue that the debate on big data often lacks clarity, direction and reason. In their attempt to define big data, the authors conclude that there is an indefinite definition of big data so far. However, according to the findings of the EU projects presented before, interdisciplinary interventions are required to tailor open and big data platforms in each project. As such, the multi-stakeholders' interdependencies should be linked to data issues insofar as platforms will be developed on the basis of tackling the following urban transformations (2012: 35): housing booms and busts in large cities, impacts of changes in energy on urban transportation systems and mobility, the fracturing of transport networks, synthesis of different urban data sets, the impact of climate change on cities in Europe, the participation of citizens in the development of plans for smart cities and the impact of immigration phenomena in a global world.

In addition to all these functionalities and urban transformations, this paper underlines that data management should strongly fit the idea of governance that extends in this way to the many functions that we envisage being coordinated in the smart city. This relatively new prospect is part of the wider debate about the metropolitan and regional devolution of governance in the information age. Hence, as we can observe, multi-stakeholders' interdependencies, urban data to decide and metropolitan and regional scalability for smart cities are firmly intertwined.

5.3 Scalability: metropolitan & regional scales

According to the latest policy report by Habitat III Policy Unit (LSE Cities 2016), there is an expansion of metropolitan areas that is producing at the same time a growing gap between these and intermediary cities by posing additional challenges to urban and national governance. This trend should be included in smart city interventions. So far, the smart city perspective has been understood and sold as a means to show better cities, just considering city centres and centric districts in the major metropolitan areas. However, as we have discovered in some on-going interventions in St. Sebastian, Florence, Bristol, Glasgow, Ghent, Riga, Gothenburg, Bilbao or Barcelona, among others, a realistic revision of the implementation of smart city interventions is required by incorporating the idea of strengthening decentralisation processes that could reinforce metropolitan- and also regional-scale governance (2016: 22). And here is where the smart city should become a smart metropolitan or city-regional entity by enhancing the institutional instrumentarium, as Noveck (2015) suggests, by reviewing and improving the public services (WEF 2016). Similarly, Martin (2016) pays attention to the role of city-regions in national development as a driver of urban growth and the way economic evolution in cities requires the scaling-up of policy solutions. Indeed, García-Ayllon and Miralles (2015) have even contributed a model of territorial analysis that consists of more than 50 indicators in the following areas: revitalisation of the urban system, R&D, crisis of rural, access to transport, access to

ICT, sustainable energy, disaster risk prevention and management of natural resources, management of cultural resources, sustainability of regional and economic resources, governance and landscape management. Thus, we can observe that despite the fact that numerous protocols are appearing worldwide to develop these processes within smart cities, the real challenge for the future is to make the leap from the urban scale to the metropolitan and city-regional scales and deploy and scale-up these policies in an integrated manner between the urban, the metropolitan and the city-regional domains.

5.4 Benchmarking: comparing smartness & city-to-city co-creation

There is a lack of comparative analysis and a dearth of knowledge about the range of urban, metropolitan and regional contexts within which forms of smart and digital urbanisation are emerging internationally. In this attempt, the author of this paper carried out a four-year comparative benchmarking between eight city-regions (www.cityregions.org). The main conclusions have been published in an article entitled 'Benchmarking Future City-Regions beyond Nation-States' in the RSRS open access journal (Calzada 2015). If we dare to suggest a comparative basis for smartness, according to Anthopoulus et al. (2015) we could be overwhelmed with the number of approaches we would find (IBM, ITU, UN-Habitat, ISO, etc.). Given the broadness of this field, it is not surprising that many benchmarking approaches have been developed. Nonetheless, few of them mention the distinctiveness of cities (Barbenhön et al. 2016), a fact that is very significant at this stage of the evolution of the smart cities. As Branchi et al. (2014: 62) stated, the history of a city cannot be detached from that of its citizens, who are the ones who have determined the city's location, spatial configuration, growth and development. These comprise the key aspects that should set the basis to compare smartness and city-to-city learning processes in the future.

5.5 Visualisation: rankings & city dashboards

Finally, as we have suggested so far, including stakeholders' interaction seems to be particularly necessary, insofar as the data that cities will deal with require a vast amount of sectoral information that would cover not only the local scale but also the metropolitan and the city-regional scales. As such, urban indicators are recurrent quantified measures that can be tracked over time to provide a picture of stasis and change with respect to urban phenomena. Nevertheless, we should advocate the usage of benchmarking and the visualisation of the indicators in rankings and city-dashboards in a more contextual way. Rather than cities being understood as mechanical systems that can be disassembled into their component parts and fixed, or steered and controlled through data levers, cities are conceived as consisting of multiple, complex, interdependent systems that influence each other in often unpredictable ways. As a consequence, as we said in the second section, governance is seen as being complex and multi-level in nature, and the effects of policy measures are perceived as diverse and multifaceted, and neither is easily reducible to performance metrics and targets (Kitchin 2015: 25).

This paper aimed to (un)plug in or unpack the term 'smart city' in the light of some EU projects' findings. It attempted to overcome the smart city trend as a fetish buzzword in the hands of indistinctive place branding (Cleave et al. 2016) in order to embrace the merger of sustainable and smart policy agendas in the direction of the sharing cities paradigm (McLaren et al. 2015). In this endeavour, it suggests five alternatives for developing a further research and policy agenda from the urban transformations perspective: the stakeholders' interdependencies, the need for urban data need to focus on local specificities rather than global features, the requirement of the territorial scale-up, comparing smartness via benchmarking and city-to-city co-creation processes and holistic visualisation tools.

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A Pilot Experiment on Affective Multiple Biosensory Mapping for Possible Application to Visual Resource Analysis and Smart Urban Landscape Design

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1 ABSTRACT

This paper is designed to identify potential stressors as well as negative and positive environmental stimulators in urban landscapes, using wearable physiological sensors and GPS devices. An 8-channeled Procomp Infiniti device was used in this study, recording electrocardiogram (ECG), electroencephalogram (EEG), skin conductance, skin temperature, electromyography (EMG) of facial muscles expression and respiration, with a maximum sample rate at 1024/s. Probands in the pilot experiment were asked to take a 15-minute walk on a designated route for three times. Physiological measures were first filtered and then combined with GPS locations and visual eyesights. Affective mapping analysis based on the collected data allows first conclusions on the responsiveness of probands towards different visual experiences. Further analyses will determine the impacts of urban environments on stressors and what role latest technological advancements in smart landscape design in form of augmented reality can play for improved well-being of city dwellers.

Keywords: biosensory mapping, China, landscape perception, urban space, wearable devices

2 ENVIRONMENTS AND WELL-BEING

Research studies revealed that exposure to natural environments would trigger positive affective responses and enhanced cognitive functions (Velarde et al. 2007; Bowler et al. 2010). Therefore, frequent access to nature may enhance human mental health. On the opposite side, city dewellers, with limited access to nature, were found more likely to suffer from mental diseases and poorer psychological well-being (Lederbogen et al. 2011; Tost et al. 2015). Up to now, findings were mostly confirmatory verifying the effect of natural environments on human affective responses. However, a recent study revealed that visual aesthetics may be another important - if not more significant - environmental factor on human health additional to nature (Seresinhe et al. 2015). Seresihe et al. revealed that better scenic view correlated with lower sickness report spatially. Surprisingly, after controlling the health effects from scenic views, they did not find relevant health benefits residual from ecological and envrionemtnal effects produced by green plants. In other words, scenic views may have a significant impact on human well-being, which may be comparable to environmental or ecological effects on health. Following those arguments, the designs of urban landscapes matter, not only in the meaning of functionality and comfort, but also for aesthetics and views.

In China, the past urban development has been criticised for its lack of human scale design (Kögel & Meyer 2000; Chen & Thwaites 2013). Rapid urbanisation and pancake-like urban growth has produced uninviting, car-dependent cities, where only outstanding and sometimes highly exaggerated architectural forms trigger visual responses (Pan 2011; Chen & Thwaites 2013).

Several studies in recent years have discussed the proposals of re-implementation of traditional elements and design aesthetics in Chinese urban and landscape planning for the purpose of creating identities and livable places (Chen & Thwaites 2013; Hassenpflug 2013; Wang & Meng 2015; Wang & Ruan 2015). In the process of smart city approaches of Chinese cities, the understanding of people's well-being and interaction with their urban environments have gained unprecedented importance in planning practice.

3 BIOSENSORY MAPPING

The availability of wearable biosensor devices, such as fitness-wristbands, smartwatches or heart rate monitors have offered new research opportunities for measuring biological data out of the lab, but in practical and natural or urban environments (Bergner et al. 2013; Burke et al. 2006).

Research on the empirical value of emotion mapping have highlighted the opportunities and possible symbiosis of individual perception of urban spaces and urban design (Kwan 2011). Studies on biosensory mapping used different wearable devices (Bergner et al. 2013; Zeile et al. 2013; Zeile et al. 2015), mostly analysing biosensors such as skin conductance and skin temperature, as general indicators for stress reaction. Yet, several evaluations have shown shortcomings of such methods on measuring emotions and in situ environmental perception. One central aspect in this discussion is the one-sidedness of single sensory measurement, which in most cases only depict negative emotions in form of stress levels. Limited indicators could only indicate a certain negative stressor in measured data, but not analyse specific triggers or positive reactions. Further indicators are needed to identify the exact valence of biosensory data.

3.1 Multiple biosensory mapping

Although emotions are complex to understand and therefore difficult to measure, recent developments in cognitive neuroscience offered new opportunities for measurment. Emotions can be understood in several dimensions, i.e. valence (biphasic emotion, whether and how much one likes or dislikes), arousal and arguably a third approaching/avoiding motivation dimension (Bradley & Lang 2006; Mauss & Robinson 2009). Most biosensory measures fell into the valence and arousal dimensions as reported by Lang and his colleagues: for example skin conductance (SCR r =.81), and agruably skin temperature too, were good predictors of self-reported arousal levels based on simple linear regression analysis, while peak heart rate acceleration (r=.76) and facial expression muscle EMG (r=-.90 for corrugator EMG, r=.56 for zygomatic EMG) were good predictors of self-reported biphaisc valence level (Lang 1995).

The state of arousal ranges from neutral to highly aroused or emotionally triggered. The valence level as a biphasic placement of either pleasant or unpleasant reaction, completes a measurable set of indicators for emotional response. For measuring arousal and valence, several indicators, such as skin conductance, skin temperature, ECG, and EMG are being assessed for their value change rates (see Fig. 1).

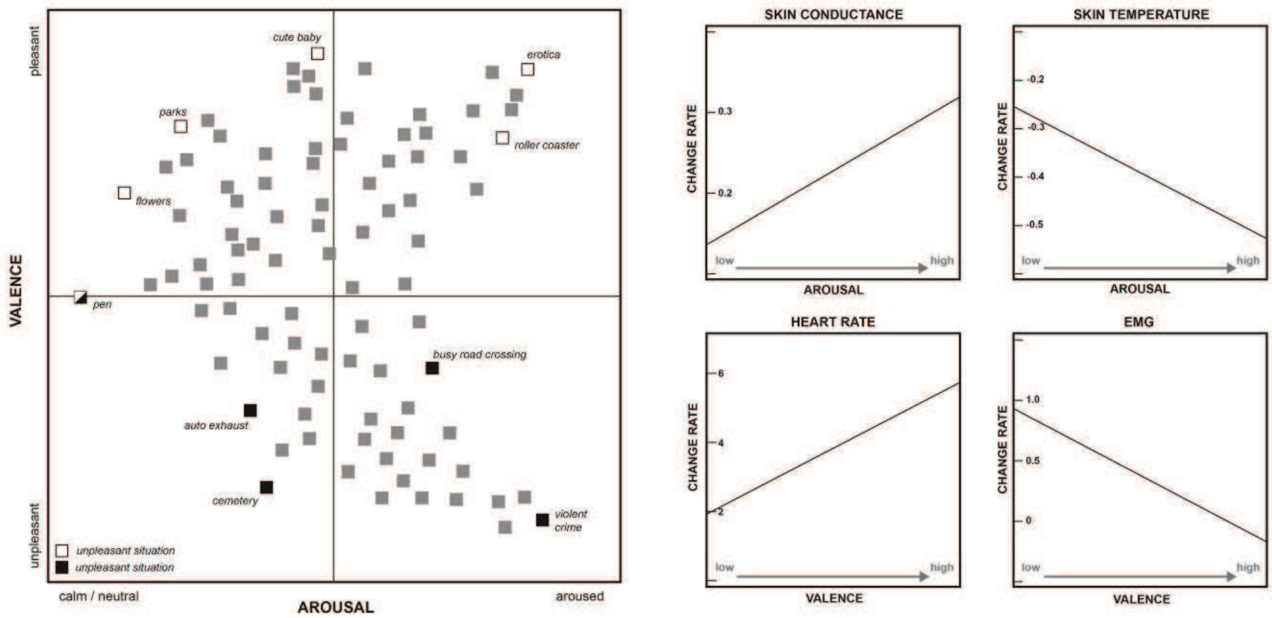

Fig. 1: Arousal and valence indicator assessment (based on Lange 1995) and expected correlation with biomeasures based on exsiting findings

When change rates correlate with each other (compare Bergner et al. 2011; Bergner et al. 2013; Lang 1995; Bradley & Lang 2006), they can indicate emotional reactions towards a specific situation, based on rated multi-sensors. Using multi-bisensory measurement offers an opprotunity to specify emotion in both valence and arousal, which therefore differentiate positive arousal (excitement) from negative one (stress/fear). To landscape architects and urban designers, these different assessments can be crucial to environmental design.

3.2 Technical challenges for multi-sensor mapping

A major obstacle for collecting multi-sensor data lies with available technology. For measuring EEG data for instance, high-technology computal devices attached to the human body are needed, which often don’t meet the requirements for portable use (Tost et al. 2015). If portable though, such as the device used in this pilot study (see chapter 4.1), measurements could still hold uncertainties in outdoor environments. The effects of weather conditions, humidity or simply the movement of probands have an influence on recorded data, as could be experienced during first initial test runs. Even though several difficulties could be improved, such as loosening sensors during walks, several obstacles could not be cleared out, yet and will be discussed further.

4 METHODOLOGY

This pilot study was designed to test the feasibility of measuring emotions, affective valence and arousal levels to be specific, using a portable multi-channel physiological device during an uncontrolled in-situ walk in the real environment. As supported by empirical evidences from literature (see chapters 2 and 3), we expected to measure affective valence using heart rate and facial muscle EMG, while to measure affective arousal using skin conductance, skin temperature and ECG based on the findings of Lang et al. 1993; Lang 1995; Mauss & Robinson 2009.

The first phase of this research project, which is described in this paper, neither can nor intends to clarify the central question about the affectiveness of visual perceptions of urban landscapes. At this point, the research focuses on technological reliability and the significance of multi-sensory data.

Therefore following questions are expected to be answered:

(1) Are portable bio-sensory techniques and in-situ walking measures good enough to capture environmental perception?

(2) Is bio-sensory data able to capture specific visual stressors or interest points? Were these results triangulated with narratives provided by participants?

(3) Did bio-sensory data reveal consistent spatial patterns across runs/ individuals?

4.1 Technological devices

For measuring multisensory data, a Procomb Infinity device was used (see Fig. 2). The device can measure 8 channels or biosensors. For the experiment described in this paper, 6 channels were used, including (1) ECG (three sensors measured on wrists, with a sampling rate at 256 per sec), (2) EEG (Fp referenced at Fz, with a sampling rate of 1024 per sec), (3) facial EMG (three sensors at forehead with corrugator muscle, with a sampling rate at 256 per sec), (4) skin conductance and skin temperture (one sensor each, both with a sampling rate at 256 per sec), (5) respiration (measured at abdomen with a sampling rate at 256 per sec). Each biosensor transmits its measurements to an “on-board” recording device (6), which again is linked to an ordinary laptop or computer.

In addition, each proband in the experiment was outfitted with a Garmin eTrex20 GPS device set at a sampling rate of 1 per second, as well as a video camera attached to the proband’s head for capturing a rough visual focus.

The “on-board” recording device was carried by each participant in a bagpack. Even though this resulted in additional weight during the walk, it was made sure for all probands that the devices and measurement parts do not conflict with movement abilities and general comfort. Wires were attached with velcro fasteners to arms or torso, given a certain tolerance for unrestrained movement.

It has to be stated, though that in comparison with wristband devices as used in previous studies (Bergner et al. 2013), the multisensor device has its limitations on practicability. There might always be a specific influence on data collection by wearing it and participants will always have some thoughts about the device during the experiment, as interviews afterwards revealed. Also other external factors, which do not appear with simple wristband devices, e.g. looks and staring from other people towards an unusual outfit, might have additional influences on nervousness and stress reactions.

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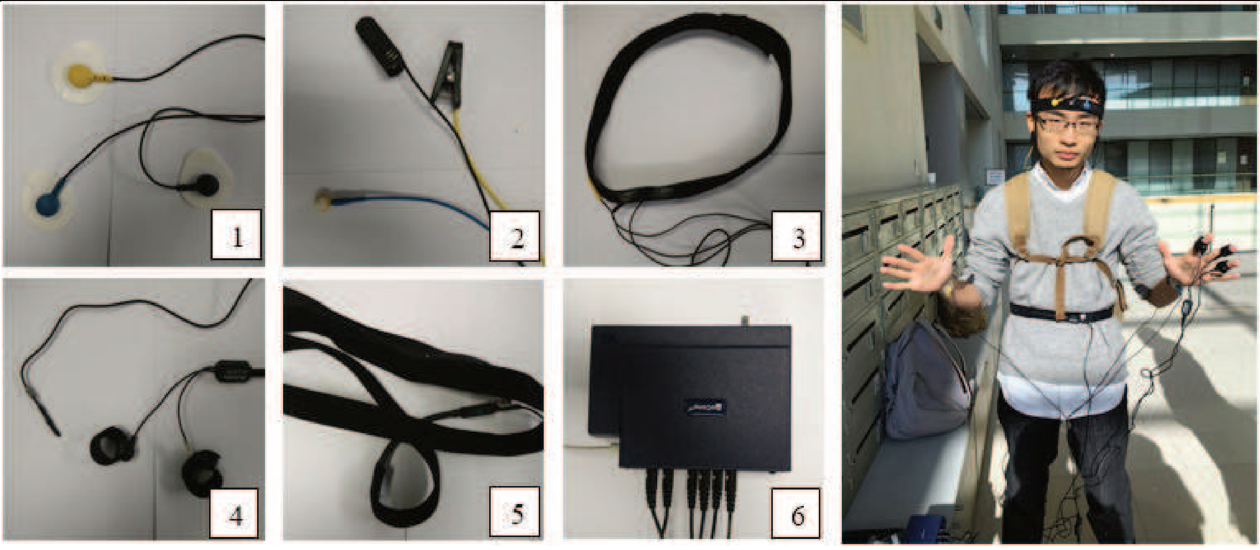

Fig. 2: Biosensor measurement parts & equipped participant (used with permission)

4.2 Visual perception

One of the central aspects of this research study revolves around visual perception and its impact on well-being. At a later point of the project, virutal or augmented reality features will be used as a comparing tool, analysing whether and to which extend design and aesthetic elements of the built environment can improve the well-being of citizens. Even though this question was not the central focus for the initial case study, the reaction and feelings towards the visable built environment shall be recorded and documented for later comparison.

Each participant was asked to write a brief narration for each walk, specifying visual experiences – whether negative or positive – and other happenings or interactions. Participants were also asked to present those specifics by photos or snapshots taken from their video-recordings from each walk.

4.3 Data collection

Data collection with such biomapping devices as presented in chapter 4.1 underly certain preconditions. Usually, multisensory data experiments took place under enclosed (indoor) lab conditions (Tost et al. 2015), where environmental impacts or external effects were minimal on the experiment. For outdoor environments, several aspects have to be named, which interfere with human biological reactions: weather, wind, temperature, air humidity, light/shadow, smell or noise, among others, which can certainly influence well-being and comfort, therefore might have impacts to the collected data. Distortions by such external influences can only be ruled out with a certainly high amount of datasets under different conditions of the outdoor environment.

Another, more difficult obstacle in the data collection is the activity on an outdoor walk itself. An ongoing walk – even just for 10 to 15 minutes – has its effects on heart rate/pulse and other biological indicators used in this study. For example, increases in ECG measurements and stress reactions towards the end of the route, could be very well linked to the activity or even to the proband's knowledge (and arousal) that the „finish line" is coming close. Some test runs also indicated that the walking speed increased after the last turn towards the end of the route for almost all probands, which also depicted effects on arousal measurements.

5 INITIAL CASE STUDY

The purpose of the first multisensory mapping case study was an effective testing of the devices, the practicability of them under outdoor conditions and their reliability as well as collected data consitency. Interviews of all probands were conducted afterwards to identify any difficulties or specifics, which could have affected the biosensory mapping or could play a role for data analysis.

5.1 Location & Route

For the test location, a 15 minute walking route across the Tongji University Campus in Shanghai was chosen. After first trials with different route styles, a clearly defined A to B route was favoured over a round trip, as it resulted in the most reliable data. It has yet to be evaluated, why round trip trial data showed lower quality results and varying consistency.

We intentionally selected a site on the university campus, which varied in self-reported environmental experiences in a walkable range. The proposed route across the campus could be divided into eight varying zones or locations (see Fig. 3). It consists of open spaces as well as dense alleys, green spaces and concrete plazas, busy roads with traffic and pedestrian walkways.

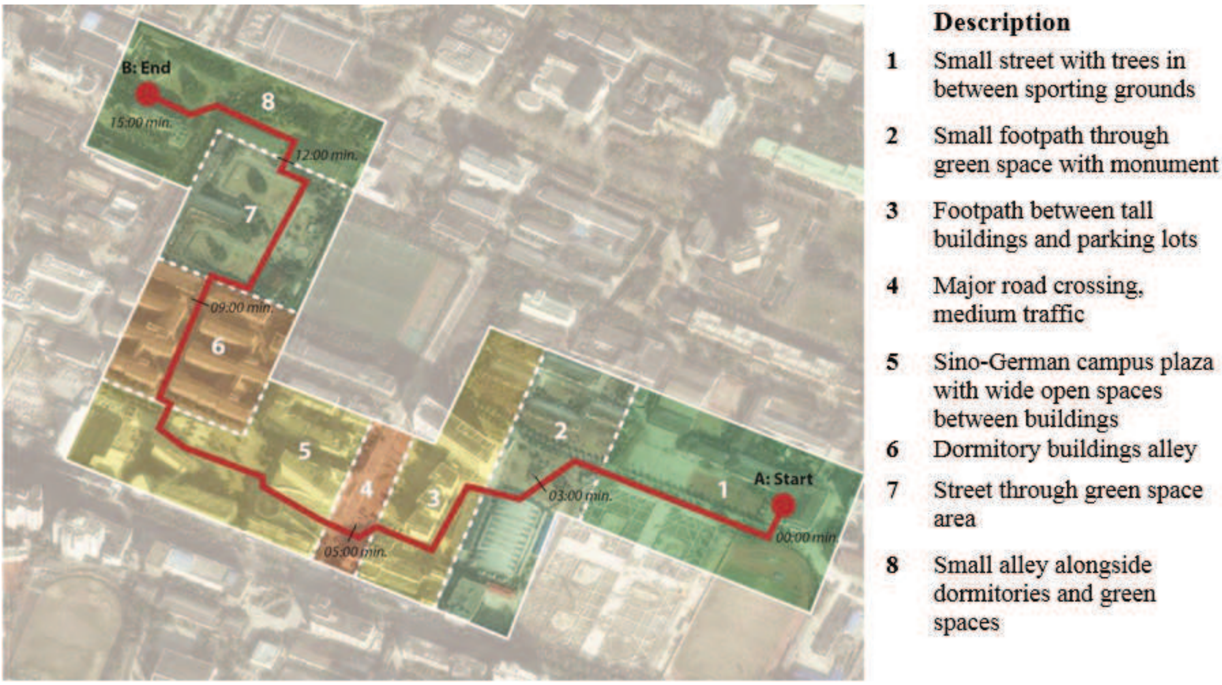

Fig. 3: Chosen route with eight different perception areas

5.2 On site biosensory mapping

Four participants were recruited and asked to walk the selected route in the same direction for three times, with small breaks in between. They were asked to perform the walk in a stable and modest walking speed, so that exhaustion and impacts on measured data were kept on a minimum level.

At each walk, they were carrying a 6-channel Procomp Infifniti device, a video-camera attached to the head gear, as well as a Garmin etrex20 GPS. The whole process of the walks was also video taped by an experiementer behind the participants. All experiements were conducted in November 2015 under varying, but mostly fair weather conditions, mainly at around 10-15°C. None of the participants did report any uncomfortable feeling neither about the outdoor conditions nor the carrying of the devices.

Also, the participants were familiar with the campus before the experiment for several years. The route and walkways were known to all participants. Influences on biosensors, e.g. stress levels, for orientation purposes can therefore be crossed out at this point. Interviews after the experiment confirmed that no participant had any difficulties with the route itself or for orientation during the walk.

All together, 12 datasets were collected from all walks, some of which could not be further analysed, due to lost signals on certain indicators during the run. In the end of the first mapping, 9 datasets could be used for further analysis.

5.3 Data analysis

Before analysing biosensor data, several processes need to be untertaken to make datasets readable and usable for the project’s purpose.

In a first step, collected data indicators were avereaged from their individual sample rate to a comparable level of 1 second each. This enables the biosensor data to be synchronized with 1 second interval GPS tracks. The average rates are still consistent and depict data in appropriate precision for the project purpose. However, not all biosensors are possible to be averaged at this stage properly. ECG, EMG and EEG data

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were recorded on several different frequency channels (see Tab. 1), which need resampling and filtering afterwards.

Biosensor	Channel	Indicator	Sample Rate	Criteria
ECG	A: ECG	ECG	1024	-
	A: ECG HR (smoothed)	Heart Rate	1024	Valence
	A: ECG LF Total Power	In (LF/HF)	16	Arousal
	A: ECG HF Total Power	In (LF/HF)	16	Arousal
	A: ECG HR mean (bpm)	Heart Rate	1024	Valence
	A: ECG peak freq. mean (Hz)	Heart Rate	16	Valence
	A: ECG LF/HF (means)	In (LF/HF)	16	Arousal
EEG	C: EEG ERP N400~700	EEG	256	-
EMG (facial expression muscle)	D: EMG	EMG	256	Valence
	D: EMG mean (uV)	EMG	256	Valence
Skin Conductance	E: Skin Cond	Skin Conductance	256	Arousal
	E: Skin Cond mean (uS)	Skin Conductance	256	Arousal
Skin Temperature	F: Temp	Skin Temperature	256	Arousal
Respiration	G: Abd Resp	Abdominal Respiration	256	Arousal

Tab. 1: Defined and measured channels for the initial case study

EEG datasets were resampled to 256 per second in order be to synchronized with other physilogical data. All raw datasets were prepocessed via BioGraph Infiniti V6.0.4., the software coming with the Infinity device. In-depth filtiering and denosing preprocessing for certain indicators were conducted using Matlab.

After preprocessing, indicators, such as ECG LF & HF Channels, were smoothed and averaged to the GPS sampling rate at one per second. Spatial data then was synchronized with physiological data using the 1-second time stamp.

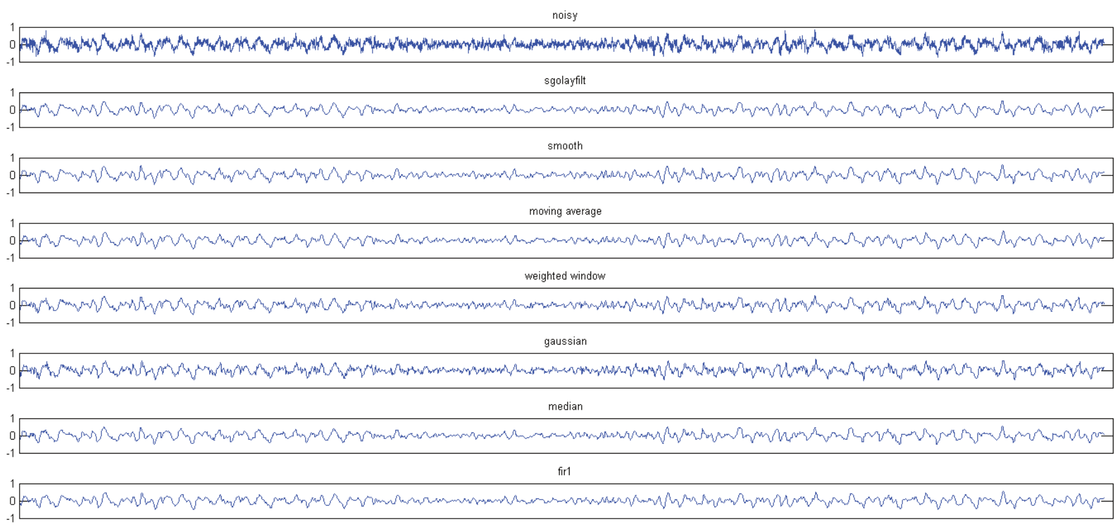

Fig. 4: Denoising of raw ECG data using different methods (a 30-sec sample from data was used to depict the denoising process)

At the time stamp interval, physiological indicators were able to be linked to locations on each GPS route. Based on the findings of Lang et al. 1993 and Lang 1995, certain indicators can depict the two relevant criteria:

- “affective arousal”, indicating biphasic levels of stress (calm/neutral vs. aroused)
- “affective valence”, indicating biphasic valence of emotional reactions (unpleasant vs. pleasant)

For locating arousal and valence in data channels, focus will be put on the change rates of single indicators and their relationship to each other. The correlated increases or decreases for arousal and valence indicators show the emotional responses of either pleasant or unpleasant feelings of the participants. After thorough analysis of the usable datasets of each walk and each participant, they were depicted via the time- and GPS-stamp in a GIS-based heat map (see Fig. 5).

According to this map, seven meaningful hot spots for emotional responses could be indentified alongside the route, three of which with unpleasant and three with mostly pleasant emotional responses. A seventh hot spot (7, see Fig. 5) depicts both a negative response followed by stronger positive responses. This can be explained by the change of environments, as participants walked first in between parked cars and two buildings and after the left turn continued to walk adjacent to a park.

For all identified hot spots, unpleasant emotions show comparably higher magnitudes than pleasant ones. Along the route, further minor responses can be found, both for positive and negative responses, which after viewing video records and interviews can be linked to occasional interactions or in some cases be the result of visual perception, as interviews showed.

To confirm the initial questions of this study (see chapter 4), as expected, unpleasant emotional responses are typically located at spots of high traffic or traffic-related interactions (road crossings, parking lots), while positive emotions or pleasant reactions can be found in rather calm areas along the route.

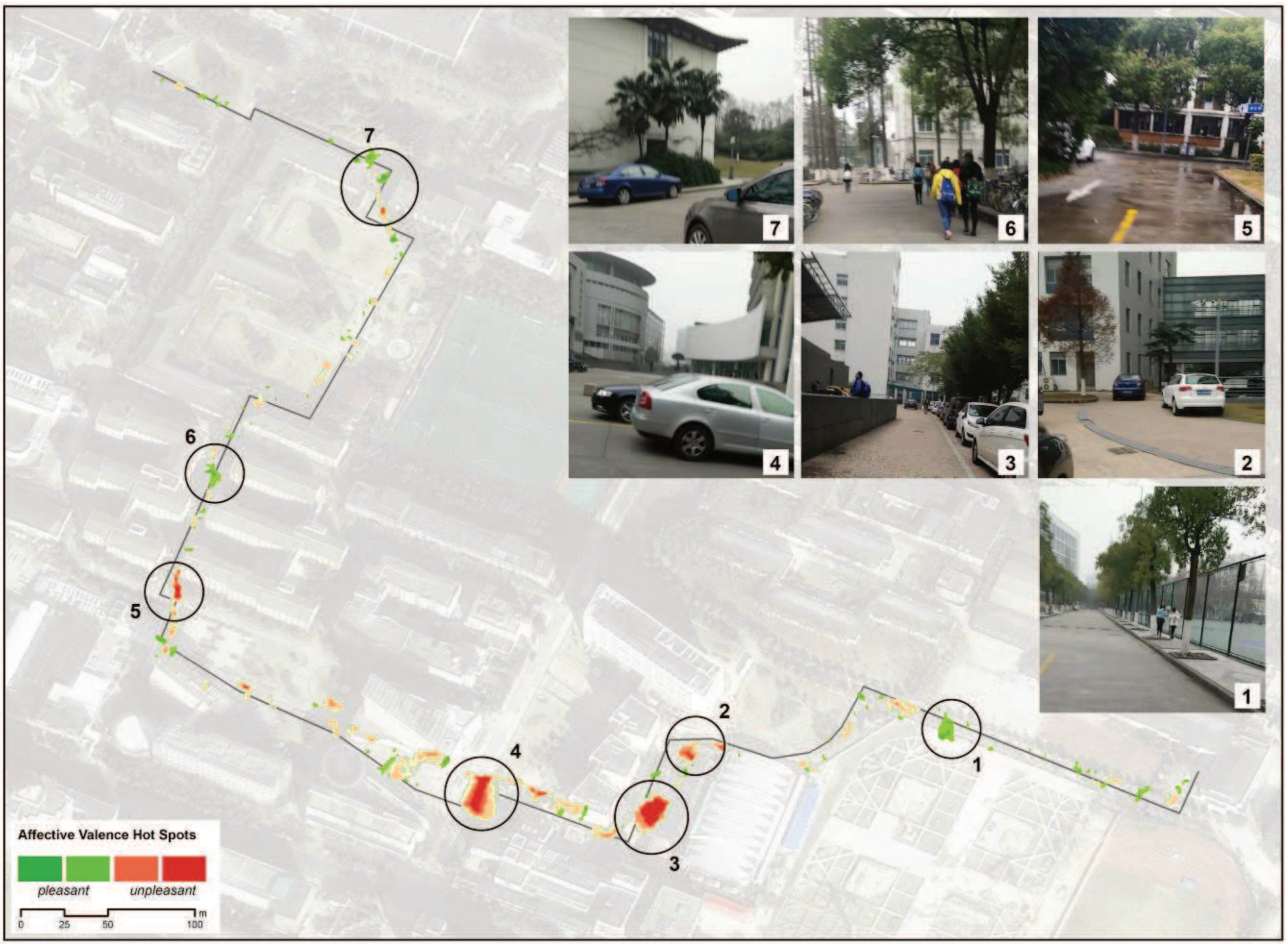

Fig. 5: Affective Valence Heat Map with captured hot spots of pleasant and unpleasant affectiveness and snapshots of the typical views

In comparison with the stated narratives of each participant though, certain spots surprisingly did not match with measured biosensors. Almost all participants named zones 3 and 5 (see Fig. 3) as the most unpleasant, especially from a visual or design point of view. On the opposite side, zones 1, 7 and 8 were named as the most pleasant, both for walkability and visual aesthetics. The measured results depicted in the heat map

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though, do not confirm strong feelings or emotional responses at all allegedly unpleasant or pleasant locations. Zone 5 on the one hand, was stated as the most negative visual perception by all participants, naming specifically the rather dark walkway in between tall and grey buildings. In data rows and hot spot analysis, slightly unpleasant emotions can be verified, but not to an extend, which would be comparable to other unpleasant hot spots linked to interactions and traffic.

Similar to these findings, zone 7, which was judged as the area with most positive visual aesthetics by the participants, does not show significant impacts on pleasant emotional responses. Minor magnitudes exist after hot spot analysis, but do not correlate with the identified hot spots (1, 6 and 7) and stated narratives.

The results of this initial case study indicate that emotional responses towards urban environments are more likely impacted by interactions to a much larger magnitude than visual experiences. It has to be further evaluated, why in both cases, the visual perceptions seem to play a minor role in comparison with interactions and if there are other calculations needed for extracting visual perceptions from interactions.

A first possible answer can lie within the varying affective responsiveness of the participants towards aesthetics, as this conscious and unconscious judgement is highly individual, while responses towards traffic and interactions might trigger more consistent responses. Further tests and the introduction of virtual features and alterations of the urban environment (augmented reality) could help identifying the impact of visual aesthetics towards the magnitudes of multi-biosensory data.

6 CONCLUSION & OUTLOOK

The case study showed some first possibilites multisensory data analysis can have on the characters of urban spaces. However, many difficulties and challenges exist for proper data interpretation and application. First of all, the tested device produces data of varying quality under outdoor conditions and activities, which has to be reviewed in timeconsuming processes. The devices used in this study, are also not suitable for common data collections, therefore is this study not fully comparable to previous studies based on wristbands or wearables. Many obstacles remain for proper data collection and analysis.

Nevertheless, with the appropriate steps taken, multisensory data is able to not only identify stressors or – in case of urban space – locations with unpleasant emotional reactions, but can also depict possible positive connotations of the built environment. In the first case study presented in this paper, positive and negative triggers could be identified, even though they could not undoubtfully linked to visual perception, yet. There are several additional factors and influences to consider in open or urban environments, which might have a higher impact on emotional responses and biosensory data rather than visual perception.

At this stage of the project, it is crucial that further research has to be conducted in order to better understand the biosensors and their sensitivity towards urban environments and visual aesthetics. For further steps, the influence of visual perceptions on the well-being or stress reactions will be investigated. This also includes further experiments with alterations of existing sceneries by using augmented reality technologies. In addition, other biosensory devices will be tested to analyse and possibly verify the measured data used in this study.

Since technological development and ongoing enhancment of multi-biosensory devices persist, the findings of emotional responses towards environments and sceneries will gain importance and hold their share for designing more livable urban landscapes.

7 ACKNOWLEDGEMENTS

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🏆 *reviewed paper*

A Spatial Microsimulation Model for the Estimation of Heat Demand in Hamburg

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1 ABSTRACT

Most spatial bottom up domestic heat models are based on an existing building stock data set, this can be the official digital cadastre (ALKIS in Germany), community based data sources (e.g: open-street) or collected data stored on a GIS system. On this paper we present an innovative method for the creation of spatial bottom up domestic heat models that do not need an existing building stock data-set as input. The advantage of this type of models are its transferability, speed and flexibility.

The presented model uses national standardized statistical data, making it possible to apply it for any region in the country without having to modify the model. Because the input data for the model is more compact the speed of the model increases significantly, the type of analysis possible with a high speed model allow us to perform a microsimulation of the building stock for the entire country, see (Muñoz H., Seller, & Peters, 2015). The presented model structure allows us to quickly develop dynamic simulation scenarios.

We present a spatial microsimulation model developed for the simulation of domestic heat demand. The presented model use the GREGWT R package to create a synthetic building stock benchmarked to aggregated small area statistics from the 2011 German census. We create this synthetic building stock from the 2010 microsensus. The heat estimation if performed on the microcensus with help of the heat R package.

The simulation results present a monthly heat demand at a microlevel for the entire city of Hamburg. The generated data for the estimation of heat demand can be use as input data for other Agent Based Models. By enriching the microcensus with time use data, we are able to generate the basis data for the construction of activity based urban models. We see the development of this type of urban models as an essential development of urban planning, specially for a smart urban development. The generation of microdata is a fundamental part of the smart city development.

Keywords: GREGWT, Hamburg, Spatial Microsimulation, Synthetic City, Urban Heat Demand

2 INTRODUCTION

This paper present a spatial microsimulation model used for the estimation of residential heat demand for the city of Hamburg. In this paper we first reweight a population sample to small geographical areas and create a synthetic population based on this reweighted sample. The reweighting algorithm is performed with an implementation of the GREGWT method and the creation of synthetic population with a Fitness Based (fbs) method. The presented results show a good internal validation of the spatial microsimulation model.

Microsimulation, introduced by (Orcutt, 1957), is a simulation method used by many scientific disciplines. The method aims to simulate many types of social phenomena at a micro-level. The main idea of this type of models is to create or sample a representative synthetic population and design simulation on this population. There is not a defined scope of the model application because this type of models can be apply to all kinds of phenomena. Commonly the subjects of the synthetic population are individuals of families, but this micro-units can be any type of agents. We can develop a model simulating firms, animals or in this case buildings.

The spatial on spatial microsimulation was introduces by social geographers (Clarke & Holm, 1987). Spatial microsimulation add the spatial constrain to these models. Instead of having a single representative population we generate synthetic populations representative of small geographical areas. The spatial "granularity" at which this models can be internally validated are these geographical areas. For overview of spatial microsimulation models see (Tanton, 2014, O'Donoghue, Morrissey, & Lennon, 2014). Theoretically we can generate synthetic populations at any geographical level, nonetheless the performance of the model will reduce as does the geographical aggregation. Trying to find a representative population for a very small area with just a few residents is harder that for larger populations. Also, on smaller geographical areas we encounter more zeros on the benchmarks, many algorithms can't deal with the zeros percent on the benchmarks, GREGWT cat. An issue that we encounter in the city of Hamburg is that at a smaller spatial aggregation we see that available data is harder to get or has been scrambled in order to protect anonymity of the residents.

On this paper we make use of a generalised regression for the weighting of sample survey results, an implementation of this process is known as the GREGWT algorithm. We use the GREGWT R library (Muñoz H., Vidyattama, & Tanton, 2015), the library is an implementation of the GREGWT algorithm. The original GREGWT algorithm was developed by the Australian Bureau of Statistics (Bell, 2000). The algorithm is also used at the National Center for Social and Economic Modeling (NATSEM) on their spatial microsimulation model spatialMSM (Tanton, 2007, Tanton, Williamson, & Harding, 2014).

The GREGWT algorithm only reweights a sample to known benchmarks of small geographical areas. The results from the GREGWT algorithm are non integer weights. We do not consider the non integer weights as a synthetic population, because we can not use this population for other urban simulations, like the population of digital building stocks or as input to agent based models. The GREGWT R library implements a slightly modified version of the algorithm proposed my Ma and Srinivasan (2015) for the creation of synthetic populations.

For the computation of domestic heat demand we make use of the HEAT R library (Muñoz H., 2015). This library implements a monthly quasi steady state model for the estimation of domestic heat demand.

3 METHOD

3.1 Reweighting the Survey Sample with GREGWT

For the reweighting of the survey to generate the representative weights for each geographical area we need two data-sets: (1) a survey to reweight with design weights; and (2) the benchmarks for each geographical area. We use the German Mikrozensus (Statistische Ämter des Bundes und der Länder, 2010), this is a representative sample of the German population of individual records. The Scientific-File contains 1% of the total population. The geographical aggregation of this sample is the federal state. Hamburg is both, a state and a city. For the reweighting of the survey we take only records from Hamburg into account. A reduction of the initial survey considerably reduces the computational time of the algorithm, specially for the later part of the analysis on which we implement the fbs method. On special cases, the results can be better if we use a bigger sample size. In this case the internal validation of the model is performing extremely well, and therefor we do not need a bigger sample size.

The parameters used on the survey sample and the corresponding benchmarks are listed on Table 1. It is important to notice that not all these parameters have the same units. While age, marital status and sex count individuals, that is f.ex: number of people on a geographical area that are male, floor area refers to the total number of dwelling units on a given floor area category. The last two parameters: year of construction and number of dwelling units count the number of buildings on these categories. The R implementation of GREGWT can deal with this variation of units and benchmark the sample accordingly.

The reweighting of the survey sample and the latter creation of a synthetic population and building stock is benchmarked not only to demographic characteristics of the small geographical areas but to characteristics of the building stock. For the computation of heat demand we need to estimate the heat transmission coefficients of the building components. The defining parameter for the estimation of these coefficients is the construction year of the building. We use this parameter, and the other two parameters describing the building stock for the classification of the individual records on the sample into building types. Attach to each building type is a heat transmission coefficient and other relevant parameters needed for the estimation of heat demand.

The GREGWT algorithm is an implementation of Sigh & Mohl (A. Singh & Mohl, 1996). For a description of the algorithm and its applications see Tanton, Vidyattama, Nepal, and McNamara (2011). A mathematical explanation and comparison to other smaptial microsimulation method can be found an Rahman, Harding, Tanton, and Shuangzhe (2010). For a comparison to the well establish IPF method and a discussion of the roll of design/initial weights see (Muñoz H., Tanton, & Vidattama, 2015).

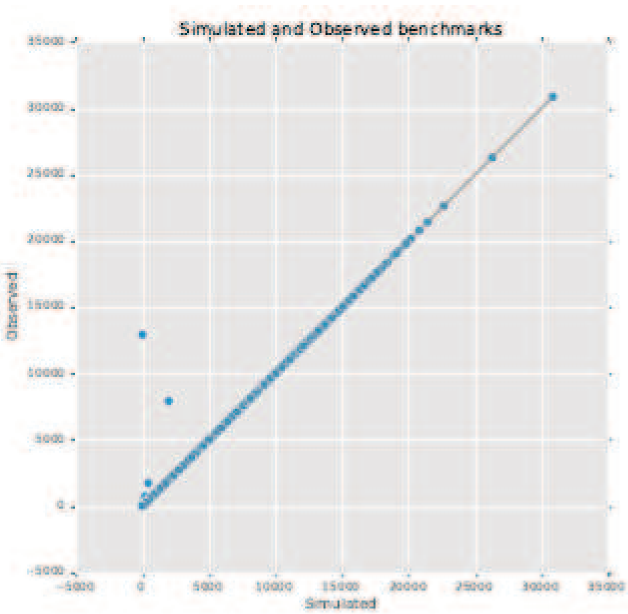

Fig. 1: Plot of simulated (x-axis) and observed (y-axis) sum of marginal totals.

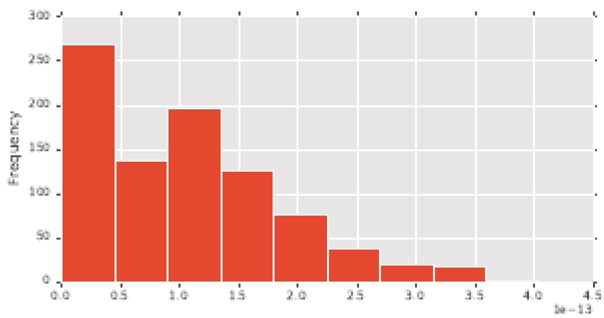

Fig. 2: Distribution of PSAE

MC Code	Census Code	Description
EF1	/	Federal State (NUTS 2)
EF952	/	Weight
EF44	ALTER KURZ	Age
EF49	FAMSTND AUSF	Marital status
EF46	GESCHLECHT	Sex
EF492	WOHNFLAECHE 20S	Floor area of the dwelling
EF494	BAUJAHR MZ	Year of construction
EF635	ZAHLWOHNGN HHG	Number of dwellings in a building

Table 1: Used benchmarks from the 2011 Census and corresponding micro census attributes. Source: Microcensus (Statistische Ämter des Bundes und der Länder, 2010) & Census (Statistische Ämter des Bundes und der Länder, 2011).

Aim of the GREGWT algorithm is to find a set of weights w that can be used to match the microdata survey X to a set of small geographical areas benchmarks T so that $T=\sum w_j X_j$. The Algorithm aims to reduce the difference between the initial d and the estimated weights w. The algorithm maintains the distance D between design and estimated weights low. The GREGWT algorithm makes use of the truncated Chi-Squared distance function, represented in Equation 1 for the computation of the distance between weights.

$$D = \frac{1}{2} \sum_j \frac{(w_j - d_j)^2}{d_j} \qquad (1)$$

The distance minimization equation is expressed as the Lagrangian function of the Chi-Squared function. With this equation we formulate an equation for the computation of new weights. Where $X'_j=\sum \lambda_k X_{j,k}$.

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$$w_j=d_j+d_j X'_j \tag{2}$$

The resulting weights from this computation can be negative. For most simulations having a negative weight presents a problem. In this case having negative weight would result in negative heat demands. In order to cope with the negative weights the GREGWT algorithm introduced an upper and lower bound constrains. In this case we set the lower bound constrain to 0. If the algorithm computes weights outside the defined bounds, the weights are truncated to the bounds and the algorithm will loop until a predefine convergence threshold is reached or there is no improvement in the iteration.

$$TAE_i=\sum_j |T_{i,j}-\hat{T}_{i,j}| \tag{3}$$

$$PTAE_i=TAE_i \div pop_i \times 100 \tag{4}$$

The internal validation of the simulation is quantified by means of: (a) the Total Absolute Error (TAE); and (b) the Percentage Total Absolute Error (PTAE). The TAE measures the absolute distance between the benchmarks and the marginal sums of the sample survey with the computed new weights. A TAE of zero would represent a perfect match. Equation 3 represents the TAE mathematically and Figure 1 plots the sum of benchmarks (y-axis) and the marginal sums of the sample survey (x-axis). The performance of the algorithm shows very good results, almost all small geographical areas are aligned to the 45 degree line. There are some small areas with a bigger error for which the GREGWT can not find a representative set of weight. The distribution of the PTAE error is plotted on Figure 2. This error measure is equivalent to the TAE but normalized by the total population of the small area. Equation 4 shows this normalization. The results from the reweighting algorithm show an extremely low error.

3.2 Creating a Synthetic Population with the fbs Algorithm

The reweighting of the sample survey computes non integer weights. On the next step we convert these weights to integer values. In order to create a synthetic population we implement a modified version of the fitness-based synthesis introduced by Ma and Srinivasan (2015).

In the following section we describe the implemented method for the construction of synthetic populations. The construction of synthetic populations consists of using the reweighted survey and using the estimated new weights for the construction of a synthetic population. Ma and Srinivasan (2015) proposed the computation of two fitness values expressing: (FI) the subtracting and (FII) the adding probability of individuals from the random selected population out of the initial sample survey.

The algorithm iterates until no record in the input data has positive values for either type FI (Equation 5) or type FII (Equation 6) fitness measure. R is the difference between the small area totals T and estimated totals $\hat{T}$ (with an integer weight w) for benchmark category k. Both fitness measures are computed for each individual j of the initial survey sample.

$$FI_j=\sum_k R_k^2-(R_k-x_{j,k})^2 \tag{5}$$

$$FII_j=\sum_k R_k^2-(R_k+x_{j,k})^2 \tag{6}$$

Where: $R_k=T_k-\sum_j x_{j,k}\times\lfloor w_j\rfloor$.

On the algorithm implementation we introduced an extra constrain, the total absolute error TAE. Performing a spatial microsimulation at a low level of aggregation with just a few people on each area (10 individuals) is difficult. By using the fbs algorithm we are able to reduce the TAE achieved by GREGWT on areas with a small population. The extra constrain introduced makes sure that changing individuals results in a reduction of TAE (i.e. the change is only accepted if the achieved TAE is lower than the previous TAE value).

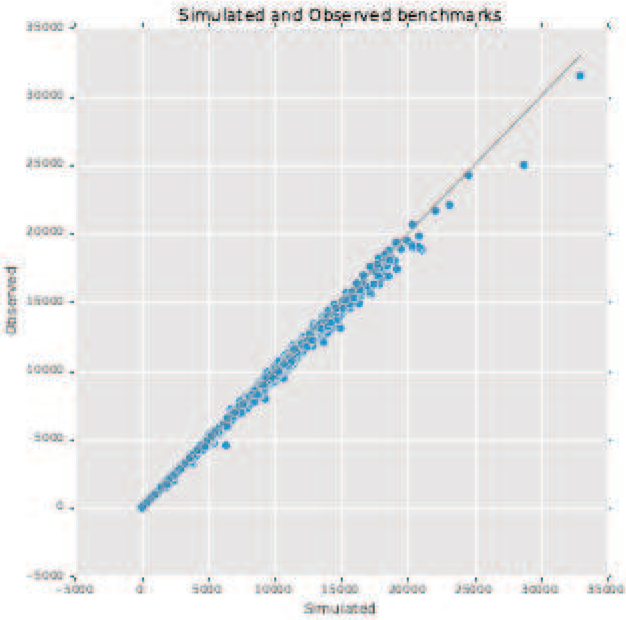

Fig. 3: Plot of simulated (x-axis) and observed (y-axis) sum of marginal totals for reweighted population with the fbs algorithm

We implement this algorithm as an addition to the GREGWT algorithm. This combination allows us to speed up the creation of synthetic families. Normally with the fbs method alone we start with a random sample of the survey. In this case, Instead of starting with a random sample of records, we start with a sample selected with the selection probability vector defined by the GREGWT computed weights. With this implementation the fbs method only needs a couple of iteration to find the best population instead of performing twice the sample size number of iterations, as reported by Ma and Srinivasan (2015).

The results from the combination of the GREGWT and the fbs method output very good results. Figure 3 shows the comparison between the small area benchmarks (y-axis) and the marginal sums of the synthetic population (x-axis). As expected, the overall performance of the model decreases. The achieved results are still good, the mean PSAE value for the synthetic population is 5.14e−1% compared to the mean PSAE value achieved by GREGWT alone of 9.93e−14%.

3.3 Computing Heat Demand

The computation of heat demand is performed for the entire input sample survey, i.e. we compute the heat demand for each individual on the sample. For the computation of heat demand we need to define the heat transmission coefficients of the building components. In order to define them we classify the survey into building types. We make use of the IWU typology (Diefenbach, Cischinsky, Rodenfels, & Clausnitzer, 2010, Loga et al., 2011) for this classification. The classification is based on the construction year, number of dwelling units and floor area. Table 2 shows the structure of the building typology.

The use of building typologies for the estimation of top down national energy models of bottom up building stock models is common practise (Caputo, Costa, & Ferrari, 2013, Hrabovszky-Horváth, Pálvölgyi, Csoknyai, & Talamon, 2013, Kragh & Wittchen, 2013, M. K. Singh, Mahapatra, & Teller, 2013, Dall'O', Galante, & Torri, 2012, Dascalaki, Droutsa, Balaras, & Kontoyiannidis, 2011, Balaras et al., 2007) among the scientific community. We make use of the R library HEAT (Muñoz H., 2015) for the computation of monthly and yearly heat demands. This library implements a quasi steady state model for the estimation of heat demand.

	<1859	1860–1918	1919–1948	1949–1957	1958–1968	1969–1978	1979–1983	1984–1994	1995–2001	2002–2009
EFHa	183	180	164	181	146	155	118	132	110	88

RH		153	137	156	106	127	127	98	78	86
KMH	190	143	168	156	129	134	118	122	92	79
GMH		127	144	142	131	117				
HH					114	113				

Table 2: IWU-de building typology matrix for Germany. Source: (Loga, Diefenbach, & Born, 2011) Specific Heat demand (spez. Wärmebedarfskennzahl) [kWh/m2a]. (EFH) Single family house "Einfamilienhaus"; (RH) Terrace house "Reihenhaus"; (KMH) Apartment house "Mehrfamilienhaus"; (GMH) Large apartment house "Großes Mehrfamilienhaus"; (HH) High-rise "Hochhaus";

The library used for the computation of heat demand needs a building geometry definition for the computation of heat demand. The created synthetic building stock does not represent the buildings geometrically. In order to estimate heat demand we construct a virtual geometry based on the floor area and number of stories of the building. The computation of heat demand is performed for each individual in the survey sample. Because of this, we need to divide the estimated heat demand by the individual household size. By doing this we avoid counting the same heat demand twice. The computation of energy demand at an individual level (per capita) rather that the estimation of heat demand per building can present itself as an opportunity for the development of activity based urban models. Instead of computing the heat demand of a residential unit and of a building office we compute the energy demand at home and at the office of the same individual.

4 RESULTS & CONCLUSIONS

The presented method makes use of a spatial microsimulation model for the estimation of residential heat demand at a low level of aggregation. In order to achieve this, we compute the heat demand for each record in the national population survey sample and (a) reweight and latter (b) create a synthetic population for each geographical small area of the city of Hamburg.

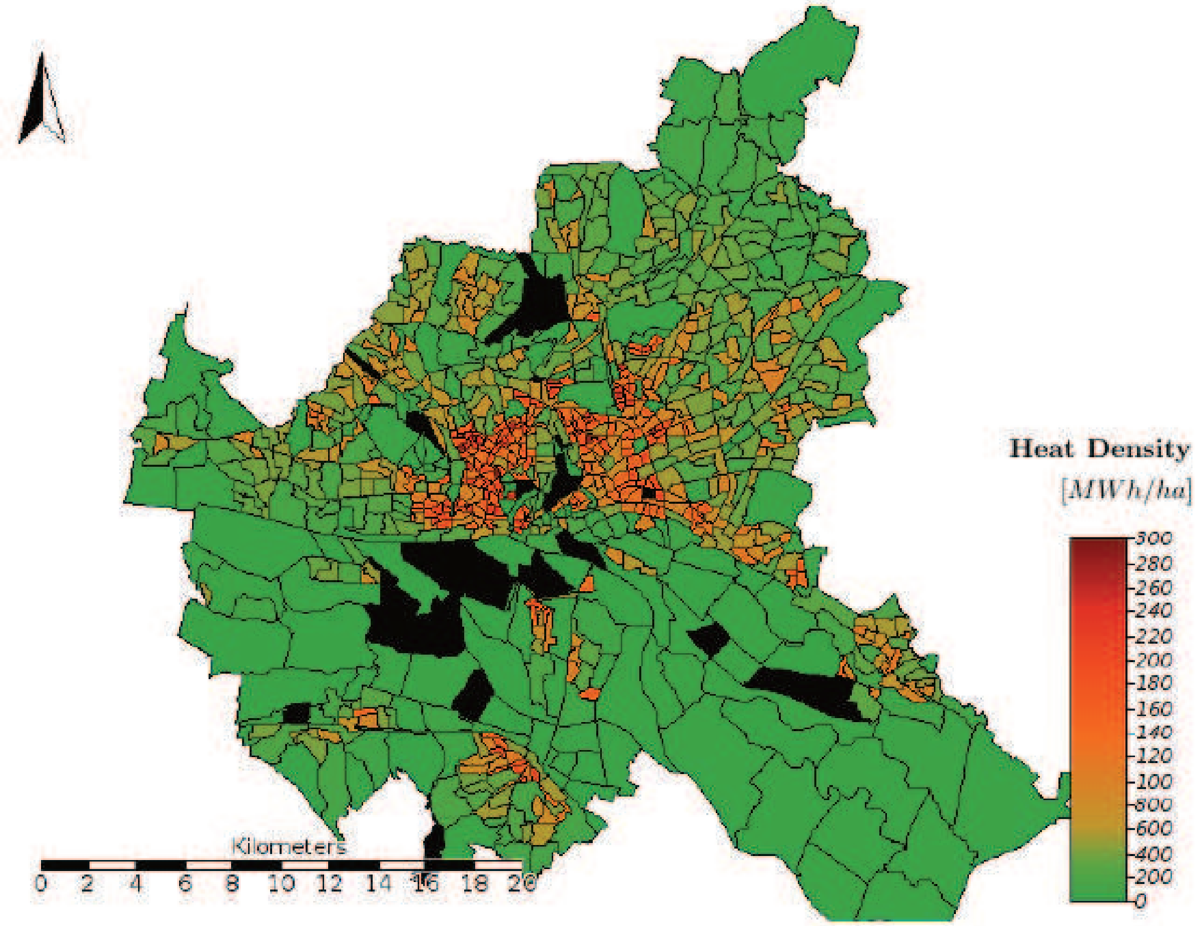

Fig. 4: Heat density for the residential sector in Hamburg

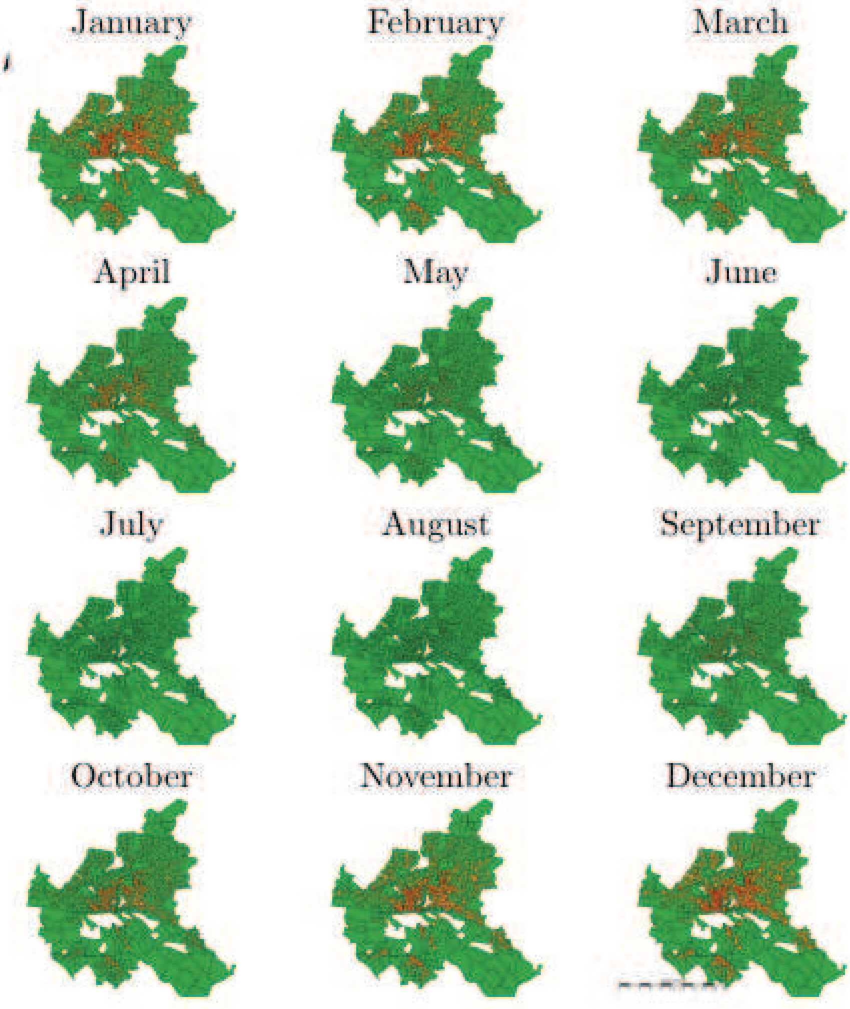

Fig. 5: Monthly heat density for the city of Hamburg

The computed heat demand is presented as heat densities of the small geographical areas. We performed the estimation of heat demand two times: (1) computing yearly heat demand and (2) a monthly heat demand. The results are presented in form of two density maps. Figure 4 shows the yearly heat density for each small geographical area in the city of Hamburg. It is clear that areas with a bigger population and with an older building stock with have a higher energy density. This model only accounts for the residential sector. A large part of the city center is covered my mix used buildings or office buildings. The heat used on this type of buildings is not taken into account on the model. The city of Hamburg also has a large industrial area, the harbor. Energy used on the industry is also not taken into account on this simulation exercise. Figure 5 shows the estimated monthly heat demand for each geographical area.

The presented method for the estimation of heat demand at a low level of aggregation shows a quick and robust performance. We have also shown the combination of two methods for the creation of synthetic populations, we take advantage of the speed provided by GREGWT to quickly compute representative weights of each small area. We use this weights to take a sample of the survey as initial population. Because this population is already close to the small area benchmarks, the fbs only needs a couple of iterations to achieve convergence. The model can be internally validated, this ensure us that the synthetic population created for each small area is a good representative of the area. Unfortunately we are still not able to make an external validation of the model.

We aim to extend the method by benchmarking the survey to aggregated energy consumption values. By benchmarking the estimated heat demands of each individual to know aggregated we can ensure that the synthetic population is not only representative by means of demographics but also by means on energy demand.

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A Study on the Lifestyles and Daily Activities of Informal Settlers in Inner Kabul City

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1 ABSTRACT

This paper analyses the lifestyle and daily activities of informal settlers in Kabul City. It begins with a review of relevant literature on the conceptualization of informal settlements as is popularly understood in Afghan's context. Primary data on informal settlers' living styles and daily activities was generated from interviews with 153 families residing in 86 houses in District Seven of Kabul. The data were analysed considering such households' characteristics as gender, affiliation (i.e. employment) and literacy. The results show that a typical dwelling unit within this informal settlement comprises multi-generational family members. Notably, men were found to be more active in daily activities than women. Similarly, literacy and affiliation were found to be important determinants of the kinds of activities that individuals in the study location engaged in.

Keywords: Daily activities of Informal Settlers, Informal Settlements, Informal Settlers, Kabul City, lifestyle of Informal Settlers

2 RESEARCH BACKGROUND AND OBJECTIVES

Kabul City has witnessed an extraordinary population explosion in recent years. The major drivers of this growth is cityward migration of refugees fleeing from insecurity in the hinterlands. The step-wise nature of these refugees' movement has been a major factor contributing to the proliferation of informal settlements in Kabul City. The city's population grew from 2 million in 2000 to an estimated 5 million in 2015, indicating a hundred and fifty percent increase within 15 years. Informal settlements accommodate about 74% of this population and cover 76% of the city's residential land (JICA, 2011a) (Fig.1). Regularizing or formalizing this vast mass of land has been a huge challenge and a top priority for the Afghan government. Consequently, various initiatives, including surveys and feasibility studies have been conducted with a view to exploring measures to address this challenge. However, these initiatives have mainly focused on built environment and physical elements in the urban context. However, in conceptualizing and planning a framework for the development of informal settlements, the social aspects such as residents' lifestyle, preferences and activities are just as important as the physical aspects, but for too long the social aspects have not received adequate attention from policy makers and development planners. According to Horgas, Wilms & Baltes (1998), activities are not only an expression of needs, preferences, and motivations, but also reflect external constraints and opportunities and the meaning attached to activities vary from one person to another depending on such characteristics as age, gender and education.

In view of the above, this paper examines the living style and daily activities of settlers in District Seven of Kabul because 95 percent of the area possess the characteristics of informal settlements. For this purpose, first, we present a review of the relevant literature on the conceptualization of informal settlements as is popularly understood in Afghan's context. Second, we present the primary data on informal settlers' lifestyles and daily activities, which were generated from interviews with 153 families, that resided in 86 houses and concentrated in an area of 4.3 km2 in the central part of District Seven. Third, we analyse the data considering such households' characteristics as gender, affiliation and literacy.

The paper draws inspiration from Clarence Perry's (1929) contention that the siting of neighbourhood unit facilities and street design should be premised on people's lifestyles and activities. This research takes the debate further by proposing that a neighbourhood unit framework should also be adopted in Kabul city. The paper proceeds by first re-examining Perry's neighbourhood unit in the context of Kabul, following initial macro surveys of the traditional neighbourhoods called "Gozar" (Sahab & Kaneda, 2015; Sahab, Meziani & Kaneda, 2014). The results from those surveys suggested that Gozars with informal settlements score less in some social and physical neighbourhood functions. Therefore, we concentrated our research on informal settlements and decided to conduct micro surveys of informal settlers.

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Studying people's daily activities has a long history in urban, geographical, social and psychological studies (i.e. Perry, 1929; Chapin, 1974; Altergott, 1989; Hanson & Hanson 1993). In the urban context, according to Hanson & Hanson (1993), activity studies enable urban planners to address the nature, the spatial extent and the diversity of people's activity patterns and how these patterns of particular social groups are different from one another. Chapin (1974) believes that such studies would be particularly valuable for urban planners as they sought, through intervening in the built environment, to improve the quality of life.

Although the study of people's lifestyles and daily activities have received considerable attention over the years in the developed countries, such studies have been comparatively scarce amid data reliability challenges in developing countries such as Afghanistan. However, just as there are differences relating to how and which activities are undertaken by different groups of people based on ages, affiliation and so on, so are there also differences in lifestyles and traditions across countries and regions. Therefore, studies such as this are highly anticipated in Kabul city to provide systematic frameworks upon which development and spatial planning of informal settlements can be predicated.

3 INFORMAL SETTLEMENTS IN KABUL

Informal settlements is a global urban phenomenon but mostly occurring in developing countries. They exist in various forms and typologies, dimensions, locations and by a range of names (UN-Habitat, 2015a). Although there are some common factors behind their emergence and growth, the amount of effect that each factor can have is different across regions. In Kabul city, the most compelling factor that led to the growth of informal settlements has been the inability of the formal sector to provide the public with a range of affordable housing options. (Gebremedhin, 2005; UN-Habitat, 2015c)

Furthermore, a review of the literature on informal settlements reveals that there are similarities between the definitions which are juridical and those focusing on illegality of the informal settlements. For example in Kabul's context, according to Gebremedhin (2005); JICA (2011a); UN-Habitat (2015c) and; AKTC (2011), informal settlements are settlements that are: (a) constructed in violation of the Kabul City Master Plan, zoning codes and regulations; (b) illegally occupying land, without having a rightful title to it.

Informal settlements are distinguishable from formal settlements by their social and physical features. From the physical point of view, while the majority of informal settlements lack basic infrastructure, in contrast to other cities, the houses in Kabul City are made of durable materials to provide adequate and permanent shelter to their inhabitants. Furthermore, the plot sizes in informal settlements are not smaller than in formal settlements and in many cases are even larger (Bertaud, 2005)

From the social point of view, comparing the neighbourhood functions of formal and informal settlements, some functions such as governance and crime prevention measures work better in formal settlements. However, such functions as mutual aid and maintenance of the neighbourhood facilities work well both in formal and informal settlements (Sahab & Kaneda, 2015)

Taking these into account, eradication of informal settlements and redeveloping to formal settlements is not an option, first because of the limited financial resources to redevelop this vast mass of land (76% of city's residential land) (JICA, 2011a; UN-Habitat, 2015b; Bertaud, 2005); second, the construction of permanent houses built mostly by labourers who had no alternative employment opportunities has contributed to the growth of fixed capital in the city and constitute an important asset rather than a liability. (Bertaud, 2005)

Therefore, the best way forward is in-situ upgrading with citizen participation (UN-Habitat, 2015b; JICA, 2011a; Bertaud 2005). The upgrading strategies should not focus only on the current physical needs of the informal settlers, but it should also take into account the social upgrading of the settlers such as rising literacy rates, women capacity, employment opportunities, etc. in the long term. These need to be first examined through some social surveys, which is the main aim of this research.

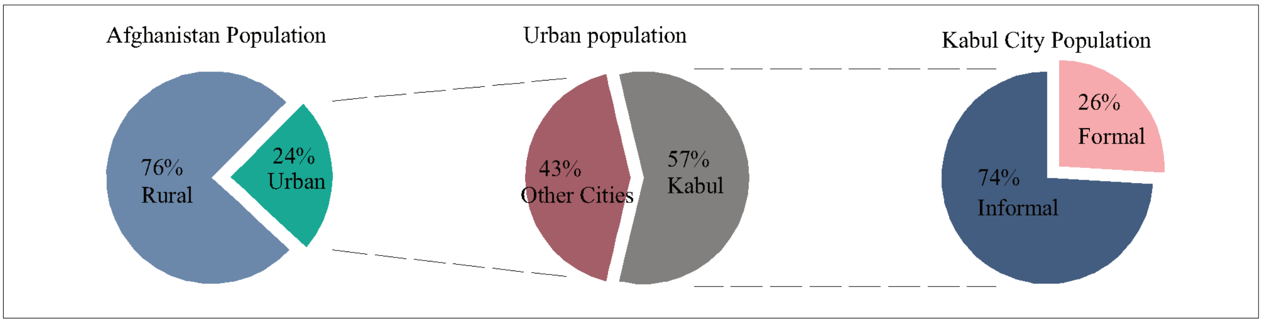

Fig. 1: The distribution of urban population in Afghanistan

4 SOCIAL SURVEY OF INFORMAL SETTLEMENTS IN DISTRICT SEVEN OF KABUL

To examine the lifestyles and daily activities of informal settlers, during August and September 2015, we conducted a survey in District 7 (a district is a municipal ward in Kabul City). This district was chosen because it is located in the southwestern part of Kabul City where informal settlements are heavily concentrated. The district is also a fast developing area with 45% new habitats and with more than 95% of the urbanised area being informal (JICA, 2011b). For ease of access and the security situation, we selected an area of about 4.3km2 in this district and 1 to 3 houses were randomly surveyed from each alley (narrow streets in the informal areas). Data collection method was through schedule (The researcher filled out the questionnaires by asking questions from the residents). The heads of the selected houses and other family members were asked both general questions and questions specific to the daily activities that they engage in.

The Questionnaire included questions on demography, daily activities and social relations, which constitute the main issues investigated in this study. A total of 86 houses, which accommodates a total of 177 families were surveyed. From those, 153 families and 800 individuals provided valid data that were analysed and presented here. The details of the sample breakdown are captured in Fig. 2 below:

	Surveyed	Sampled
No. of houses	86	86
No. of families in the houses	177	153
No. of persons	809	800
Male	-	384
Female	-	416

Fig. 2 Sampling statistics and surveyed district

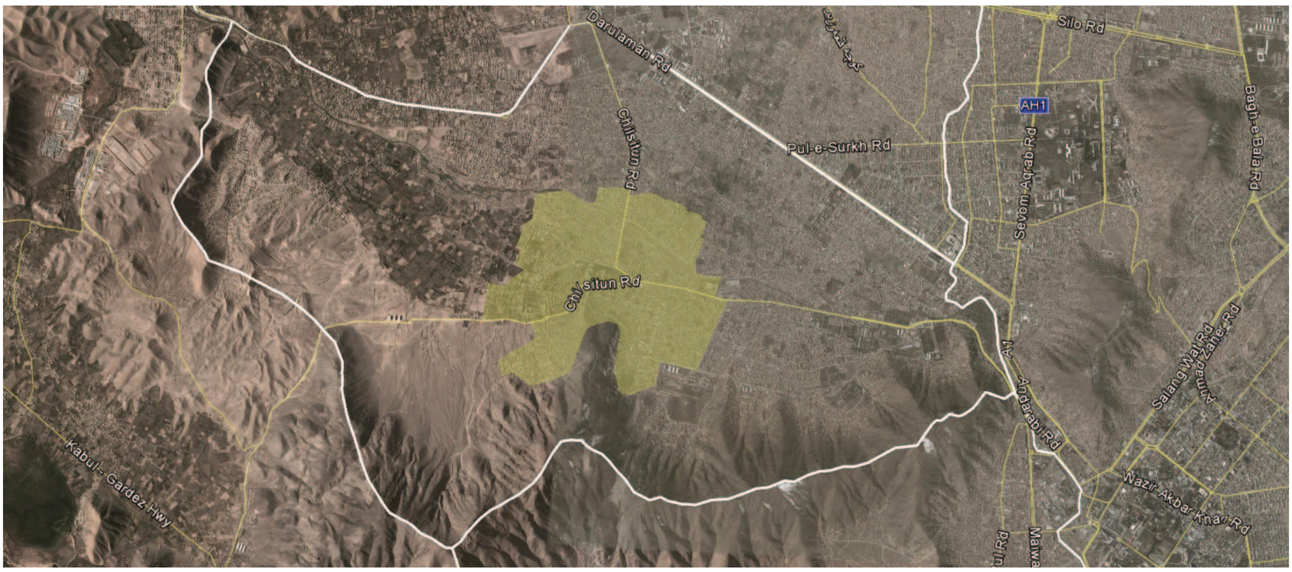

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Fig. 3: The location of the surveyed area in District 7

5 LIVING STYLE AND DAILY ACTIVITIES OF INFORMAL SETTLERS ASCERTAINED THROUGH SURVEY

5.1 House and Family Sizes

To develop any framework for upgrading informal settlements, the primary and perhaps the most essential data needed is the measures of population densities and family structures. Therefore, one of the main purposes of our survey was to investigate the family sizes and structures in the housing units of informal settlements.

The survey findings are shown in Fig. 4 below. As could be seen, in more than half of the houses (56.98%), multiple families, comprising mainly relatives are living together. Questions relating to the duration of stay in the houses show that the families have lived in there for a relatively long time, with the average being 25 years. Even though some of their children born in these houses have grown and married, they still live in there with their spouses. The predominant pattern is that each newly wedded couple still maintain their link with their family houses by extending such buildings which suggests that multi-generations co-exist in multiple families within the houses.

The range of house and family sizes are shown in Fig. 4 below. Accordingly, the figures suggest that single person houses are unlikely. The family sizes ranges from 2 to 10 members, and the average size is 5.27. In sum, the results suggest that an average of 9.38 persons live in a house.

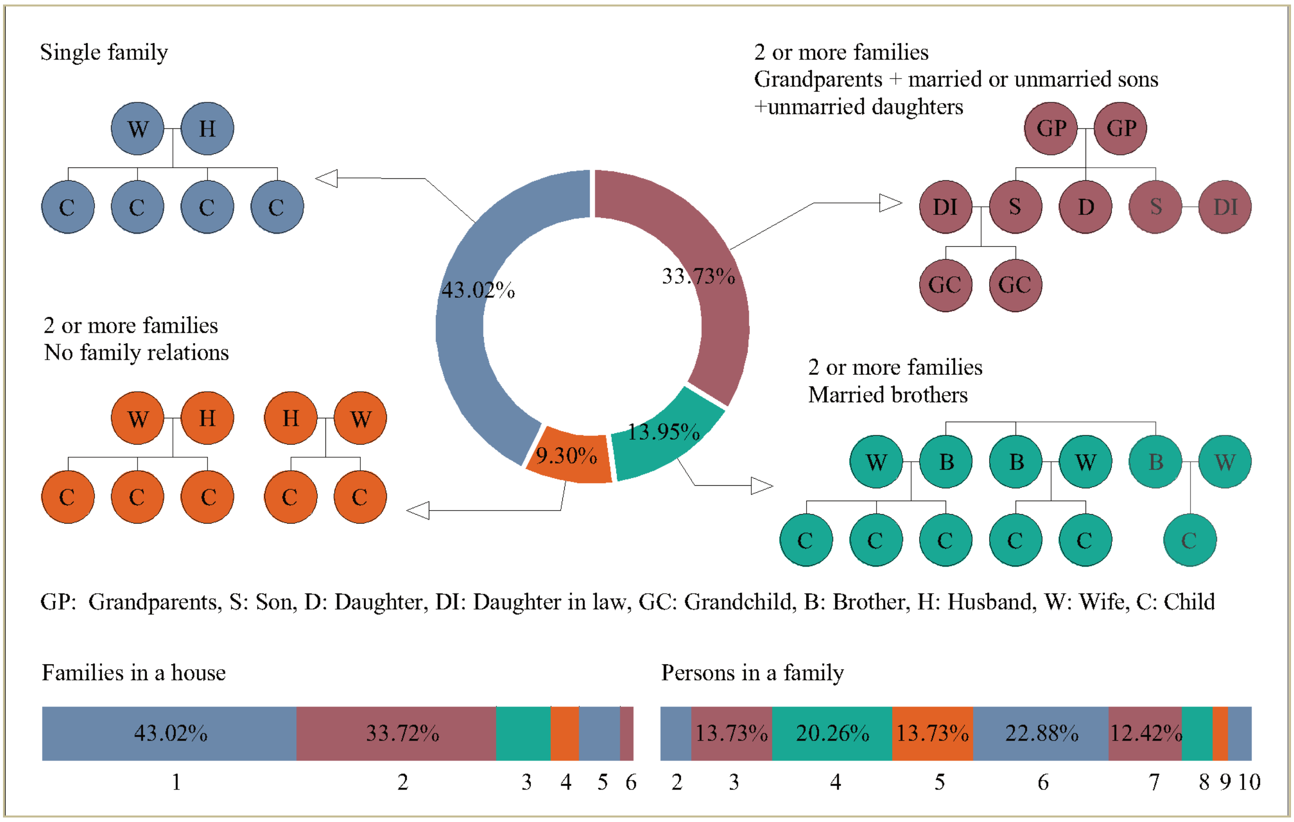

Fig. 4: The Characteristics of Families in the Sampled Houses (n=86)

5.2 Daily Activities

As mentioned before, the motivation behind this research was to understand people's actual daily activities, so as to be able to propose appropriate frameworks for developing informal settlements in Kabul City. This is because by understanding the current activities of informal settlements, the social and physical needs and preferences of the people can be more appropriately addressed, and long-term goals of improving social capacities among others can be set. To achieve this goal, the residents were asked about the most frequent activities or routines that they engage in during the days of a week. The frequencies of their engagements in these activities were counted in terms of the number of trips from the house to the specific destinations (one-way trip from the houses). Questions related to the places of work and studies were also asked to enable us to measure the distances using measuring tools on the map. From the findings of the survey, we produced a diagram (Fig. 5) that shows the average distances and the frequency of trips per person per week. However, we could not cover the distances to shops, mosques and garbage disposal places through the interviews. Therefore, we measured them using the physical maps of the area.

As could be seen in the diagram, the frequency of trips to mosque is the highest and the distance to university is the farthest. Although this is not true for all the trips, it seems that there is an inverse relationship between frequency and distance–the higher the frequency, the nearer the distance.

For some of the activities such as going to school, university, or work, we can hypothesize the characteristics of these actors. However, for some activities such as going to mosque, shops and disposing garbage, it is rather difficult to deduce the characteristics of the actors, since this might take on such characteristics as gender and/or age. To further probe these aspects of daily routines, questions that disaggregates such characteristics were included in the interviews. The results constitute the main body of the next section.

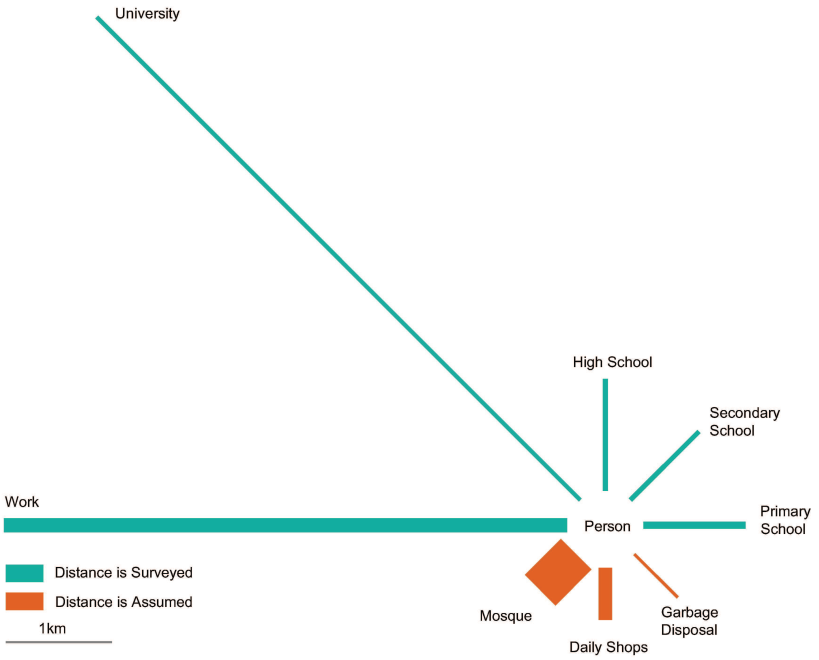

Fig. 5. Average distances (line measure) and frequency of trips (line thickness) in a week per person

6 ANALYSIS OF CHARACTERISTICS AFFECTING DAILY ACTIVITIES

To analyse the characteristics which might affect engagements in daily activities, we compiled a list of characteristics and activities. Such characteristics included age, gender, affiliation, and literacy, while the activities included going to mosque, shopping and garbage disposal. Since going to school and to work were included in 'affiliation', we decided to exclude them from the activities. The assumed relationships are shown in fig. 6.

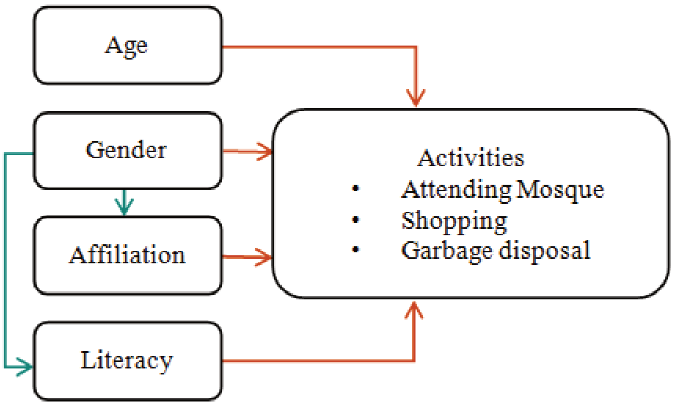

Fig. 6: Characteristics affecting daily activities

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6.1 Age:

To examine age-related differences in the daily activities, we categorized our sampled individuals into seven age groups (7-14, 15-24, 25-34, 35-44, 45-54, 55-64, 65+). As could be seen, younger age brackets were omitted since there was usually no activity for them. Fig. 7 show the weekly frequency of trips for each group.

In figure 7(a), it could be seen that the frequency of trips per person is the highest in 15-24 ages, this is because the number of persons in this age is the highest (n=233). This helps to understand the majority of users of a facility. However, to know which age group is more active, there is a need to ascertain the frequency of trips for each age group per number of persons in that group as shown in figure 7(b). The evidence suggests that the most active groups in terms of going to mosque is age 55-64 and 65+.

On the characteristics of the people going to shops, the most active groups were 45-54, 35-44 and 25-34. Although the frequency of trips to shops are less in comparison to the above-mentioned active groups, ages 7-14 also frequently go to shops. This is because young ones often go to nearby shops during the day when the adult have gone to work.

Garbage is mostly disposed by ages 15-24. However, slight differences can be observed between all the age groups. It should not go without saying that in 23.53% of the surveyed houses garbage is collected by waste collectors, which are not included in the above results. The waste collectors are either from the municipality or from low income people who are paid by the residents.

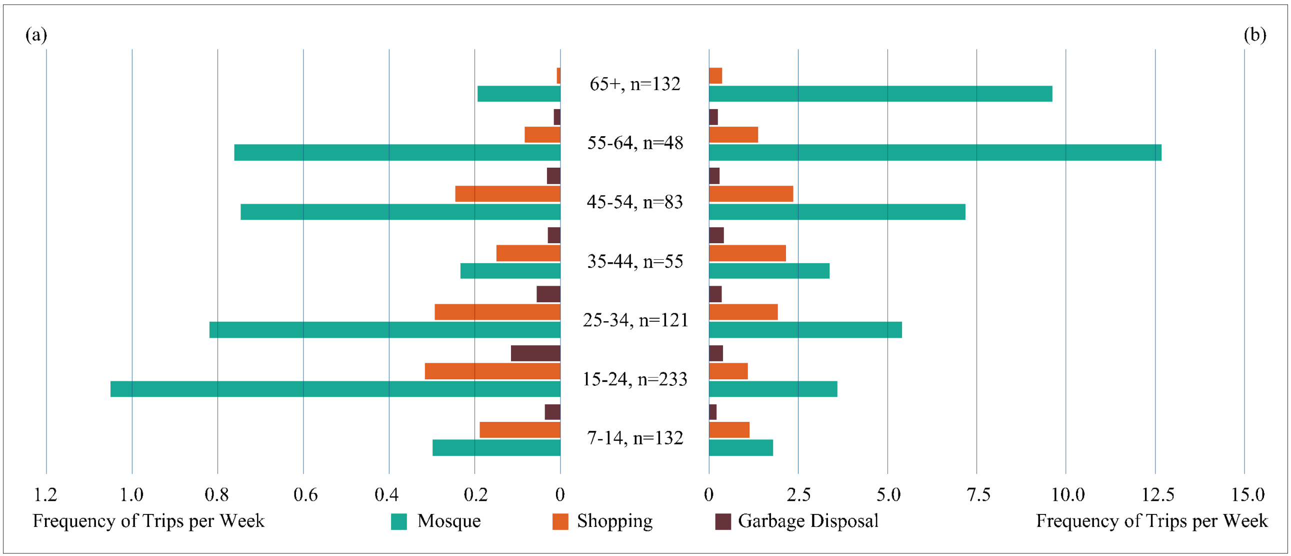

Fig. 7: Frequency of trips in a week (a) per person (b) per number of persons in each group

6.2 Gender

There were 416 females and 384 males in our sampled houses. To ascertain the differences between males and females, there was a need to investigate the frequency of trips undertaken by males and females per number of male and female groups in a week. This data is captured in figure 8. Accordingly, male groups were found to be likely more active in all the three activities.

In comparison to other activities undertaken by females, the only activity where they featured somewhat more was shopping, although this is also not comparable to male groups. Furthermore, we recorded no trips to mosque, and only few trips for garbage.

While Gender differences exist in varying degrees across all countries of the world, the situation of Afghan women particularly leaves much to be desired. Notably, women who do not go out of their residence are usually responsible for household chores such as cooking, washing, cleaning, grooming, fostering and so forth. However, this study does not focus on gender inequality per se, but tries to generate data upon which a systematic framework for developing urban environments can be based.

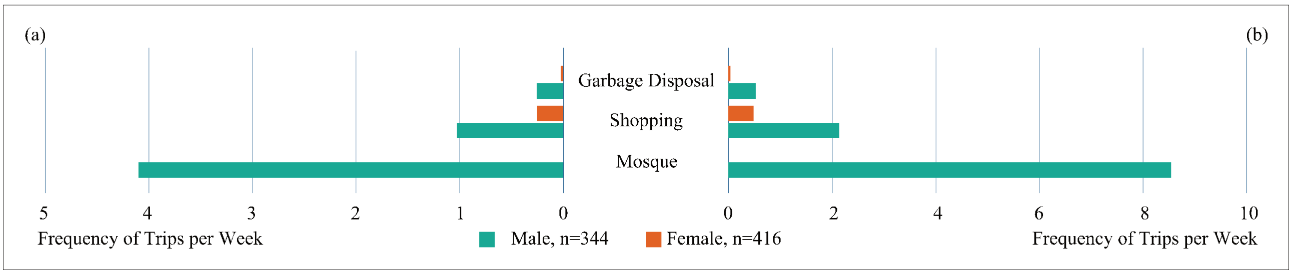

Fig. 8: Gender distribution of the number of trips undertaken in a week (a) per person (b) per number of persons in each group

6.3 Affiliation

To examine affiliation related differences in the daily activities, the sample was categorized into five groups comprising school students, university students, the employed, unemployed and retired ones. We excluded the kids (age 0-5) and the school age children, who were not attending school because we had recorded no activities from them. Looking at the frequency of trips per person in figure 9(a) below, it could be seen that the employed group recorded the highest frequency of trips, while after them, school students dominated shopping-related trips. Furthermore, to investigate the frequency of being active among the groups, we refer to Figure 9(b) which shows the frequency of trips per number of persons in each group. Thus, it could be seen that with as regard going to mosque, the retired group led the pack. The data also show that the employed group was likely more active than the unemployed just as school students were more active than university students, except with respect to going to mosque.

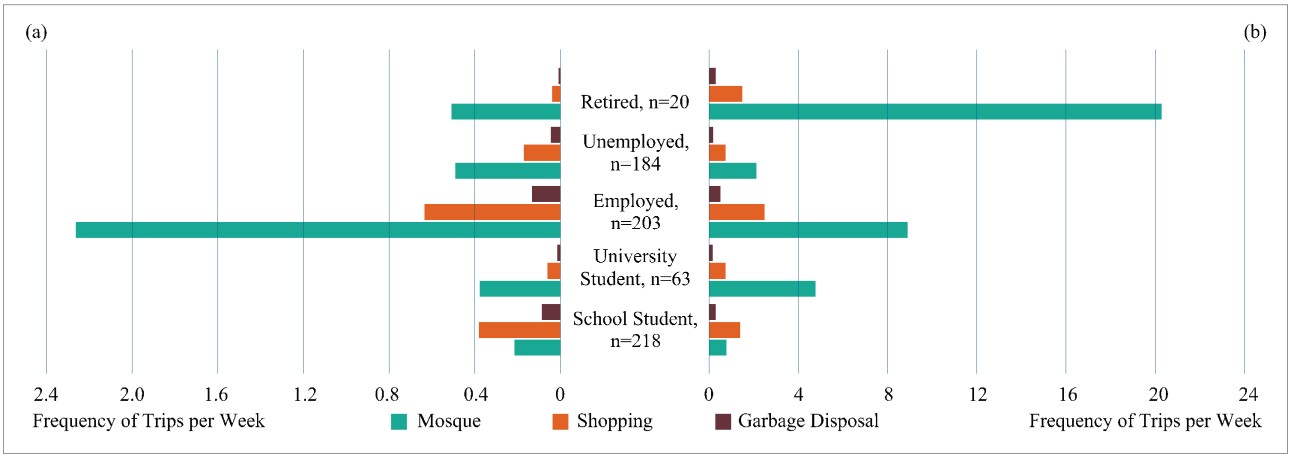

Figure 9: Frequency of trips by people with different affiliations in a week (a) per person, (b) per number of persons in each group

6.4 Literacy

To help us ascertain how literacy affects engagements in daily activities, questions on individual's level of education were included in the interview. The sample was then divided into literate and non-literate respondents according to various levels of educational attainments (Fig. 10). Accordingly, 82.86% of the people in our sampled houses were literate and 17.14% were non-literate. However, these figures might be different from the related statistical data in other reports due to the difference between definition of the term and the measurement tools used.

Regarding the daily activities, figure 10 shows that literate people are likely more active in all three activities done during a week.

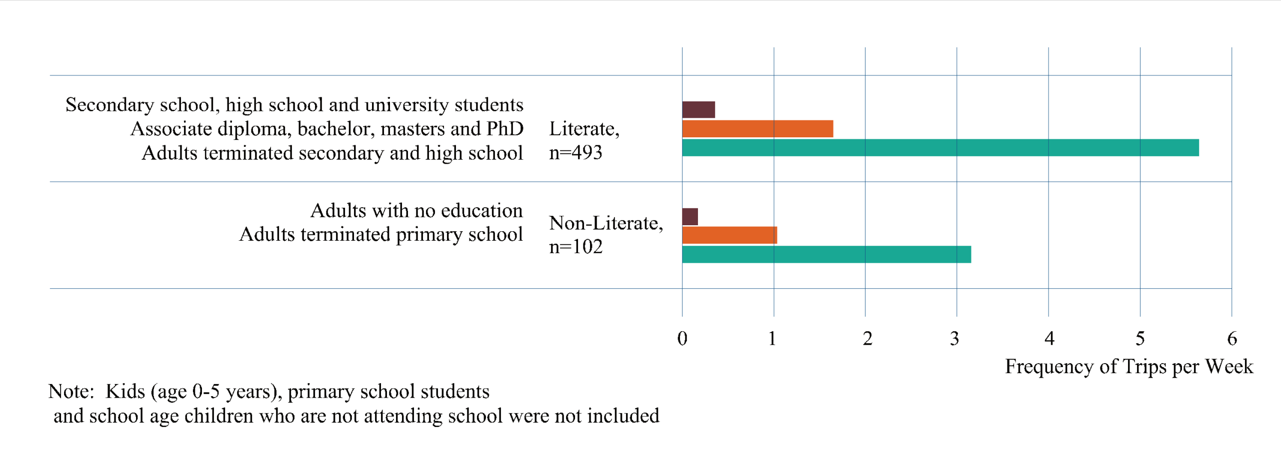

Fig. 10: Frequency of trips in a week per number of literate and non-literate persons

7 CONCLUSION

This paper sets out to provide a clear picture of the composition of families and the daily activities of the informal settlers in Kabul City. To this end, (1) a detailed profile of the families showing number of families in the houses, family sizes and family structures were presented; (2) an explicit layout of the most common daily activities were examined; (3) how the activities engaged in by the respondents relate to such characteristics as age, gender and affiliation were presented.

With respect to the composition of the family, our survey showed that in more than half of the houses, multiple families co-exist but are usually part of a larger family that includes multiple generations of grandparents, parents and their children. While this practice might be linked to Afghan tradition, it is also a strategy adopted by the respondents to cope with housing challenges induced by population explosion and the attendant rising cost of living in more formal settlements of the city. Therefore, it is envisaged that apart from planning for facility and infrastructure upgrade goals to check the rising population densities in the informal settlements, attention should also be paid to addressing the physical and psychological needs of the people across various age categories and abilities.

Also, the study revealed that five main activities: (1) going to mosque; (2) going to school or university; (3) going to work; (4) shopping; and (5) disposing garbage were predominantly undertaken by the respondents. The results suggest that the frequency of going to mosque is comparably higher than other activities. While going to mosque has the highest frequency and the lowest average distance, going to university emerged as the lowest frequency and the highest average distance (excluding trips for garbage disposal, because it is partially done by waste collectors). In addition, going to school had a slightly medium frequency and medium average distance, thus suggesting an inverse relationship between frequency and distance; that is the higher the frequency, the closer the distance.

The study also shows a likelihood of variation in the daily activities of the respondents according to age, gender, affiliation and literacy characteristics. However, the influence of gender seems to be more significant than the others. Females were found to be less active in all the daily activities except going to school and university. They were also likely less employed and literate. While these gender variations are largely attributed to social and cultural barriers, poor urban safety and insecurity are also culprits that should be addressed systematically.

Furthermore, the study showed that older adults of 55 years and above were more likely to have frequent trips to mosque, while adults aged 44 to 55 were more engaged in shopping. As expected, the employed and literate groups were recorded as the highest frequency of engaging in all the daily activities covered in this study.

Notably, the study did not find any group involving in leisure activities around the neighbourhood during the week. This is not only attributable to social, cultural and security constrains (especially for women and children), but lack of such facilities is also a contributing factor. Although there were no recreational facilities around the neighbourhood, over half (56.96 percent) of the respondents asserted that they currently visit such places. For such persons, they have to travel an average distance of 39.45km for an average frequency of 3.63 times in a year. Most respondents (83.12 percent) also showed positive dispositions to allowing women and children to visit parks in the event that they were available close to the neighbourhood with a suggested average distance of 0.6 kilometre. Therefore, providing such facilities in line with these considerations is likely to affect women's activities and promote their well-being at least in the short term. However, it is envisaged that long-term goals, focusing on increasing access to education and employment opportunities for women should also be considered.

The study discussed the peculiar opportunities and challenges posed by the living style and daily activities of informal settlers in Kabul city against the background that the development of an appropriate framework to harness these opportunities and mitigate the challenges will be based on this understanding. Although the research focus of this paper was informal settlements, the results and recommendations could be applied to formal settlements as well, especially detached houses. Therefore, we propose that further work be done to consolidate a neighbourhood-based framework for developing informal settlements.

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A Suite of Novel EO-Based Products in Support of Urban Green Planning

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1 ABSTRACT

The strategic implementation of green infrastructures can sensibly help facing the effects of climate change in urban areas by reducing high temperatures, decreasing stormwater runoff, saving energy, improving air quality and increasing biodiversity. In this framework, the benefits of green roofs and urban trees are many and well documented in several recent studies, hence their monitoring is of high use for urban planners to properly design effective adaptation and mitigation strategies. Nevertheless, such activities have been so far solely carried out by means of in situ surveys or photointerpretation of very high resolution airborne imagery, thus being very costly both in terms of money and time. To overcome this drawback, we implemented two novel techniques aimed at automatically identifying current and potential green roofs, as well as mapping tree location and canopy, respectively. In particular, this is carried out by jointly exploiting satellite/airborne color infrared remote sensing imagery and LiDAR height data. Experimental results obtained for Antwerp, Milan, the Helsinki Capital Region, and the Royal Borough of Kensington and Chelsea assess the effectiveness and potential of the proposed techniques.

Keywords: Earth Observation, Green Roofs, Tree Canopy, Tree Location, Urban Green

2 INTRODUCTION

Climate change poses serious challenges to urban areas affecting different sectors of the city life; accordingly, decision makers need to implement suitable plans to effectively lessen its negative effects. In this framework, maintaining and increasing urban green areas is of great importance for many reasons like reducing stormwater runoff (which transports toxic chemicals, dirt and trash from roofs and roads into lakes, streams and rivers but also leads to an increased occurrence of urban flooding events), lowering air pollution (which is responsible for a variety of respiratory and cardiovascular conditions) and mitigating the urban heat island effect (which causes high-energy consumption for cooling and an increase of heat-related illness and fatalities). Furthermore, green areas enable biodiversity and the conservation of several species and enhance the wellbeing and quality of life of urban residents. In such scenario, we present a suite of novel Earth Observation (EO) based products developed for supporting urban managers to improve their urban green planning strategies. In particular, this includes key information about green roofs and trees derived from very high resolution satellite/airborne color infrared (CIR) remote sensing imagery and LiDAR height data.

On the one hand, green roofs are gaining increasing attention as a versatile new environmental mitigation technology (Oberndorfer et al., 2007; Ansel and Appl, 2009). In particular, they exhibit several advantages like:

- absorbing rainwater: the installation of a green roof can significantly improve rainwater quantity and quality, hence reducing the stormwater runoff (through membrane absorption and plant evapotranspiration) which can have a significant impact on natural environments as well as sewage conveyance given the presence of pollutants and suspended solids in the water (VanWoert et al., 2005; Ansel and Diem, 2009; Berndtsson 2010);
- providing thermal insulation: in summer, a green roof not only acts as an insulation barrier, but the combination of plant and soil processes reduces the amount of solar energy absorbed by the roof membrane, thus leading to cooler temperatures beneath the surface; in winter, green roofs can help to reduce heat loss from buildings when root activity of plants, air layers and the totality of the specific system create heat and thereby provide an insulation membrane (Liu and Baskaran, 2003; Hui 2009; Gall et al., 2010);
- increasing energy efficiency: the greater insulation offered by green roofs can reduce the amount of energy needed to moderate the temperature of a building, as roofs are the sight of the greatest heat loss in the winter and the hottest temperatures in the summer. For example, research published by the National Research Council of Canada found that a green roof can reduce the daily energy demand for air conditioning in the summer by over 75% (Liu and Baskaran, 2003);

- reducing air pollution: green roofs contribute to the reduction of a number of polluting air particles and compounds not only through the plants themselves, but also by deposition in the growing medium itself; therefore, being absorbed into the green roof system these polluting particles do not enter the water system through surface run off leading to improvement in water quality (Yang et al., 2008; Rowe 2011);
- reducing electromagnetic radiation: the risk posed by electromagnetic radiation (from wireless devices and mobile communication) to human health is still a question for debate; nonetheless, green roofs are capable of reducing electromagnetic radiation penetration by 99.4% (Herman 2003);
- reducing noise: green roofs have excellent noise attenuation, especially for low frequency sounds; in particular they can reduce sound from outside by 40-50 decibels (Peck et al., 1999).

In this context, mapping green roofs is then of high importance; moreover, being their installation usually supported by subsidies, a precise identification of their location is of great help (also to properly plan activities for checking their actual status). Nevertheless, green roof identification is presently extremely costly and time demanding being it mostly carried out by photointerpretation of airborne imagery or in situ surveys by experts. To overcome this limitation, we implemented a novel method which allows to automatically identify actual green roofs and determining which roofs can be potentially converted into green roofs along with the corresponding expected impact (which is of valuable support to target subventions in areas which would more benefit from this change). Specifically, by analyzing the slope computed from the height data, we first identify flat roofs. Among these, we then mark as green those exhibiting consistent vegetation coverage using the normalized difference vegetation index (NDVI) computed from the CIR imagery. All the remaining are denoted as potential green roofs and their impact is finally estimated by taking into account the local surface imperviousness. The support of an operator is mainly requested only at the end of the processing chain to visually check the results and exclude roofs falsely identified as green roofs due to intrinsic limitations of the input data used. This represents a great advantage with respect to current approaches (i.e., lower costs and shorter time) and also allows an easy and straightforward update once provided with new suitable imagery.

On the other hand, in several cities it occurs that no or incomplete trees inventories (e.g., just including public ones) are available directly at the municipality. However, this source of information is of high importance being trees capable of absorbing carbon dioxide while releasing oxigen back into the air, cooling the cities by shading, reducing runoff by breaking rainfall, as well as providing habitat to wildlife. Furthermore, an exhaustive tree register allows to identify where there is a higher need for planting new ones and enhances the ability to educate the public and decision makers about their importance as well as the need to care for and protect them. Presently, tree records are generally compiled via in situ surveys (often by volunteers) which require plenty of time. In the literature, only few techniques have been presented so far to address this task, which are mostly based on Geographic Object Based Image Analysis (GEOBIA) applied to satellite CIR imagery (Karlson et al., 2014). Nevertheless, the lacking of height information results in poor performances. To tackle this issue, we developed an automatic technique that allows to routinely create a reliable map of the tree location and of their canopy in a given study area. In particular, all the vegetated areas are first identified by the analyis of the NDVI calculated from the CIR data; then, the tree canopy is delineated accounting for the height information and finally a tree location is set in correspondence of the highest peak of its crown.

The whole suite of presented products has been developed within the FP7 DECUMANUS (DEvelopment and Consolidation of geo-spatial sUstainability services for adaptation and environmental and cliMAte chaNge Urban impactS) project. In particular, DECUMANUS had the principal objective to develop and consolidate a set of sustainable services that allows city managers to incorporate EO-based geo-spatial products and geo-information services in their climate and environmental change strategies to support the sustainable management of the cities in Europe. In the following, the two corresponding services will be described into details, namely current and potential green roof mapping and tree location and canopy mapping, respectively. Experimental activities in cooperation with the DECUMANUS partner cities of Antwerp, Milan, the Helsinki Capital Region (including the cities of Helsinki, Espoo, Vantaa and Kauniainen), and the Royal Borough of Kensington and Chelsea (RBKC) assess the accuracy of the developed products and confirm their great potential for supporting climate change mitigation strategies.

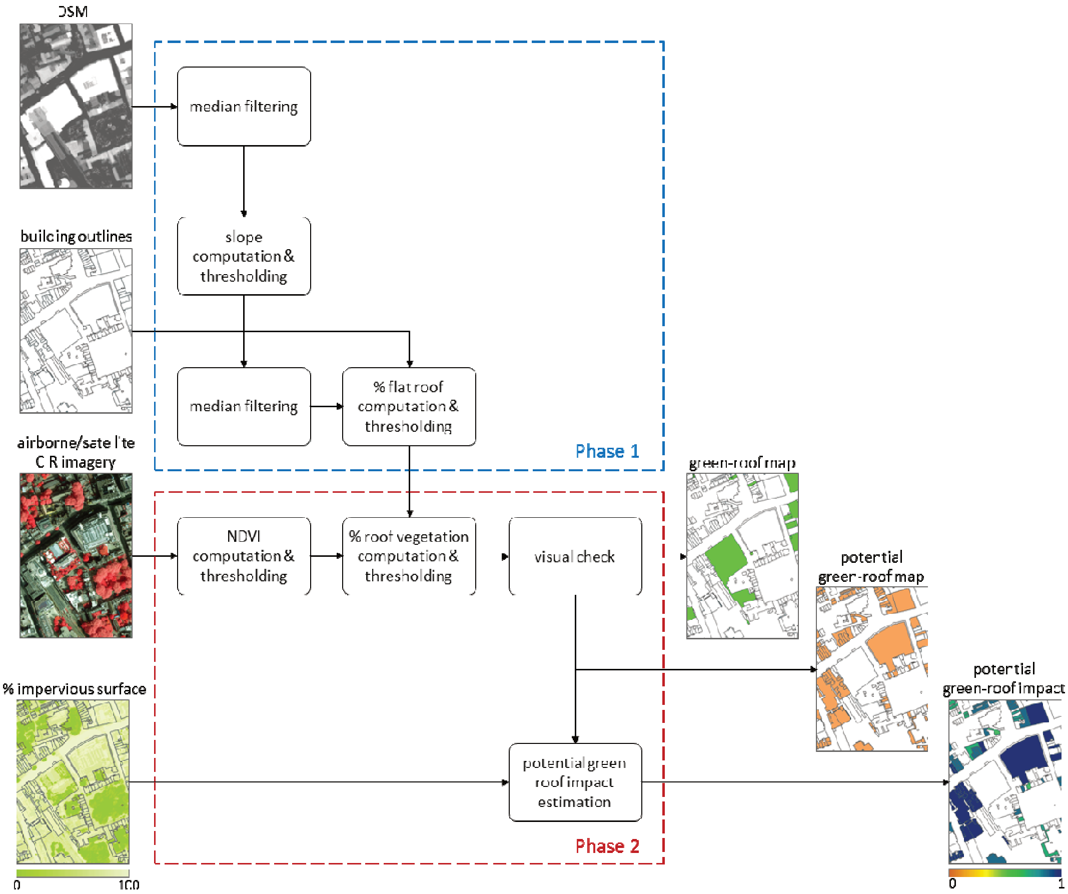

Fig. 1: Block scheme depicting the algorithm developed for mapping both current and potential green roofs.

3 CURRENT AND POTENTIAL GREEN ROOF MAPPING

A block scheme depicting the algorithm designed for mapping both current and potential green roofs is provided in Fig. 1. In particular, the developed technique improves the one originally implemented at the German Aerospace Center (DLR) in cooperation with the German Roof Gardener Association (DDV) in the context of the project "Remote Sensing: Green Roof Inventory and Potential Analysis" financed by the German Federal Environmental Foundation (DBU) (Zeidler et al., 2015).

For a given area of interest, the requested input data are:

- Digital Surface Model (DSM): raster file where each pixel is associated with the elevation above the sea level of the corresponding ground or any feature on it (hence also including buildings and trees);
- building outlines: vector file solely including building types which are suitable for hosting a green roof according with the specific policies of the city under investigation (e.g., underground garages covered by gardens in Milan are still considered as green roofs, while this is not true for Antwerp);
- CIR imagery [either airborne or satellite]: raster file including one band acquired in the near infra-red (NIR) and one in the red portion of the electromagnetic spectrum;
- imperviousness map: raster file where each pixel is associated with the (percentage) amount of the corresponding surface covered by paved structures [also available as DECUMANUS service (Marconcini et al., 2015)].

In order to properly characterize small structures as building roofs, both the above-mentioned DSM and CIR imagery have to be provided at very high resolution (VHR). Specifically, the most suitable range proved to be between 25cm and 2m. Indeed, for resolutions finer than 25cm the computational load generally becomes extremely high without bringing any significant benefit; instead, at resolutions coarser than 2m most of the roofs cannot be correctly identified. As regards the imperviousness map, since (as it will be clarified next) its average is computed for each building within a buffer around its outline, a spatial resolution up to some tens

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of meters is acceptable [e.g., the percentage imperviousness map generated in the context of DECUMANUS by means of Landsat imagery at 30m spatial resolution (Marconcini et al., 2015)].

Fig. 2: Current and potential green roof maps obtained with the presented technique overlaid to the available CIR airborne imagery for a subset of the Antwerp (top left) and Helsinki (top right) study areas, along with the corresponding potential green roof impact maps (bottom left) and (bottom right), respectively.

The implemented methodology is structured in two phases: Phase 1 is dedicated to identifying those roofs where at least a significant portion is flat enough to host (or potentially host) a green roof; Phase 2 aims at assessing the portion of the roofs identified in Phase 1 covered by vegetation and generating the intended products, namely the green roof map, potential green roof map, and potential green roof impact. In the following each of them is described into details.

3.1 Phase 1

As the DSM is mostly derived from LiDAR airborne acquisitions, it is often affected by speckle (granular) noise. To overcome this issue, a common but effective approach is to employ a median filter which generally allows to remove the noise while preserving the edges of different objects. Since we are dealing with VHR data, based on extensive empirical analysis a reasonable choice proved to be a median filter of size 3x3 pixels. Afterwards, for each pixel of the filtered DSM we compute the slope, defined as the maximum rate of elevation between the given pixel and its neighbors. Flat (or quasi-flat) roofs are the ones more suitable for installing a green roof. Accordingly, a binary mask is derived based on a prefixed threshold σ on the slope (which is set by default to 12□ but might vary depending on specific city policies/ requirements, e.g. 15□ was requested by the city of Antwerp) and then filtered again by means of a 3x3 median filter in order to remove single pixel objects or fill single-pixel gaps. Next, based on the resulting mask we compute for each building the corresponding percentage of flat surface. A vector file is finally generated solely including the roofs whose flat surface percentage is greater than 10% if their size is lower than 100 m² or greater than 5% if their size is greater than 100 m², which are those considered as suitable for hosting a green roof (this ruleset generally proved to be rather effective; nevertheless, it can easily be tuned according to the specific needs of the final users).

3.2 Phase 2

By means of the NIR and red bands of the available CIR imagery, we compute the NDVI which ranges from -1 to +1 and is used in a variety of remote-sensing applications to assess for each pixel the amount of live green vegetation present in the corresponding portion of the surface (Rouse et al., 1974). Here, the idea is to derive a binary mask based on a threshold η on the NDVI where pixels exhibiting values higher than η are associated with vegetated areas. However, the NDVI strongly depends on the specific time of the year when the CIR imagery has been acquired, as well as from the geographical location of the city under investigation. Accordingly, it is not possible to set a priori a reliable threshold η but simply an operator has to manually derive it. In particular, the value is determined as the minimum NDVI computed for a certain amount of pixels (generally few tens are sufficient) extracted throughout the entire study site from areas covered by grass (i.e., where the NDVI is lower compared to areas covered by bushes or trees). Then, based on the resulting mask, for each of the buildings identified as suitable for hosting a green roof obtained at the end of Phase 1 we compute the corresponding percentage of surface covered by vegetation.

Two vector files are finally generated: one includes the estimated green roofs defined as those whose percentage vegetation cover is greater than 10%; the other includes all the remaining (whose percentage vegetation cover is lower or equal to 10%), hence corresponding to the estimated potential green roofs. It is worth pointing out that in this case selecting 10% as a threshold results in a slight overestimation of the green roofs. Nevertheless, being anyhow a visual check mandatory to deal with challenges posed by the data themselves (as clarified in Section 4), it is preferable to avoid any false detection and to manually exclude roofs falsely identified as green roofs (which are then merged to the estimated potential green roofs). Indeed, while the total number of buildings for the 4 cities investigated in the context of DECUMANUS is of the order of tens/hundreds of thousands, the number of automatically estimated green roofs is generally of some few thousands. Accordingly, it is evident the big improvement with respect to current practices where the entire analysis is carried out by photointerpretation. The refined layers obtained after the visual post-processing delineate the final green roof and potential green roof maps.

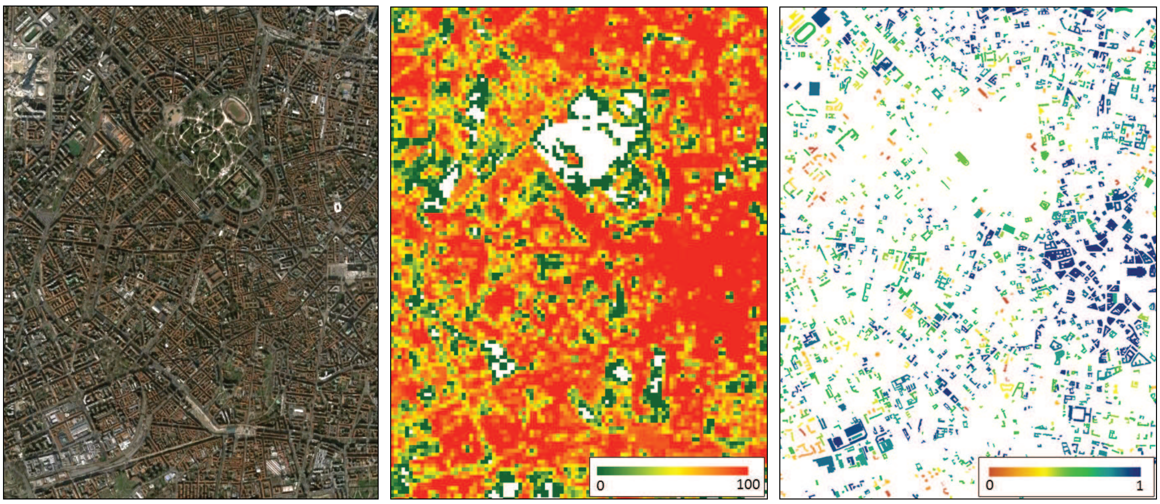

Fig. 3: Milan – GoogleEarth imagery of a subset of the study area including the city center (left), along with the corresponding percentage imperviousness map generated in the context of the DECUMANUS project (middle), and the potential green roof impact map generated by means of the presented approach (right).

It is important to highlight that not all the identified potential green roofs might have the chance to be actually converted into real green roofs. In fact, they also need to fulfill the structural requirements for the

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Editors: Manfred SCHRENK, Vasily V. POPOVICH, Peter ZEILE, Pietro ELISEI, Clemens BEYER

load necessary to mount a green roof (while newly constructed buildings should meet them, this might not be true for older constructions). Nonetheless, such type of information cannot be retrieved from any remote-sensing data, but exclusively via in situ survey.

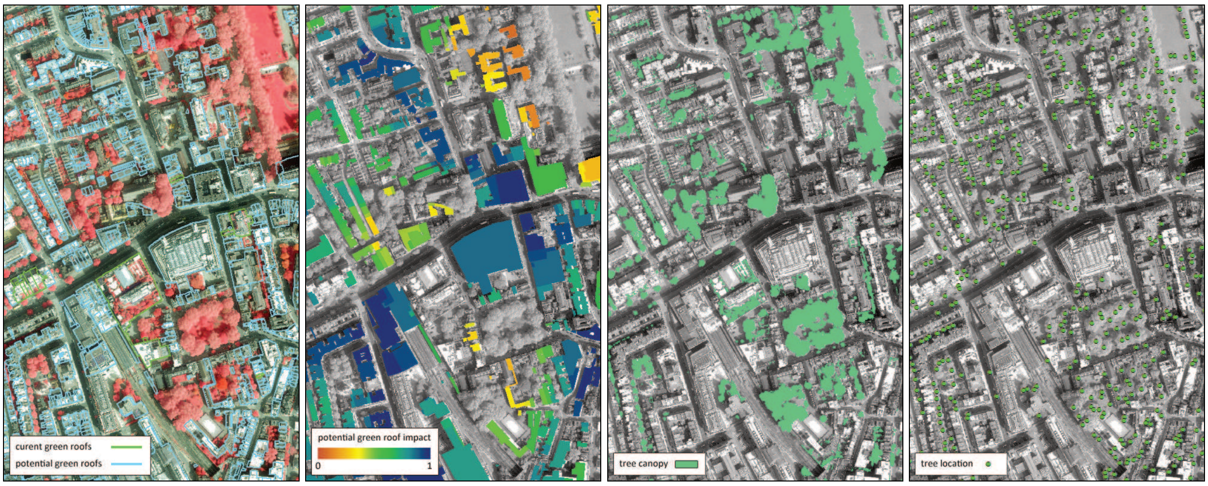

Fig. 4: RBKC – Current and potential green roof maps obtained with the presented technique overlaid to the available CIR airborne imagery (a), estimated potential green roof impact (b), tree canopy coverage (c), and tree locations (d) derived with the proposed methodologies.

Finally, it is intuitive that installing a new green roof in an area with a high local imperviousness is expected to be more beneficial to the whole urban environment than installing a green roof in a rural area yet characterized by a consistent presence of vegetation in the surroundings. Accordingly, as a means for estimating their impact, we compute for each potential green roof the average percentage imperviousness within a buffer of 100m outside its outline. The output is rescaled between 0 and 1, where 0 corresponds to “no effect”, and “1” to “maximum effect”.

3.3 Experimental Results

The above-mentioned green roofs maps have been produced for the 4 listed DECUMANUS partner cities. In particular, CIR airborne imagery was available for Antwerp, the Helsinki Capital Region and the RBKC at 25-50cm spatial resolution, while for Milan WorldView-3 satellite data at 1.2m spatial resolution have been employed. LiDAR-based DSM layers at 50cm/1m resolution were available for all the study areas. Examples of the final products are reported in Fig. 2 for a subset of the Antwerp and Helsinki areas of interests. Moreover, in Fig. 3 GoogleEarth imagery of a subset of the Milan study site including the city center is shown, along with the corresponding percentage imperviousness map generated in the context of the DECUMANUS project (Marconcini et al., 2015), and the resulting potential green roof impact map. Results for a portion of the RBKC are also given in Fig. 4 a-b.

It is worth pointing out that for all the investigated cities no green roof database is available for comparison, being their growing employment a new trend occurring only very recently. Instead, the outcomes of the proposed methods are intended to be used as first reference layers by the municipalities. The main idea of the described method is to avoid missed alarms while setting an NDVI threshold which results in a low amount of false alarms to be refined in the post-processing visual check. This last step also aims at overcoming the issues related to the specific available data as described in Section 4. In this framework, we expect the final output products to be correct with, in case, negligible over and underestimation (indeed, any identified error is properly corrected in the post processing). This has also been confirmed by the highly satisfactory feedback received from the users.

4 TREE LOCATION AND CANOPY MAPPING

A block scheme depicting the algorithm developed for mapping tree location and their canopy is reported in Fig. 5. As one can notice, in addition to DSM, building outlines and VHR CIR airborne/satellite imagery for the area under investigation (also used for deriving the green roof products), the corresponding Digital Terrain Model (DTM) needs to be provided as input too. In particular, the DTM is a raster file where each pixel is associated with the elevation above the sea level of the corresponding ground (hence – contrarily to the DSM – not including buildings or trees).

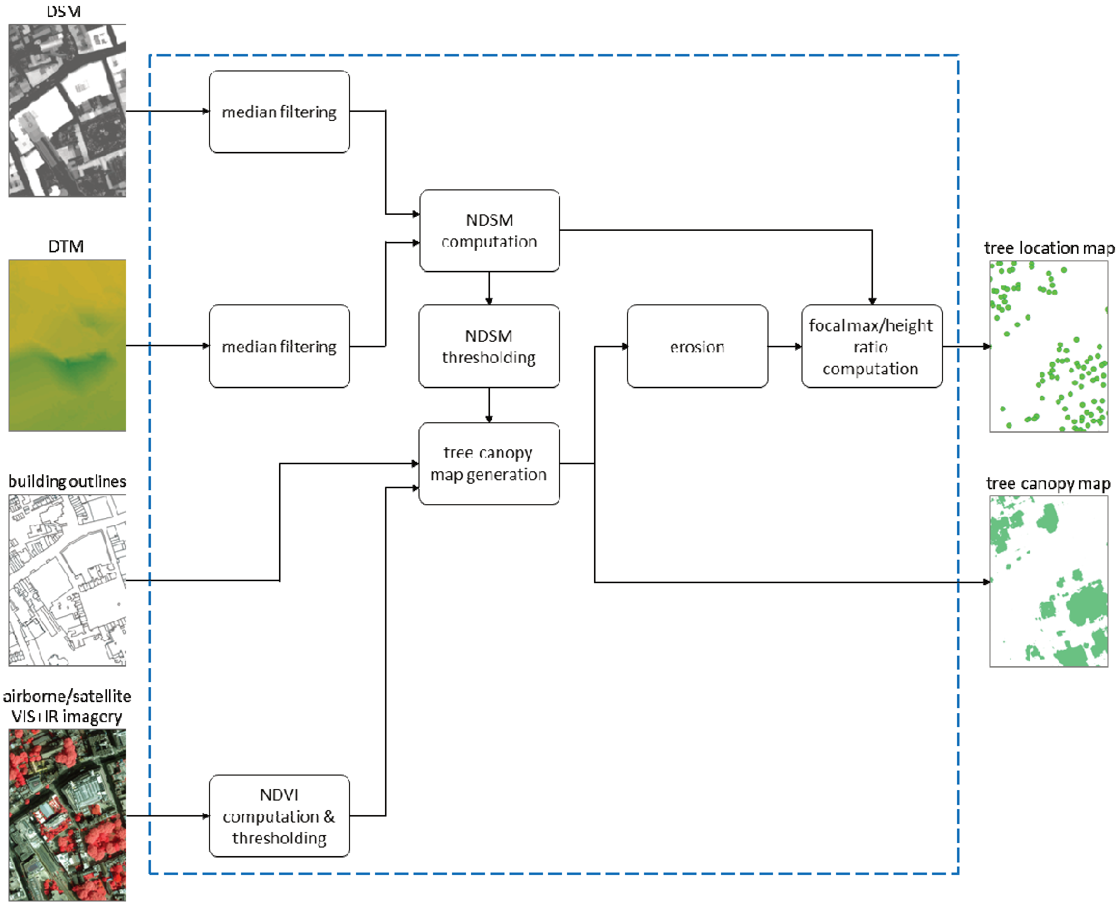

Fig. 5: Block scheme depicting the algorithm developed for mapping tree location and their canopies.

To properly calculate the relative height of an object with respect to the ground, we compute the so-called normalized DSM (nDSM), which is given by the difference between the available DSM and DTM. As described in the previous section, to remove the speckle (granular) noise affecting the DSM and DTM, we first apply to both a median filter of size 3x3 pixels. A binary mask is then derived from the nDSM, where all the pixels whose relative height is lower than 2m and those whose relative height is equal or greater than 2m are associated with different values, respectively. In parallel, as done for mapping current and potential green roofs, we compute the NDVI from the available CIR imagery and derive from it a binary mask where pixels higher than the threshold η are associated with vegetated areas. Since the NDVI strongly depends on the geographical location of the study area, as well as the specific time of the year when the CIR imagery has been acquired, here the value of η is determined as the minimum NDVI computed for some tens of pixels manually extracted from random tree crowns. The resulting mask is further combined with both the available building outlines and the above-mentioned nDSM-based mask. In particular, only the vegetated pixels outside the building outlines whose relative height is equal or greater than 2m are kept (indeed, after consulting with the DECUMANUS users it has been agreed that vegetation lower than 2m shall never be categorized as “tree”). The output exactly corresponds then to the tree canopy map.

In general, the position of a trunk can be reasonably set to the pixel where its crown has the maximum height. Therefore, in order to derive the intended tree location map, the idea is to identify local maxima in the nDSM within the areas delineated as tree crowns. To this purpose, we first apply an erosion filter (of 1 pixel size) which allows to slightly simplify the geometry at the borders of the objects marked as canopies. Next, we mask the nDSM with the obtained layer and employ a focal maximum filter which computes for each pixel the maximum height among its neighbors within a circle of pre-defined size. In particular, we assume that on average the tree crown diameter is of the order of 3.5m within urban areas, hence we set the filter size accordingly based on the nDSM spatial resolution (e.g., for an nDSM of 50cm spatial resolution a circle of 7 pixels diameter is used). Finally, we divide the output of the focal maximum filtering by the nDSM. Pixels exhibiting a ratio equal to 1 (i.e., those whose height coincides with the maximum within the considered circle) are the intended local maxima and are set as the tree location sites.

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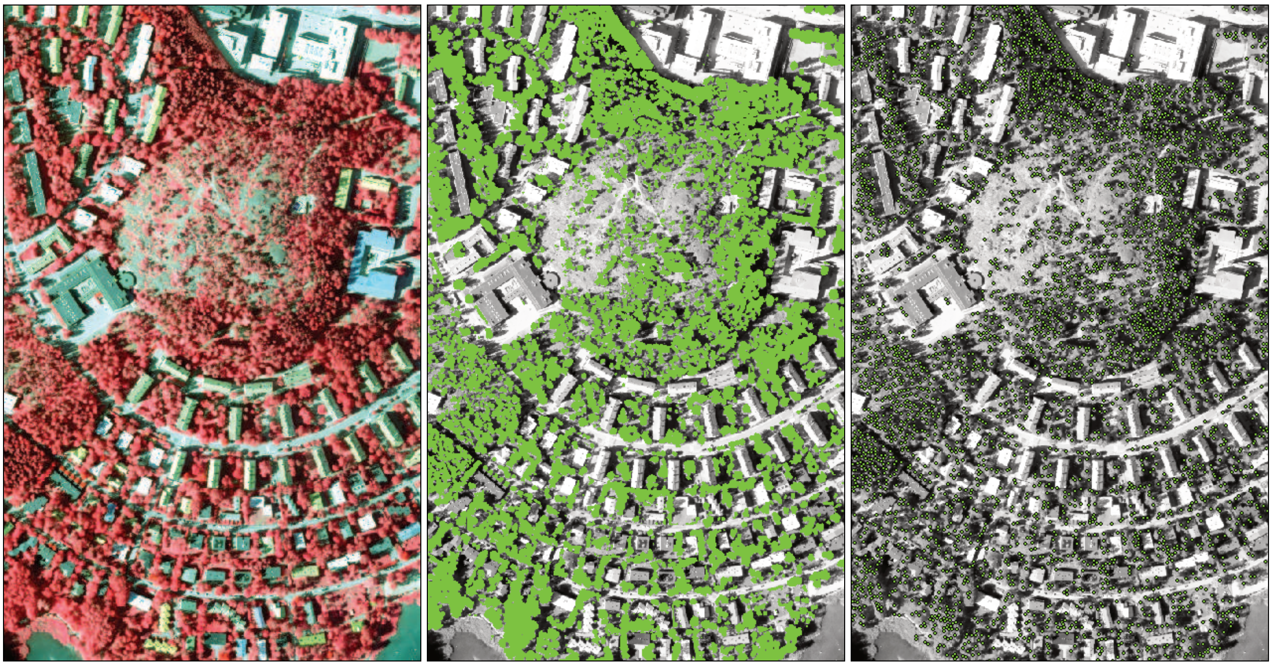

Fig. 6: Helsinki – available CIR airborne imagery for a subset of the study area (left), along with the corresponding tree canopy map (middle) and tree location map (right) derived with the presented technique.

4.1 Experimental Results

Basd on the DECUMANUS user requirements, the tree location and canopy maps have been produced for the Helsinki Capital Region and the RBKC. The data used are the same employed for deriving the green roof maps described in Section 3 with the addition of LiDAR-based DTM available in both cases at 50cm spatial resolution. An example depicting a portion of the final products derived for the RBKC is given in Fig. 4 c-d. Moreover, in Fig. 6 the available CIR airborne imagery for a subset of the Helsinki study area is reported, along with the corresponding tree canopy and tree location maps. In both cases, the proposed algorithm proved to be very accurate and allowed to obtain extremely reliable products. To quantitatively assess their effectiveness, we performed two different types of validation analyses. As regards the tree canopy map, we randomly subsampled 3000 pixels from those categorized as canopies and 3000 pixels from all the remaining; then, we visually checked their labels and finally compared it to that automatically associated by the presented method. Both for the RBKC and Helsinki, we obtained an overall accuracy higher than 98%. Instead, concerning the tree location map, we compared the obtained final product against the location of 3000 trees manually selected within the study area by photointerpretation; moreover, we randomly selected 3000 among the trees identified by the presented technique and visually assessed whether a tree was actually present nearby. In both cases, we allowed a tolerance of 2m between the estimated and actual location of the trees. Also in this case the obtained performances are highly satisfactory, with overall accuracies higher than 95% for both the RBKC and Helsinki. False alarms are very unlikely, whereas missed alarms are few and mostly occur in the presence of clusters where several trees are very close to each other (where even by photointerpretation it is tough to reliably understand how many trees are present).

5 DISCUSSION AND CONCLUSION

As confirmed by the very positive feedback from the municipalities of the DECUMANS city partners, the EO-based products derived by applying the proposed techniques are very effective and reliable. However, some limitations might occur mostly due to the specific EO data employed, but also to the lack of clear common definitions. In this context, a summary is given below on the basis of the performed extensive experimental analysis.

Definition of green roof: Presently, there is not a common agreed green roof definition at the European level, but rather each country or municipality has its own specific guidelines. As an example, in some cities all vegetation layers on top of any construction are basically considered as green roofs (thus also including underground garages with gardens at the ground level on top of them), while in some others underground garages are excluded from the green roof count. Accordingly, the provided building outlines shall include the information necessary to exclude from the analysis all those roofs which do not match the criteria for the specific investigated city. In case this is not available, additional resources are needed in the post-processing phase to manually overcome the resulting overestimations.

Definition of tree: despite the term "tree" is of regular use in everyday life, actually there is no common agreed definition of what a tree is, either botanically or in common language. Broadly speaking, a tree is any plant with the general form of a single elongated stem (or, in case, of coppice several stems), or trunk, which supports the photosynthetic leaves or branches at some distance above the ground (Gschwantner et al., 2009). In our case we assumed it to be 2m; however, this value might be changed depending on the specific requirements from the end users.

Green roof type: green roofs are categorized either as intensive or extensive. Intensive green roofs are characterized by deep substrates and a variety of plantings and have the appearance of conventional ground-level gardens (Oberndorfer et al., 2007); in particular, they mostly include perennials, lawn, putting green, shrubs and trees. Instead, extensive green roofs have shallower substrates, require less maintenance, and are more strictly functional in purpose than intensive green roofs (which are often used as leisure roof gardens). In their simplest design, extensive green roofs consist of an insulation layer, a waterproofing membrane, a layer of growing medium, and a vegetation layer (Oberndorfer et al., 2007) typically composed of mosses, sedums, succulents, herbs or grasses. Intensive green roofs are easier to identify as they are normally characterized by high NDVI values, whereas extensive green roofs generally exhibit lower NDVI, hence being more difficult to recognize. Accordingly, it is important to properly set an NDVI threshold that allows to avoid missed alarms.

Actuality of data: DSM, DTM, CIR imagery and building outlines should refer to times as close as possible. If this does not occur, then both under and over estimation might occur. In case demolished buildings are not erased from the databse, they often result in overestimations due to the appearance of natural vegetation, thus requiring more efforts in the post-processing visual check.

CIR imagery acquisition time: the NDVI has an ascending trend from the beginning to the peak of the growing season (in correspondence of which it exhibits its minimum and maximum, respectively); then, it gradually decreases again to its minimum at the end of the growing season. Typically the growing season starts in April and ends around October/November; however, it strongly varies with the altitude and latitude. For instance, in the alpine region and in Northern Europe it spans from June to September, whereas in Spain and Portugal it is almost year-round. The closer is the available CIR imagery to the peak of the growing season for the specific study area, the better are the expected performances of the presented methods. In general, June and July acquisitions are ideal. For acquisitions taken in March or September it might be not feasible to properly identify extensive green roofs due to the corresponding very low NDVI value; moreover the absence of leaves might also prevent detecting deciduous tree species.

CIR imagery spatial resolution: the higher is the spatial resolution, the more are the details which can be recognized. Accordingly, airborne imagery is preferred as its spatial resolution is typically of the order of few tens of centimeters; nevertheless, it is generally very costly. Alternatively, VHR satellite imagery can be employed with spatial resolutions between 1 and 2m. In this case, costs are sensibly lower; however, the coarser resolution might result in some underestimations of smaller trees/green roofs that can be solely correct by visual check, hence requiring longer post-processing working time. Ideally, to avoid discrepancies, the available DSM/DTM should have the same spatial resolution of the CIR imagery.

CIR imagery viewing angle: the viewing angle at which the CIR imagery is acquired is one of the key factors especially for the green roof mapping. Indeed, the lower it is, the more critical are the shadowing effects and the misalignment of the higher buildings with respect to the available outlines. In the former case, green roofs falling in shadowed areas due to higher buildings in the surroundings cannot be identified (not even by means of post-processing corrections). In the latter case, the higher is one building, the greater is the shift of the corresponding outlines (which can result either in underestimations or overestimations and might take several time to be manually corrected). In the case of satellite imagery (as for the Milan study site), the viewing angle is constant for the entire scene. Accordingly, in such circumstance, to properly account for the abovementioned shift we perform different analyses based on the height of the buildings. In particular, we first analyze the only buildings with height lower than 10m (for which the outlines are fitting perfectly). Next, we solely take into account the buildings whose height is between 10 and 20m and shift the CIR

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imagery so that it matches the corresponding outlines. Then, we do the same for the buildings with height from 20 to 30m and so on up to when all the buildings matching the flat roof criteria are analyzed. In the case of airborne data, different stripes are acquired separately and then properly mosaicked. However, the buildings far from the center of each acquisition stripe might exhibit a shift with respect to the corresponding outlines (which depends on the swath width). Once combined together all the stripes, there is no systematic means for properly shifting the CIR imagery as done for the satellite data. Typically, the swath width is rather small, hence the effects are limited.

Tree coverage: often one-two story houses in residential areas have gardens with trees even higher than the neighboring building. Sometimes, it might occur that their crown covers partly or even entirely the building roof hence forbidding a correct green roof analysis and resulting in overestimations. This issue is rather challenging and can be solved only during the visual check in the post-processing.

Despite these drawbacks intrinsic to specific data, the developed methods allowed to obtained very accurate products, which have already started being used by the municipalities involved in the DECUMANUs project. Moreover, once finalized the algorithm implementation, it was possible to generate them solely in few days of work, which represent just a very small fraction of the time that would be needed by means of in situ surveys or pure photointerpretation.

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Air-Based Mobile Urban Sensing – Copters as Sensor Carriers in Smart Cities

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1 ABSTRACT

Smart Cities sind nur durch den allgegenwärtigen und alldurchdringenden Einsatz von Sensoren umsetzbar. Eine Vielzahl von Sensor-Arten und Sensor-Trägern sind nötig, um eine smarte, städtische Struktur und damit einhergehend, eine smarte Umwelt, ein smartes Leben, mit einer smarten Bevölkerung sowie eine smarte Wirtschaft, eine smarte Verwaltung und eine smarte Mobilität zu schaffen. Für all dies braucht es aber smarte Fachkräfte, die schon früh durch eine spezielle MINT-Förderung neugierig auf Technik gemacht werden müssen und speziell gefördert werden sollten. Abgesehen von dem klassischen Top-down Verfahren der Sensornutzung wie beispielsweise die Fernerkundung und der Einsatz von Bottom-up Methoden wie zum Beispiel die Nutzung von embeded systems (u. a. Smartphones), die die Bevölkerung täglich mit sich führt, könnte dabei ein neues Träger-System eine wichtige Rolle spielen. Dieser Träger-Typ wird als Multicopter oder auch oft umgangssprachlich als Drohne bezeichnet und bietet die Möglichkeit einer aeronautischen Plattform für eine mobile Sensornutzung. Im vorliegenden Paper werden dabei drei selbstentwickelte Quadrocopter vorgestellt, die als Sensor-Träger fungieren können und aufzeigen, wie beispielsweise Klimadaten mit einem Quadrocopter aufgezeichnet werden können. Einer dieser vorgestellten Coptern ist zum großen Teil aus einem kostengünstigen 3D-Drucker erstellt. Ein weiterer Copter wird so ausgelegt sein, dass er eine möglichst lange Flugzeit aufweisen wird. Dies ist besonders wichtig, da in Smart Cities Umwelteinflüsse aus der Luft über einen längeren Zeitraum zu detektieren sind. Ebenso ist es ein weiteres Ziel des Papers, darzustellen, ob die Systemeffizienz des Multicopters durch das Verarbeiten von effektiv eingesetzter Solartechnik gesteigert werden kann. Ferner werden die verschiedenen Arten von Multicopter-Typen mit ihren grundlegenden Konstruktions- und Theoriegrundlagen beschrieben und die rechtlichen Gegebenheiten, Gefahren und Nutzungsbedingungen erläutert.

Keywords: Copter, Drohne, Klima, Monitoring, Sensing

2 QUADROCOPTER

2.1 Definition

Die Namensgebung des Quadrocopters leitet sich im technischen Sinne von den sogenannten Multicoptern ab. Ein Multicopter ist nach Definition ein Hubschrauber, welcher mehr als einen Rotor besitzt [vgl. BACHFELD, 2013, S 42]. Ein Multicopter kann demnach von mehreren Rotoren angetrieben werden. Der Quadrocopter weist vier Rotoren auf und wird hierdurch namentlich als solcher gekennzeichnet. Diese Fluggeräte besitzen eine ähnliche Steuerung und ein Flugverhalten wie ein Hubschrauber und werden somit als eine Sonderform dessen definiert [vgl. Büchi, 2013a:9F]. Alle Multicopter und somit auch die Ausprägung des Quadrocopters werden ebenso im Allgemeinen und im vorliegenden Paper als Drohnen bezeichnet [vgl. Westphal, 2015]. Ebenfalls wird im englischen Sprachraum von Unmanned Aerial Vehicle“ (UAV) oder „Unmanned Aerial System“ gesprochen. Im deutschsprachigen Raum wird oftmals nach Duden auch die Schreibweise „Kopter“ verwendet.

2.2 Bestandteile

Ein Quadrocopter besteht aus mehreren Komponenten, welche spezifische Aufgaben erfüllen und in einem System zusammenarbeiten müssen. Das Fluggerät besteht im Wesentlichen aus einer Rahmenkonstruktion, den Motoren, Motorreglern, Luftschrauben, einem Akkumulator, einem Flightcontroller und einer Fernsteueranlage.

2.2.1 Rahmen

Der Rahmen eines Quadrocopters hat die Aufgabe, alle Bauteile des Fluggerätes aufzunehmen und zu fixieren. Hauptsächlich besteht er aus einem Mittelstück, welches auch Centerplate genannt wird und den Auslegern als Verbindungsstück zu den außen angebrachten Motoren dient. Die Centerplate dient vor allem dem Zusammenhalt aller mechanischen Komponenten sowie der Aufnahmen des Flightcontrollers, das Herzstück des Quadrocopters [vgl. BACHFELD, 2013:44FF]. In der Luftfahrt werden überwiegend die Materialien Glasfaserverbundstoffe, Kohlenfaserverbundstoffe, Aluminium und Titan im Bau verwendet [GARTNER, 2009: 7FF]. Da Kohlenfaserverbundwerkstoffe (CFK) gegenüber Glasfaserverbundwerkstoffen (GFK) oder Stahl ein relativ geringes, spezifisches Gewicht, bei gleichzeitig hoher Zugfestigkeit aufweisen, wird dieser Werkstoff auch im Multicopter-Rahmenbau sehr oft eingesetzt (Abb. 1 links). Zur Realisierung einer konstruktiv erarbeiteten Quadrocopter-Rahmenkonstruktion kann ebenso ein 3D-Drucker verwendet werden. In diesem Fall muss die Konstruktion an die spezifischen Eigenschaften des verwendeten Druckmaterials wie PLA oder ABS sowie an das spezielle Herstellungsverfahren des 3D-Drucks angepasst werden [vgl. GEBHARDT, 2013:70ff].

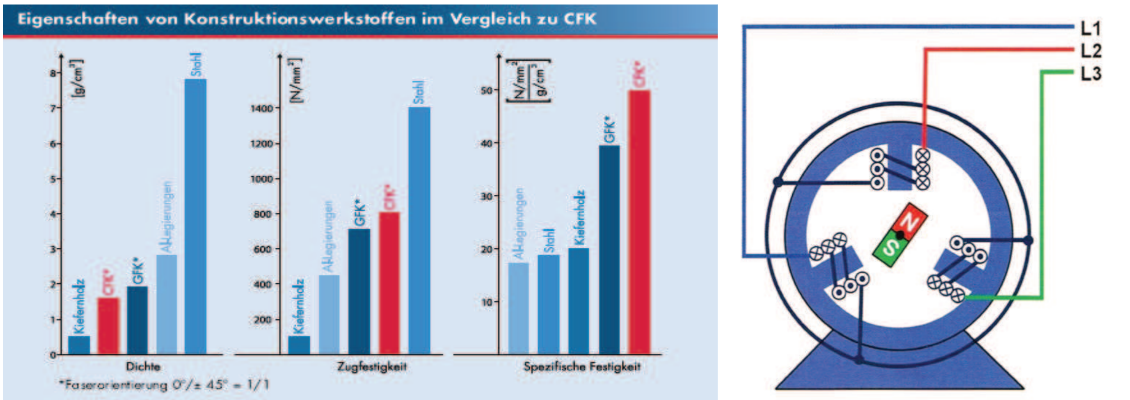

Abb. 1: Werkstoffe & Motor [Quelle: WWW.BENTELER-SGL.DE & BÜCHI, 2013b:16].

2.2.2 Motoren

In Quadrokoptern sowie generell im Multicopterbau kommen heute überwiegend bürstenlose Brushlessmotoren (Abb. 1 rechts) zum Einsatz. Vorteil dieser Motorenbauart ist die Tatsache, dass diese keine Kohlebürsten besitzen, welche in den Vorgängermodellen, den Gleichstrombürstenmotoren, das Hauptverschleißteil darstellten. Die Permanentmagnete befinden sich im Falle der Brushlessmotoren auf dem Rotor, was eine Stromübertragung auf ein rotierendes Bauteil überflüssig macht. Aus diesem Grund besitzen die Brushlessmotoren eine höhere Lebensdauer und Effizienz [vgl. BÜCHI, 2013a:17].

2.2.3 Brushlessregler (ESC)

Die Ansteuerung eines Brushlessmotors erfolgt immer über einen speziellen Brushless-Motorregler. Dieser wird auch als ESC (electronic speed controller) bezeichnet. Er steuert den Stromfluss zum Motor und sorgt für einen Drehstrom über drei Anschlusskabel [vgl. BACHFELD, 2013:46FF].

2.2.4 Luftschrauben

Die Luftschrauben sorgen für den notwendigen Schub, um einen Quadrocopter abheben zu lassen. Der Brushlessmotor treibt diese an. Durch ihre geschwungene Form drücken sie während des Betriebs die Luft nach unten. Luftschrauben werden über zwei wichtige Kennzahlen definiert, der Durchmesser und die Steigung. Der Durchmesser gibt die Gesamtlänge der Luftschraube an. Die Steigung definiert die theoretische Vorwärtsbewegung der Luftschraube nach einer Umdrehung. Beide Kennzahlen werden in Zoll angegeben. Eine Luftschraube mit der Bezeichnung 10x4,7 besitzt einen Durchmesser von 10 Zoll sowie eine Steigung von 4,7 Zoll [vgl. BACHFELD, 2013:47].

2.2.5 Akkumulator

Der Akku eines Quadrokopters trägt im hohen Maße zur Effizienz des Fluggerätes bei. Heute werden im Flugmodellbau vor allem Lithium-Polymer-Akkumulatoren (LiPos) verwendet. Der Vorteil dieser Technologie liegt in ihrer hohen Energiedichte. Diese gibt an, wie viel Energie ein Akkutyp pro Eigengewichtsanteil speichern kann. Früher eingesetze Nikel-Cadmium (NiCd) oder Nikel-Metall-Hydrid (NiMH) Akkus weisen im Durchschnitt eine Energiedichte von 5 bis 7 Watt pro 100 Gramm Eigengewichtsanteil auf. LiPos kommen hier im Durchschnitt schon auf eine Energiedichte von 14 Watt pro 100 Gramm [vgl. LENZ, 2015]. Eine LiPo Zelle besitzt immer eine Nennspannung von 3,7 Volt. In der Regel werden diese zu einem LiPo-Pack von 3-4 Zellen seriell geschlossen, was eine Gesamtnennspannung von 11,1 Volt oder 14,8 Volt ergibt [vgl. BÜCHI, 2013a:20]. Die hohe Energiedichte sowie der chemische und technische Aufbau birgt jedoch auch Gefahren. Wird eine Zelle unter 2,5 Volt entladen oder über 4,25 Volt geladen, kann der Akku geschädigt werden und beginnen zu brennen [vgl. PASSERN, 2013:20FF]. Um das zu verhindern, werden alle Zellenspannungen am sogenannten Balancerkabel ausgegeben und können überwacht werden [vgl. BÜCHI, 2013a:30F].

2.2.6 Flightcontroller

Der Flightcontroller ist sozusagen das Gehirn eines Quadrokopters. Er ist mit Gyroskop-Sensoren, Beschleunigungssensoren und weiteren optionalen Sensoren, wie Barometer oder GPS bestückt. Die Sensoren messen die aktuelle Lage des Fluggerätes. Der Flightcontroller errechnet über eine PID-Reglerschleife die Abweichung zur stabilen Fluglage und regelt diese über einen Informationsfluss zu den Brushlessregler. Diese wiederum passen dementsprechend die Drehgeschwindigkeit der Motoren an [vgl. BACHFELD, 2013:45FF]. Ebenso fließen die Steuerbefehle des Piloten mit Hilfe einer Fernsteuerung in die Flugberechnung mit ein, wodurch das Fluggerät durch den Piloten steuerbar wird.[vgl. BÜCHI, 2013a:14].

2.3 Risiken & Gefahren

Ein Quadrocopter besitzt ein nicht unerhebliches Gefahrenpotential. Im Wesentlichen können beim Betrieb solch eines Fluggerätes zwischen den Gefahren durch drehende Rotoren, dem Gefahrenpotential der verwendeten Lithium-Polymer-Akkus sowie dem Risiko eines Ausfalls in der Luft und dem damit verbundenen Absturz, unterschieden werden. Je größer die verwendeten Luftschrauben sind, desto ernsthafter sind die potentiellen Verletzungen, welche durch den Propeller verursacht werden können. Ist die Luftschraube aus einem hoch stabilen Carbon-Material gefertigt, steigt das Gefahrenpotential um ein Vielfaches [vgl. BRUNNER, 2015]. Lithium-Polymer-Akkumulatoren besitzen eine relativ hohe Energiedichte. Allerdings weist diese hierdurch sowie aufgrund ihres chemischen und konstruktiven Aufbaus eine gewisse Sensibilität gegenüber Unter- und Überladen einer einzelnen Akkuzelle auf. Wird eine Zelle unter 2,5 Volt entladen oder über 4,25 Volt geladen, kommt es zur Schädigung der Zelle [vgl. PASSERN, 2013:20FF]. Auch durch eine mechanische Beschädigung aufgrund eines Absturzes wird der Akku zu einer Gefahr. Ein Defekt des Akkus äußert sich im sogenannten Ausgasen, womit der Austritt von gefährlichen Stoffen, wie etwa Wasserstoff gemeint ist. In diesem Fall besteht höchste Brand- und Explosionsgefahr [vgl. BÜCHI, 2013a:20FF]. Kommt es zu einem LiPo-Brand, ist dieser nicht mit Wasser zu löschen. Hierfür muss eine Löschdecke oder ein Pulverfeuerlöscher verwendet werden. Beim Absturz eines Quadrocopter besteht ebenso ein sehr hohes Gefahrenpotential. Die gesamte Energie des Falls wird am Boden freigesetzt. Hier stellen die Motoren die größte Gefahr dar [vgl. BRUNNER, 2015]. Eine weitere Gefahr bzw. Handicap ist der Wind. Bis ca. 50 km/h Windgeschwindigkeit ist das generelle Fliegen möglich, wobei bei ca. 30 km/h die Aufnahmesituation von Bildmaterial aller Art derzeit fast unmöglich wird [vgl. IKEN, 2016].

2.4 Gesetze & Versicherungen

Bei den Gesetzen und Versicherungen ist zu beachten, dass es keine international einheitliche Regelung, Gesetze und Versicherungen gibt. Im Bundesverkehrsministerium wird aktuell noch über eine Art „Führerschein“ für Drohnen diskutiert. Oftmals unterscheiden sich die Gesetzte von Staat zu Staat. Beispielsweise benötigt man eine Aufstiegserlaubnis für Österreich („Betriebsbewilligung von unbemannten Luftfahrzeugen“) und diese wird von der Luftfahrtbehörte „Austo Control“ erteilt. Bei Austro Control sind dafür umfassende Unterlagen einzureichen. Drohnen und Quadrocopter fallen in Österreich in der Regel in die Klasse 1 (unbemannte Luftfahrzeuge der Klasse 1 mit Sichtverbindung). Die Luftfahrzeuge sind auf ein Gewicht von 150kg begrenzt und dürfen (wie auch in Deutschland) nur mit Sichtverbindung geflogen werden. Die Flughöhe ist auf maximal 150m limitiert [vgl. WESTPHAL, 2015]. Der Betrieb eines Quadrocopters ist in Deutschland nicht uneingeschränkt erlaubt. Vielmehr müssen vor jedem Flug eines Quadrocopters gewisse rechtliche Aspekte und Gesetze beachtet werden. Mit dem 14. Gesetz zur Änderung des Luftverkehrsgesetztes (LuftVG) sind zivile Drohnen anerkannte Luftfahrtzeuge und können sich damit nicht mehr in einer Art rechtsfreien Raum bewegen [vgl. SOLMECKE; NOWAK, 2014]. Rechtsgrundlage für die Zuordnung der geltenden Verordnungen und Gesetzen, ist die Definition, ob es sich beim Betrieb des Fluggerätes um ein Flugmodell oder um ein unbemanntes Luftfahrtsystem (UAS = Unmanned Aerial System) handelt. Ein Flugmodell wird zur reinen Freizeitgestaltung und als Sport betrieben. Ist dies nicht der Fall, gilt der Quadrocopter automatisch als unbemanntes Flugsystem [vgl. BUNDESMINISTERIUM FÜR

VERKEHR UND DIGITALE INFRASTRUKTUR, 2014]. Wiegt ein Quadrocopter mehr als 5 Kilogramm ist es nicht von Bedeutung, ob dieser lediglich zu Freizeitzwecken eingesetzt wird oder nicht. In diesem Fall wird das Fluggerät immer als unbemanntes Flugsystem eingestuft [vgl. NOÉ, 2015]. Grundsätzlich wird immer im ersten Schritt eine spezielle Haftpflichtversicherung (eine „normale" Haftpflichtversicherung reicht nicht aus) für ein Flugmodell oder ein UAS benötigt, um alle eventuell entstehenden Schäden abzudecken [vgl. Luftvg §43]. Weiterhin ist der Aufstieg eines UAS immer erlaubnispflichtig. Solch eine Einzel- oder Allgemeinerlaubnis muss beim zuständigen Landesamt beantragt werden. Ein Quadrocopter muss zudem immer in Sichtweite, mindestens 1,5 Kilometer entfernt zu einer Flughafenbegrenzung und unter Einhaltung aller geltenden Luftfahrtregeln und Gesetzen betrieben werden [vgl. LANDESBETRIEB MOBILITÄT RHEINLAND-PFALZ, 2015]. Hierzu zählt vor allem, dass ein Quadrocopter nicht in kontrollierten Lufträumen geflogen werden darf. Hierfür kann jedoch ebenso eine Fluggenehmigung eingeholt werden.

3 NUTZUNG VON MULTICOPTER IM STÄDISCHEN RAUM

In den letzten Jahren hat sich die Entwicklung von Drohnen enorm weiterentwickelt. Derzeit werden Drohnen vermehrt im militärischen Bereich genutzt. Die zivile und private Nutzung ist aber wünschenswert. Zum einen eröffnet die Drohnentechnik neue Möglichkeiten bei der Beobachtung des Klimas und ebenso der Naturraumüberwachung. Zum anderen können aufgrund der günstigen Preise in der Anschaffung und im Unterhalt vielfältige Daten mit Hilfe der unbemannten Helfer gewonnen werden. Mittels der Drohnen lassen sich im Gegensatz zu Ballons und Flugzeugen auch das Klima und Wetter in Häuserschluchten bzw. knapp über Gebäuden beobachten – sofern dies gesetzlich erlaubt ist. Möglich ist die Beobachtung sowohl an einem fixen Standort, als auch über einer Wegstrecke. Zusätzlich ist die Möglichkeit vorhanden, eine genauere horizontale bzw. vertikale Untersuchung der Stadtatmosphäre durchzuführen, sowie theoretisch präzisere Messungen zwischen Stadthindernisschicht (urban canopy layer) und Übergangsschicht (urban turbulent wake layer). Eine weitere Idee stellt das Verfolgen von Personen in der Stadt dar, was bisher aus der „Vogelperspektive" unmöglich war. Die zu verfolgende Person kann beispielsweise mit einer Wärmebildkamera beobachtet werden, um folglich neuartige Wechselwirkungen zwischen der Stadtstruktur (z.B. der Oberflächenabstrahlung) und dem menschlichen Organismus zu erhalten [vgl. ALLBACH; HENNINGER, 2013]. Unter Mobile Mapping wir die Erfassung raumzeitlicher Phänomene mit Hilfe einer bewegten Multisensorplattform definiert, die das Ziel hat, strukturierte Objektinformationen aus den erfassten Daten abzuleiten [vgl. NEITZEL; ET AL, 2011]. Mittlerweile bietet sich die Möglichkeit, mit Hilfe von Drohnen 3D-Modelle durch die Nutzung der Luftbildphotogrammetrie zu erstellen. Zudem sind erste Apps in Betrieb, die z.B. DJI Drohnen auf dem Android und iOS Betriebssystem zu einem 3D-Scanner machen [vgl. KNABEL, 2016]. Weitere Beispiele für die Nutzung von Multicoptern im städischen Raum sind logistische Aufgaben wie z.B. die Auslieferung von Paketen. Auch wenn dies zurzeit eher als Marketing von Amazon, UPS, DHL usw. angesehen werden kann, gibt es durchaus vorstellbare Szenarien [vgl. WISCHMANN, 2015]. Multicopter, die mit Wärmebildkameras ausgestattet sind, können nicht nur zur Personensuche und zum Auffinden von Brandnestern genutzt werden, sondern auch zur Identifizierung von defekten Solarmodulen eingesetzt werden. Defekte Module können erhitzen, mindern die Gesamteffizienz des Solarsystems und liefern keinen Strom. Die einzelnen Module sind zu Blöcken zusammengeschaltet, weshalb es sich bisher als schwierig erweist, vom Boden aus das ausgefallene Modul zu identifizieren. Mittels der Thermographie aus der Luft lässt sich dies von oben erledigen [vgl. SCHLEEH, 2016]. Für die Kontrolle von PV-Anlagen in Deutschland und dem noch erheblich ausbarbaren Potential an weiteren Anlagen, eröffnen sich große Marktchancen für einen kommerziellen Einsatz von Drohnen und sind eine geeignete alternative zu Hubsteigern oder Kransteigern [vgl. IKEN, 2016]. In Katastrophenszenarien erweist sich die Nutzung von Unbemannten Luftfahrzeugen (UVAs) als erfolgreich. Dieses Einsatzmittel kann z. B. zur Ortung von vermissten bzw. verschütteten Personen benutzt werden. Auch Funksignale von LVS-Geräten bei der Lawinenverschüttetensuche (LVS) können von den UVAs geortet und detektiert werden. Dadurch kann bei der Suche nicht nur Zeit gespart werden, sondern auch den Helfern bzw. Suchern wird ein besserer Schutz geboten, da sie nicht permanent den Gefahren ausgesetzt sind. [vgl. ANDERT; ET AL, 2013]. Ebenso können die Copter zum sogenannten Smart Farming eingesetzt werden, was von der Deutschen Landwirtschaft-Gesellschaft (DLG) positiv bewertet wird. Der Entwicklung von Smart Farming bzw. „Networked Farming" werden mehr Chancen als Risiken beigemessen – die Bauern sollten zunehmend im Sinne des Precision Farming aufrüsten, um dann Smart Farming betreiben zu können. So ist es beispielsweise möglich aus aufgenommenen Fotos ein Gesamtbild zusammen zu setzen, welches als Biomassekartierung oder Dokumentation von Hagel-, Wasser-, oder Wildschäden genutzt werden kann [vgl. HOFFMANN, 2014]. Derzeit kommen Drohnen in der Landwirtschaft häufig zur Bestimmung verschiedener Vegetationsindizes mittels Multispektralkameras zum Einsatz. Dadurch lassen sich unter anderem der Blühbeginn und die Wuchshöhe diverser Kulturen feststellen. Ein zukünftiges Nutzgebiet stellt die Ausbringung von Nützlingen zur biologischen Schädlingsbekämpfung dar, beispielsweise bei Schlupfwespen-Gelegen im Maisbestand [vgl. PAAR, 2015]. Landwirte können durch den Einsatz von Infrarot-Aufnahmen (NDVI) feststellen, wo mögliche Probleme entstehen können bzw. wo sich kranke Pflanzenbestände befinden. Gesunde Pflanzen reflektieren die Infrarotstrahlung, wohingegen kranke Pflanzen dies nicht können. Dadurch ist die frühzeitige Erkennung und Visualisierung kranker Bestände möglich, bevor die Pflanzen welken. Auch Pflanzenschutzmittel können punktgenau zum Einsatz kommen. Weiterhin lassen sich z.B. vermeintliche Schädlinge, wie Wildschweine, jagen. Auch Rehkitze lassen sich durch eine Luftbeobachtung vor Mähern schützen. [vgl. SCHLEEH, 2016].

3.1 Wetterdaten – Klimanonitoring mit Multicoptern

Im Allgemeinen sollten Monitoringmethoden genaue und kontinuierliche Erfassungen des Beobachtungsgegenstandes gewährleisten. Die dabei entstandenen Zeitreihen bilden die Grundlage für Prognosen. Vor allem im Bereich der Raumplanung spielen Zeitreihen und die dazugehörigen Zeitreihenanalysen eine bedeutende Rolle. Als Beispiel gelten Niederschlagsmengen und Temperaturschwankungen in der Raumplanung und in der Klimatologie,die auch in der Verkehrsplanung einbezogen werden [vgl. STREICH, 2005:211FF]. Des Weiteren kann man eine Unterscheidung zwischen deduktivem und induktivem Monitoring vornehmen. Beim deduktiven Monitoring werden Daten in ihrer Vielfalt und allgemeinen Form erhoben und gesammelt. Nach deren Auswertung werden sie zu einer Aussage zusammengefasst. Beim induktiven Monitoring hingegen wird innerhalb der Wissenschaft durch Beobachtungen von Phänomenen eine abstrahierende Folgerung abgeleitet. Bei induktiven Monitoring-Ansätzen in der räumlichen Planung ist dies jedoch nicht der Fall, da einzelne Personen unbewusst dieselben Phänomene beobachten. [vgl. ZEILE, 2011]. Die Geschichte der Klimamessung lässt sich grob in vier Abschnitte unterteilen: Experimentelle Messungen (1592-1700), erste regelmäßige Messungen (1700-1850), frühe Messnetze (1780-1850) und moderne Messnetze (seit 1850). In der heutigen Zeit zählen auch nicht-bodengebundene Messsysteme dazu. Der internationale Austausch der Daten eines Messnetzes von mehr als 10.000 Bodenstationen wird von der World Meteorlogical Organization (WMO) geregelt. Über 1000 Bodenstationen lassen mehrmals täglich Wetterballone mit Radiosonden aufsteigen. RADAR, LIDAR und SODAR zählen überwiegend zu den bodengestützten Fernerkundungsverfahren. Ebenso ist eine Erkundung durch Flugzeuge und Satelliten möglich, wobei die Atmosphäre mit Radio-, Licht- bzw. Schallwellen erkundet wird [vgl. ZAMG, 2016]. Das Sammeln von Daten durch mobile Messungen sowie Urban Sensing Ansätze ist für die Meteorologie bzw. die Stadtklimatologie von großem Interesse. Ebenso offeriert dies einen enormen Mehrwert für das Klima-Monitoring [vgl. ALLBACH, HENNINGER, 2013]. Bei mobilen Klimamessungen oder Feldexperimenten wird auf feste Messstandorte verzichtet, sie ermöglichen jedoch Messungen mit spezieller Sensorik und diversen Verfahren. Mobile Messmethoden sind besonders geeignet, um das Klima im städtischen Raum zu untersuchen. Mit Hilfe von Fahrzeugen, Fahrrädern oder gar zu Fuß können verschiedene Messverfahren durchgeführt werden [vgl. OTTE, 1999:298]. Das Leibniz-Institut für Troposphärenforschung e.V. (TROPOS), die Universität Tübingen und die Technische Universität Braunschweig testen unbemannte Luftfahrzeuge um die schädlichen Feinstaub-Partikel (Aerosole) auf ihre Größe und Konzentration hin zu untersuchen. Das TROPOS betreibt eine Messstation, die Teil des globalen Erdbeobachtungssystems der WMO ist und den Kern der jüngsten Wolkenmesskampagne ist. Die Drohne namens ALADINA vom Typ „Carolo P360“ ist am Institut für Luft- und Raumfahrtsysteme der TU Braunschweig entwickelt worden und hat eine Spannweite von ca. 3,6 Metern bei ca. 22 kg Gewicht mit einer Traglast von ca. 2,5 kg und erreicht eine maximale Geschwindigkeit von ca. 80 km/h. Der verwendete Akku ermöglicht eine Flugzeit von ca. 30 Minuten. Frau Dr. Wehner von TROPOS sieht die Vorteile des wissenschaftlichen Drohnen-Einsatzes vor allem darin, dass die unbemannten Flugzeuge, bei atmosphärischen Aerosol-Messungen, die Lücke zwischen Langzeitmessungen vom Boden und kostenintensiven Hubschraubermessungen schließen könnten [vgl. WESTPHAL, 2013]. Der verwendete Drohnentyp ähnelt allerdings eher einem großen Modellflieger und hat auch die Stärken und Schwächen wie ein Flugzeug im Vergleich zu einem Multicopter. Durch den Einsatz von Mikrocontrollern und Sensoren ist es möglich eine mobile, autonome, leichte, kostengünstige und modulare Wetterstation zu entwickeln [vgl. ALLBACH; HENNINGER, 2013a+b & ALLBACH; HENNINGER; DEITCHE, 2014]. Bei mobilen Messungen stellt ein Multicopter ein neuartiges Trägersystem für Messinstrumente dar.

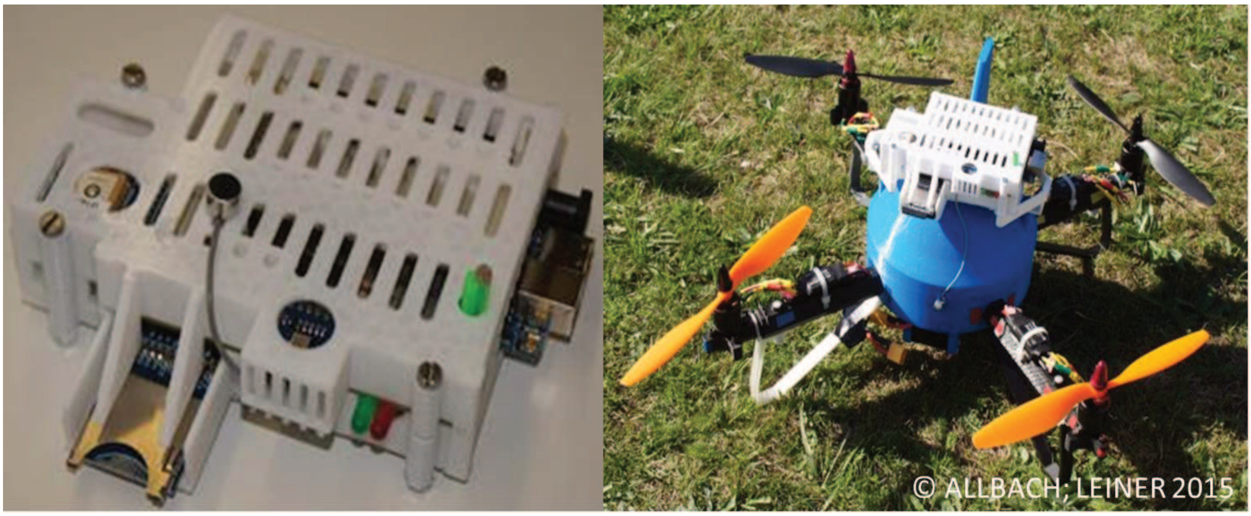

Abb. 2: Mikrocontrollerbasierte Wetterstation & Copter als Trägersystem der Wettertation [EIGNENE DARSTELLUNG, 2014, 2015].

4 COPTER ALS TRÄGERSYSTEME – ENTWICKELTE COPTERVARIANTEN

4.1 Quadrocopter aus dem 3D-Drucker

Im Jahr 2013 begann durch uns die Entwicklung eines Quadrocopters aus dem 3D-Drucker. Die Besonderheit des Copters ist, dass die komplette Rahmenkonstruktion (fast alles außer der Elektronik) im 3D Druckverfahren erstellt wird (Abb. 3 links-oben). Die Drohne/Copter soll zum einen bei Workshops der Hochschule Kaiserslautern als kostengünstige und gleichzeitig innovative Form der MINT-Förderung (aus den Begriffen Mathematik, Informatik, Naturwissenschaft und Technik zusammengesetzt) für Schülerinnen und Schüler eingesetzt werden (Abb. 3 rechts-oben) und gleichzeitig als erster Prototyp für eine leicht reproduzierbare Sensor-Träger-Plattform dienen (Abb. 2 rechts). Mittlerweile gibt es auch vergleichbare Projekte für fortgeschrittene „Bastler“ mit Zugriff auf 3D-Drucker (z.B. die IRIS+ Drohne oder auf der Crowdfunding-Plattform Indiegogo die BonaDrone Mosquito). Bei der Produktion mit 3D-Druckern wurden fast ausschließlich nicht professionelle 3D-Drucker eingesetzt, die in einem anderen Schülerinnen-Projekt konstruiert wurden [vgl. RHEINPFALZ, 2014a+b]. In diversen evaluierten Workshops und Aktionstagen der Hochschule Kaiserslautern wurde in den Jahren 2015 und 2016 dieser Quadrocopter von Schülerinnen und Schülern gebaut, geflogen und mit einer äußerst positiven Resonanz bewertet. Das Ziel eines kostengünstigen, robusten und Interesse weckenden Mediums konnte erfüllt werden. Das Ziel eine geeignete Sensor-Träger-Plattform mithilfe dieses Copters zu schaffen, konnte allerdings nur bedingt erfüllt werden. Die Kluft zwischen Kostengünstigkeit, Einfachheit bei gleichzeitiger Robustheit und möglichst langer Flugzeit ist nur schwer erreichbar. Daher wurde nach einer Lösung gesucht, einen Multicopter zu konstruieren, der eine möglichst lange Flugzeit aufweisen kann bei gleichzeitiger Nutzung als Sensor-Plattform-Träger. Zu erwähnen ist, dass die Reichweite und Flugdauer schon immer ein Streitpunkt ist. Es ist ein theoretischer Wert. Oftmals wird dieser nur erreicht, wenn die Drohne „ruhend“ in der Luft steht und die Kamerasensorik deaktiviert ist. Dies gilt nicht nur für die günstigen Drohnen, sondern auch für die Drohnen in der Preisklasse um ca. 40000 Euro [vgl. IKEN, 2016:44FF]. Dennoch soll mit diesem Paper rechnerisch und theoretisch dargelegt werden, wie ein Langzeit-Flug-Copter aussehen könnte und wie durch Solartechnik die Flugdauer weiter gesteigert werden kann.

Abb. 3: 3D-Drucker & Worshops für SchülerInnen [EIGNENE DARSTELLUNG, 2014, 2015].

4.2 Langflug Quadrocopter

Um eine möglichst lange Flugzeit zur Detektion von Umwelteinflüssen durch die Wetterstation zu gewährleisten, wird ein Quadrocopter entwickelt, welcher die Wetterstation tragen kann und aufgrund der geforderten, langen Flugzeit, möglichst leicht ist. Aus konstruktiver und materialtechnischer Sicht kommt für den Prototyp das Material Carbon (CFK) zum Einsatz. Da der Akku einen nicht unerheblichen Beitrag zur Gesamteffizienz des Flugsystems beiträgt, wird untersucht, unter welchen Bedingungen und Spezifikationen ein Lithium-Polymer-Akku die höchste Energiedichte aufweist. Hierfür wurde eine umfangreiche Benchmarkanalyse des vorhandenen Akkumarktes durchgeführt und die Parameter Gewicht und Energieinhalt untersucht. Hier stellt sich heraus, dass nach einer statistischen und parametrischen Analyse verschiedener LiPo-Akkus, diejenigen die höchste Energiedichte aufweisen, welche auch die höchste elektrische Leistung in Watt (W) innehaben. Es zeigt sich, dass genau jene Akkus, eine Energiedichte von bis zu 19 Watt pro 100 Gramm Eigengewicht aufweisen. Die Konstruktionsstudie (Abb. 4) zeigt, dass mit einem Quadrocopterrahmen in Leichtbauweise aus Carbon und einer effektiven Auslegung hoch effizienter Leistungselektronik nach einer umfangreichen Benchmark- und Berechnungsanalyse eine maximale, effektive Flugzeit von 60 Minuten möglich wird. Zu diesem Zweck wurde eine umfangreiche Analyse des bestehenden Marktes im Bereich Multicopter-Brushlessmotoren und Luftschrauben durchgeführt und auf die zu realisierende Konstruktionsstudie angewendet. Die effizienteste Leistungselektronik-Kombination gewährleistet hier eine praktische Flugzeit von 60 Minuten. Ebenso konnte ein Trend in der Effizienzsteigerung beobachtet werden. Je größer die verwendeten Luftschrauben des Multicoptersystems sind, desto effizienter setzen diese die Leistung der Motoren mechanisch in die benötigte Schubkraft um. Ebenso erfahren die Motoren selbst eine Effizienzsteigerung, je größer sich ihre Bauform zeigt. Die Gesamteffizienz des Multicoptersystems steigt somit mit zunehmender Größe der Leistungskomponenten.

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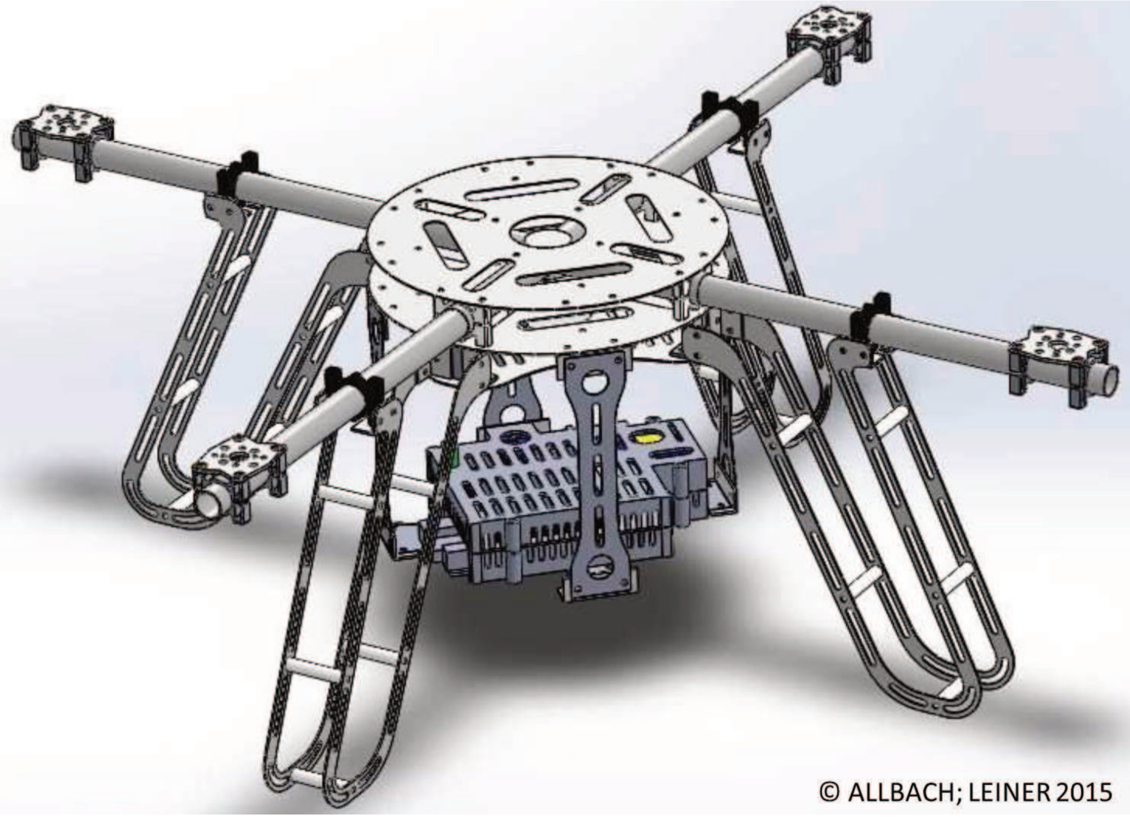

Abb. 4: Langflug Quadrocopter [EIGNENE DARSTELLUNG, 2015].

4.3 Langflug Quadrocopter (mit Solar)

Eine weitere Konstruktionsstudie (Abb. 5) zeigt, wie sich die Flugzeit, bei der Erweiterung des Designs mit unterschiedlich leistungsstarken Solarsystemen, verhält. Hier zeigt sich, dass die bestehende Fluggerätegröße keinen positiven Flugzeiteffekt durch eine Solarsystemintegration erfährt. Je größer die Konstruktion und somit auch die Leistungselektronik und die Luftschrauben werden, desto effizienter wird das Gesamtsystem des Quadrocopters. Durch die Integration eines effizienten Solarsystems in einem größeren Quadrocopter-Design mit einem Motorachsenabstand von 1400 Millimeter, kommt es zu einer Flugzeitsteigerung um bis zu 200 Prozent. Hier kann eine maximale Flugzeit von 160 Minuten bei optimalen Wetterbedingungen erreicht werden.

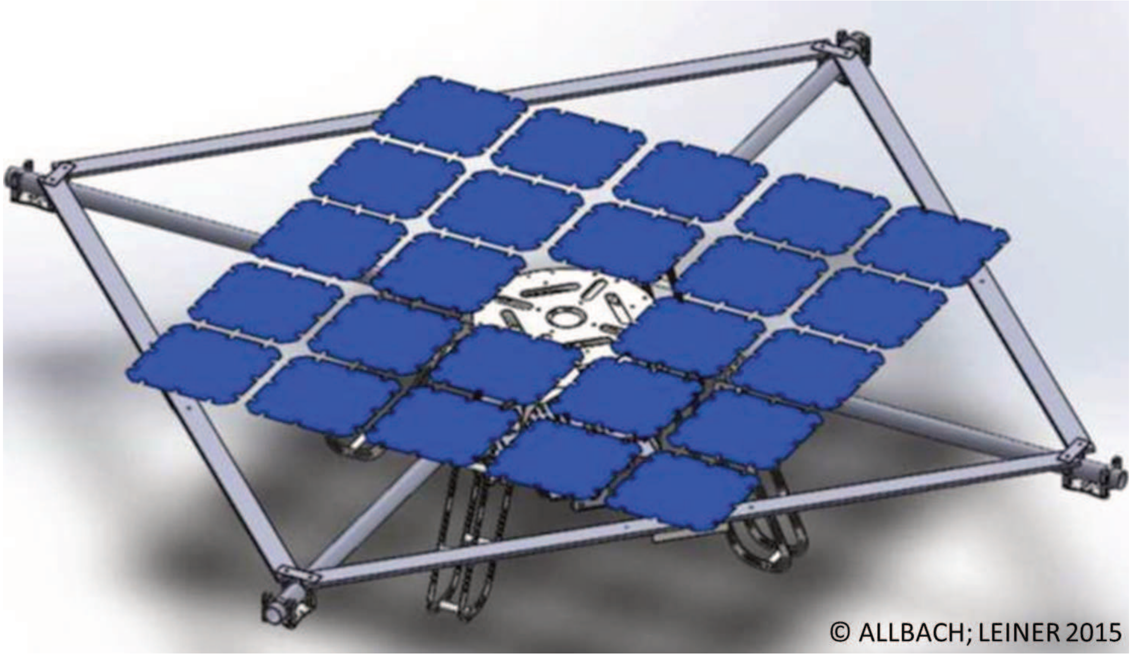

Abb. 5: Langflug Quadrocopter (mit Solar) [EIGNENE DARSTELLUNG, 2015].

5 KLIMAMONITORING - BEISPIEL

Nachfolgend wird ein kurzes Beispiel für die Dedektion von Umwelteinflüssen bzw. eine neue Form des Klimamonitoring gezeigt.

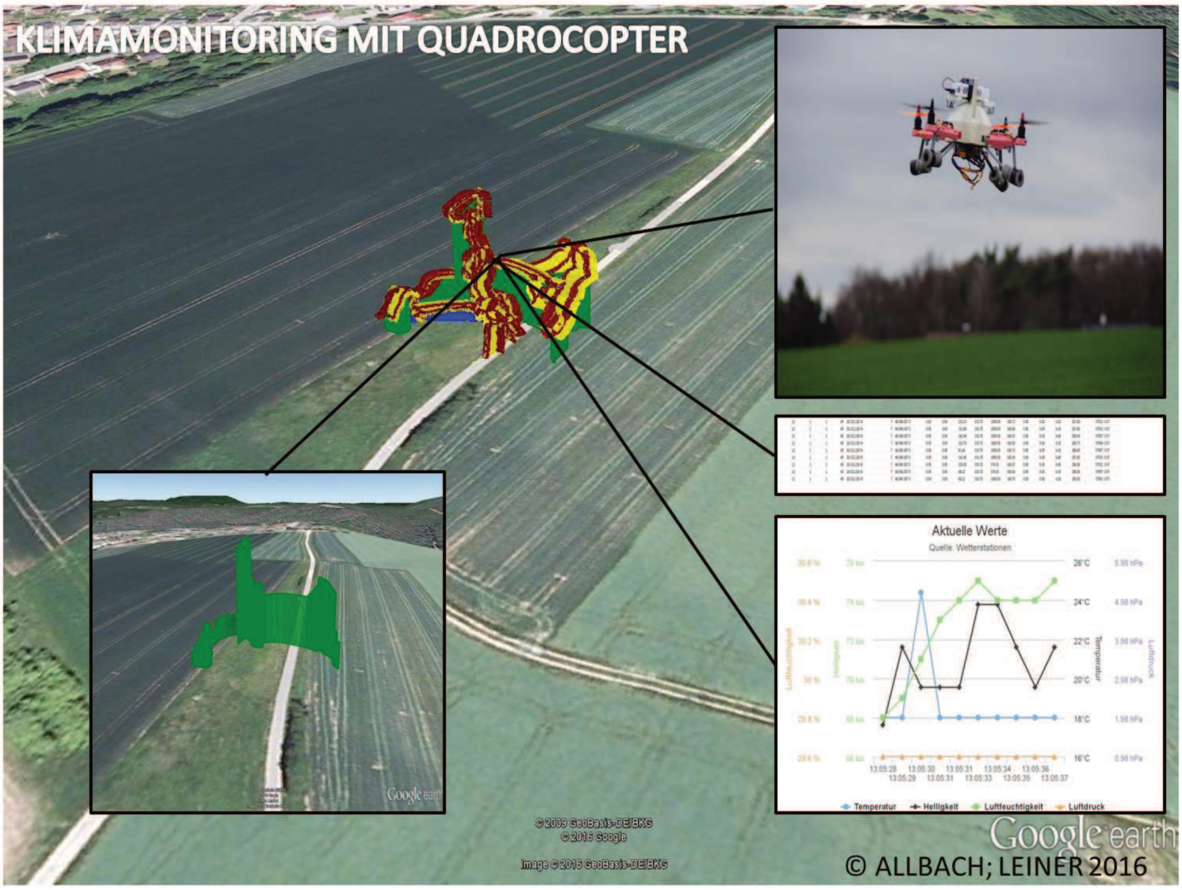

Abb. 6: Der Copter als Sensing-Plattform [EIGNENE DARSTELLUNG, 2015, 2016].

Die Abb. 6 zeigt den Verlauf eines Testflugs des Copters aus dem 3D-Drucker mit montierter Wetterstation. Die Flugdauer beträgt ca. sieben Minuten mit einer rudimentären Basis-Wetterstation von ca. 200 Gramm. Die Darstellung der aufgenommenen Daten erfolgt über dem Umweg des Online verfügbaren Urban Sensing Systems. Diese selbstentwickelte Sensing Plattform ist immer noch in Entwicklung und nicht fertig gestellt. Die Daten wurden manuell über eine SD-Karten-Importierfunktion in eine Datenbank eingespielt. Nicht valide Daten (z.B. keine GPS-Position) werden hierbei automatisch durch einen Importfilter aussortiert [vgl. ALLBACH; HENNINGER; DEITCHE, 2014]. Zur Darstellung der Werte wurde ein Mixchart gewählt. In dieser Version erfolgte die Visualisierung im Urban Sensing System mit dem offenen und freien Tool Highchart, das zu Testzwecken integriert wurde. Weiterhin sichtbar in der Abbildung ist das Höhenprofil des Fluges, verschiedene Daten wie z. B. die Geoposition, Datum, Uhrzeit sowie die Wetterdaten bestehend aus Lufttemperatur, Luftfeuchte, Luftdruck, Lautstärkemessung und Lichthelligkeit. Ebenfalls lässt sich das Höhenprofil des Flugs mittes KMZ-Import in Google Earth darstellen. Geschwindigkeit, Lagesensoren bzw. die gesamte Telemetrie des Copters lassen sich ebenfalls auslesen.

6 CONCLUSION

Multicopter und Drohnen eigenen sich sehr gut um Schülerinnen und Schüler neugierieg auf Technik zu machen und sich intensiver mit MINT-Themen auseinander zu setzten. Die angebotenen Workshops erfreuen sich einer großen Beliebtheit bei den SchülerInnen und können eine Beitrag leisten um zukünftige Fachkräfte im MINT-Bereich zu gewinnen.

Es konnte gezeigt werden, dass Mithilfe der 3D-Druck Technologie ein durchaus robuster und kostengünstiger Quadrocopter gebaut werden kann. Ersatzteile lassen sich ebenfalls gut erstellen. Es wurde gezeigt, dass ein Quadrocopter, welcher mit Hilfe eines 3D-Druckers realisiert wurde, durchaus als aeronautische Trägerplattform zur Detektion von Umwelteinflüssen bzw. als eine Art Sensor-Plattform dienen kann. Kritisch zu sehen ist allerdings die geringe Flugzeit des 3D-Druck-Copters, das verwendete PLA-Druck-Material ist deutlich schwerer als Leichtbaumaterialien. Außerdem musste der Copter bewusst durch den Einsatzzweck in Workshops robust ausgelegt werden. Aus diesem Grund zeigte eine zweite Konstruktionsstudie, dass durch eine effiziente Leichtbauweise und eine optimierte Auslegung hoch effizienter Leistungselektronik, eine Flugzeitexpansion bis auf 60 Minuten möglich ist. Hierdurch können Wetterdaten im größeren Umfang und statistischer Qualität erfasst werden. In einer dritten Konstruktionsstudie konnte aufgezeigt werden, dass durch die Integration einer effizienten Solaranlage die Flugzeit bis auf 160 Minuten gesteigert werden kann. Hierzu ist allerdings eine optimale Wetterlage und die damit verbundene direkte Sonneneinstrahlung auf die Solarkollektoren Voraussetzung. Durch die Konstruktionsstudien wurde eine evolutionäre Weiterentwicklung der Trägerplattform zur Detektion von Umwelteinflüssen mit Hilfe einer Wetterstation aufgezeigt. Eine Trägerplattform, welche eine Flugzeit von 60 Minuten gewährleistet, dient der Erfassung von Umweltdaten wesentlich besser.

Allgemein wird die vorgestelle Technik erheblich das tägliche Leben beieinflussen. Drohnen bieten für Montitoring Aufgaben eine immense Kosteneinsparung. Weiterhin sind sie auch in engen urbanen Strukturen, wie z.B. Häuserschluchten navigierbar und bieten die Möglichkeit in der Luft schwebend auf der Stelle zu stehen. Durch die Copter-Technik sind Vor-Ort-Messungen von Daten aller Art umsetzbar. Die Technologie der Multicopter hat das Potential ein Bindeglied zwischen Top-down Verfahren und Botton-up Verfahren bei Monitoring-Aufgaben zu leisten. Rechtlich gesehsehen müssen die damit einhergehenden Möglichkeiten klar geregelt werden. Sicherungssysteme, wie z.B. Redudanzen bei der Energieversorgung und programmiertes Verhalten bei Abriss des Funksignals, müssen zwingend vorhanden sein. Trotz der vielen Gefahren dieser Technik ist die Drohnentechnologie ein Schlüssel für die Umsetzung von Smart Cities. Scheinbar ist es wie bei vielen andern Technologien vorher … je stärker bzw. mächtiger eine Technologie ist, desto größer können auch die Gefahren sein, die von ihr ausgehen.

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reviewed paper

Altern im urbanen Umfeld dargestellt an ausgewählten Beispielgebieten von Graz

Josef Gspurning, Julia Kügele

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1 ABSTRACT

Der in jüngster Zeit in vielen urbanen Zentren zu erkennende Transformationsprozess hin zur sogenannten "smarten City" ist unter anderem charakterisierbar durch die fortschreitende Durchdringung der Gesellschaft mit digitalen Technologien, durch eine Veränderung der Art und Weise wie kommunale Serviceleistungen erwartet und angeboten werden und schlussendlich auch durch die Altersstruktur der Bevölkerung und ihrer damit verbundenen Bedürfnisse. Dabei zeigt sich, dass gerade der demographische Wandel, von dem unsere Gesellschaft seit einigen Jahrzehnten betroffen ist, insofern für eine Polarisierung des Problemfeldes sorgt, als die betroffenen Altersgruppen (z.B. Jugendliche oder Seniorinnen und Senioren) nicht nur unterschiedliche Bedürfnisse haben, sondern auch unterschiedliche Vorstellungen davon, wie diese befriedigt werden können. So verschiebt sich etwa das Verhältnis von alten Menschen zu jungen stetig zu Gunsten der älteren, was einerseits auf die steigende Lebenserwartung der Babyboomgeneration der 40er und 60er-Jahre als Folge der Fortschritte in der Medizin, andererseits auf die seit über 40 Jahren rückläufigen Geburtenzahlen, zurückzuführen ist. Dies gilt generell für die gesamte Steiermark, im besonderen Maße aber auch für den urbanen Raum Graz. Heute sind rund 250.000 Menschen in der Steiermark über sechzig Jahre alt, im Jahr 2030 werden es fast 400.000 sein. Dies bedeutet, dass der Bevölkerungsanteil der über 60-Jährigen von derzeit einem Fünftel auf ein Drittel ansteigen wird. Während die Einwohnerzahlen der Steiermark zwischen 2006 und 2010 um nur 0,7% anstieg, nahm die Bevölkerung in der Stadt Graz um 5,6% zu. Dabei lässt sich der Trend erkennen, dass die Einwohnerzahl und damit im selben Ausmaß auch die Zahl der Senioren und Seniorinnen in den nächsten Jahren nicht nur durch Alterung sondern auch durch Zuzüge weiterhin ansteigen wird; dies findet seine Bestätigung sowohl in den gesamtstädtischen Ergebnissen als auch in den Detailergebnissen aller 17 Bezirke der Steiermark und unterstreicht damit die stadtplanerische Relevanz dieser Altersgruppe und ihrer Lebensbedingungen. Dabei macht die Zugrundelegung allgemein anerkannter Wertmaßstäbe (wie etwa der Richtlinien der WHO für "age friendly cities") deutlich, dass eine Bewertung der Situation nur über die Analyse jener Parameter führt, welche die Möglichkeiten der Senioren zur aktiven Lebensführung, Gesundheit und Partizipation zu charakterisieren vermag. Demnach konzentriert sich die vorliegende Studie auf die Erfassung, Analyse und Beschreibung der Lebensverhältnisse der alten Menschen in ihrem urbanen Umfeld - sowohl in versorgungs-, als auch in verkehrstechnischer Hinsicht. Als Untersuchungsgebiet wurde der Bezirk Geidorf (III.) gewählt, der auf einer Fläche von 5,5 km2 rund 24.990 Einwohner und Einwohnerinnen beherbergt (Stand: Jänner 2016). Räumlich gesehen liegt der Bezirk relativ zentral, nördlich der Innenstadt und gilt durch den Standort der Karl-Franzens-Universität und die Universitätsklinik (LKH-Ost) auch als Bildungsstandort von Graz. Durch die Ansammlung vieler Studenten und die Nähe zur Innenstadt ist Geidorf einerseits ein relativ „junger" Bezirk mit starker Besiedlung (hauptsächlich Altbauten) entlang des Stadtparks. Andererseits handelt es sich jedoch – besonders stadtauswärts - auch um ein relativ ruhiges, städtisches Wohnviertel mit Einfamilienhäusern ergänzt durch Villen. Außerdem zählen die Grünflächen des Rosenhain, gemeinsam mit dem Hilmteich und den Grünarealen des Universitätssportzentrums zu den stark frequentierten Grünflächen in Graz. Der Bezirk ist durch die Straßenbahnlinien 1,4 und 5, sowie die Buslinien 30, 31, 41, 58/E, 62, 63, 81 und die Nachtlinien N1, N2 und N5 gut an das öffentliche Verkehrsnetz von Graz angebunden. Desweiteren kann im Bezirk in den nächsten zwei Jahrzehnten mit einem relativ hohen Anstieg an älteren Menschen gerechnet werden (über 20%). Er ist daher repäsentativ, sowohl für die Verteilung und Struktur, als auch für das Umfeld der Seniorinnen und Senioren und ermöglicht die Konstruktion einer „Topographie des Alters". Alle weiterführenden Detailstudien (Infrastruktur und Accessibility) beziehen sich auf ein Sub-Sample aus 11 (von 28) Zählsprengeln des Bezirks für die zusätzliche Daten (seniorinnen- und seniorenrelevante Infrastruktureinrichtungen) erhoben wurden. Als Grundlage für die Kalkulation der Erreichbarkeiten dient ein Verkehrsnetz-Layer, dessen Kanten-/Knotenimpedanzen entsprechend dem Mobilitätsverhalten älterer Menschen (Bord-steinkanten, Verkehrsbelastung, straßenbegleitendes Grün, etc.) gewichtet wurden. In einem weiteren Schritt wurden die Möglichkeiten der alten Menschen zur Teilnahme am ÖPNV untersucht, wobei bezüglich der Modellierung von Reichweite und Frequenz auf vergleichbare Untersuchungen

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zurückgegriffen wurde; gebotene Anonymität hat eine detaillierte Zuordnung von Zielgruppenmitgliedern zu Haltestellen-einzugsbereichen verhindert, wodurch durchgängig mit raum-zeitlichen Flächenzuordnungen und einer Gleichverteilung der Seniorinnen und Senioren innerhalb des jeweiligen Sprengels ausgegangen wurde. Die Auswahl der berücksichtigten Themenkomplexe deckt jene Bereiche ab, die als bestimmend für den Alltag der alten Menschen angesehen werden: Lebensmittelkauf und Marktbesuch, Arzt bzw. Apothekenbesuch, Bank- und Postgeschäfte, Aufsuchung von Grüninseln etc. Dabei zeigt sich ein differenziertes Bild der Realität; es stellt sich heraus, dass die gesundheitliche Ausstattung des Untersuchungsgebietes als sehr zufriedenstellend bezeichnet werden kann, gefolgt von der Versorgung mit Gütern des täglichen Bedarfs. Defizite ergeben sich jedoch für die Bereiche Grünland/Parks sowie Post- und Bankdienste, die nur eine unvollkommene Abdeckung aufweisen.

Keywords: ageing, Geidorf, Graz, mobility, quality of life

2 MOTIVATION, FORSCHUNGSFRAGEN UND METHODISCHE ANNÄHERUNG

Der demographische Wandel, vom dem unsere Gesellschaft seit einigen Jahrzehnten betroffen ist, stellt den Ausgangspunkt für die vorliegende Analyse dar. Der Anteil älterer Menschen steigt stetig an, dies gilt sowohl für die Steiermark insgesamt, als auch für den urbanen Raum Graz. In diesem Kontext ist der in jüngster Zeit in vielen urbanen Zentren zu erkennende Transformationsprozess hin zur sogenannten “smart City” besonders relevant zumal er unter anderem von einem fortschreitenden Prozess der „Verdigitalisierung“ der Gesellschaft (d.h. verstärkte Nutzung digitaler Technologien innerhalb aller Bevölkerungsschichten), von einer Veränderung der Art und Weise wie kommunale Serviceleistungen erwartet und angeboten werden begleitet wird; dies alles steht natürlich auch in enger Beziehung mit der Altersstruktur der Bevölkerung und deren damit verbundenen Bedürfnisse. So haben die hiervonvon diesem Wandel betroffenen Altersgruppen (z.B. Jugendliche oder Seniorinnen und Senioren) nicht nur weitestgehend unterschiedliche Bedürfnisse, sondern auch unterschiedliche Vorstellungen davon, wie diese erfüllt werden können. In Österreich lag das Pensionsalter 2015 tatsächlich bei durchschnittlich 60,2 Jahren (Sozialministerium Österreich, 2015). Geschlechtsspezifisch betrachtet liegt das Durchschnittsalter der Frauen bei 59,1 und bei Männern bei 61,3 Jahren, daher wurden in der vorliegenden Analyse Personen ab 60 Jahren als Senioren und Seniorinnen angesehen. Städte sind als Ballungsräume naturgemäß intensiver von solchen Veränderungen und den Konsequenzen des demographischen Wandels betroffen, wodurch Planungsstrategien in Zukunft noch mehr in den Mittelpunkt der Stadtforschung rücken werden. Die demografische Entwicklung und die „Vergreisung“ der Stadt Graz sollen als Ausgangspunkt gewählt werden, um anhand von Netzwerkanalysen zu überprüfen, wo und in welchem Maße Infrastruktureinrichtungen, die sich auf die Lebensqualität von Seniorinnen und Senioren auswirkt, welche nach gewissen Prinzipien Stadtteil bezogen agieren, vorhanden sind. Demnach konzentriert sich die vorliegende Studie auf die Erfassung, Analyse und Beschreibung der Lebens-verhältnisse älterer Menschen in ihrem urbanen Umfeld, sowohl in versorgungs- als auch in verkehrstechnischer Hinsicht und ermöglicht dadurch die Konstruktion einer „Topographie des Alters“. Es soll in diesem Zusammenhang besonders betont werden, dass die solcherart exemplarisch gewonnenen Ergebnisse auf ganz Graz anwendbar sein und wertvolle Grundlagen für nachfolgende Studien bzw. weitergehende Analysen liefern sollen.

Als Untersuchungsgebiet der vorliegenden Analyse wurde aus später noch zu diskutierenden Gründen der Grazer Stadtbezirk Geidorf gewählt, der auf einer Fläche von 5,5 km2 rund 24.990 Einwohner und Einwohnerinnen beherbergt (Stand: Jänner 2016). Alle weiterführenden Detailstudien (Infrastruktur und Erreichbarkeit) beziehen sich auf ein Sub-Sample aus 11 (von 28) Zählsprengeln des Bezirks für die zusätzliche Daten (seniorinnen- und seniorenrelevante Infrastruktureinrichtungen) erhoben wurden. Als Grundlage für die Kalkulation der Erreichbarkeiten dient ein Verkehrsnetz-Layer, dessen Kanten-/Knotenimpedanzen mit Informationen zu das Mobilitätsverhalten älterer Menschen beeinflussenden Faktoren angereichert wurden. Ein weiterer Ansatz konzentriert sich auf die Untersuchung der Möglichkeiten alter Menschen zur Teilnahme am ÖPNV, wobei für Hintergrundinformationen zur Modellierung von Reichweite und Frequenz auf vergleichbare Untersuchungen zurückgegriffen wurde; weil dabei fehlende Primärdaten bzw. die gebotene Anonymität eine detaillierte Zuordnung von Zielgruppenmitgliedern zu einzelnen Haltestellenein-zugsbereichen verhindert haben, musste hinsichtlich der raum-zeitlichen Flächenzuordnungen in erster Näherung von einer Gleichverteilung der Seniorinnen und Senioren innerhalb des jeweiligen Sprengels ausgegangen werden. Die Zugrundelegung allgemein anerkannter Wertmaßstäbe - wie etwa die Richtlinien der WHO für "age friendly cities" - macht deutlich, dass eine Bewertung der Situation nur über die Analyse jener Parameter führt, welche die Möglichkeiten der Senioren zur aktiven Lebensführung, Gesundheit und Partizipation zu charakterisieren vermag. Die Auswahl der berücksichtigten Themenkomplexe deckt daher jene Bereiche ab, die von den genannten Quellen als bestimmend für den Alltag der alten Menschen angesehen werden: Lebensmittelkauf und Marktbesuch, Arzt bzw. Apothekenbesuch, Bank- und Post-geschäfte, Aufsuchung von Grüninseln etc.

2.1 Altern in Land und Stadt

Altern in der Stadt findet primär in der Kleinräumigkeit der eigenen Wohnung und des näheren Umfeldes statt, denn ältere Menschen handeln, mehr als alle anderen Altersklassen, besonders wohnungszentriert (SAUP, 1999:44). Die Lebensphase Alter umfasst somit eine große Zeitspanne, daher ist es wenig zweckdienlich, die Gruppe der Seniorinnen und Senioren mit einer einzigen, allgemein gültigen Charakteristik zu beschreiben; trotzdem sollen im Folgenden, die für diese Kohorte wichtigen Gegebenheiten dargestellt werden, wobei der Mobilitätsbezug und der Bezug zur Wohnung und zum räumlichen Umfeld im Vordergrund stehen. Unter außerhäusliche Mobilität versteht man die Bewegung im öffentlichen Raum, die einem Ortswechsel dient. Die Art der Bewegung, ob zu Fuß oder mit öffentlichen Verkehrsmitteln wird dabei außer Acht gelassen. Der individuelle Aktionsraum von älteren Personen ist unterschiedlich groß, da dieser von verschiedenen Parametern beeinflusst wird. Einerseits sind die individuellen Indikatoren wie Gesundheitszustand, Bildungsgrad und persönliche Motive, andererseits aber auch Einflüsse des Wohnumfeldes, wie Infrastruktureinrichtungen, Ausstattung und Erreichbarkeit, daran beteiligt (PETER, 2009:147). Die räumliche Wahl, wo Aktivitäten ausgeübt werden, wird hauptsächlich von zwei Faktoren bestimmt: durch das Angebot im näheren Wohnumfeld und von der Entfernung des Aktivitäts-Ortes von der eigenen Wohnung. Die Angebotsvielfalt, individuelle Präferenzen und zeitliche Rahmenbedingungen können Orte, die sich nicht im näheren Aktionsraum befinden, attraktiver erscheinen lassen und Defizite im Wohnumfeld kompensieren (z.B.: das Aufsuchen von Grünflächen). Voraussetzung hierfür ist jedoch, dass die jeweilige Person mobil ist (OOSTENDORP, 2010:63). Von den fünf Daseinsgrundfunktionen Wohnung, Arbeit, Bildung, Versorgung und Erholung / Freizeit können die letzten beiden als Hauptaktivitäten älterer Menschen betrachtet werden (SCHÖPFER, 1999:206). Der Anteil der Wegzwecke Arbeit geht ab dem 60. Lebensjahr deutlich zurück, während die Wegzwecke Versorgung und Freizeit kontinuierlich zunehmen. Mit zunehmendem Alter liegt die Konzentration auf dem Wegzweck Versorgung, wobei die tägliche Versorgung von Gütern hauptsächlich im näheren Wohnumfeld stattfindet (Infas/DLR, 2010:75). Im Durchschnitt werden von der steirischen Wohnbevölkerung 2,8 Wege pro Tag zurückgelegt. Dieser Wert unterscheidet sich in den einzelnen Altersklassen, ist jedoch bei den unter 55-Jährigen mit 3,2 Wegen pro Tag weitaus höher. Ab 55 Jahren wird dieser Wert wieder geringer, denn die Mobilitätsbereitschaft sinkt bei Älteren kontinuierlich ab (SCHÖPFER, 1999:206). Die Mobilitätsbereitschaft von Senioren ist eng verknüpft mit der Erreichbarkeit von Standorten. Durch den im Alter abnehmenden Aktionsradius wird es für Senioren immer wichtiger, dass sich Einrichtungen, die sich entscheidend auf ihre Lebensqualität auswirken, im nahen Wohnumfeld befinden (BLANDOW et al., 2012:48). Als Richtwerte für Nahversorgungs- und Dienstleistungseinrichtungen im näheren Wohnumfeld spricht KREUZER (2006) von 500 Metern für Güter des täglichen Bedarfes und einem Kilometer für Güter des wöchentlichen Bedarfes. Problematisch ist dabei, dass in den letzten Jahren eine zunehmende Konzentrierung des Einzelhandels und damit eine funktionale Trennung der einzelnen Bereiche Arbeiten, Wohnen, Einkaufen und Freizeit erfolgte. Kleinräumige Nutzungsstrukturen werden zu großräumigen Funktionsteilungen. Heutzutage sind Städte immer mehr geprägt durch die Schließung oder Standortverlagerung wohnortnaher kleiner Geschäfte und Nahversorger innerhalb der Stadt, anstelle der Tante-Emma-Läden um die Ecke wird mehr Wert auf große Supermärkte an der Peripherie gelegt. Ältere Menschen sind damit oft doppelt benachteiligt: Einerseits sind die Standorte an der Peripherie ohne PKW nur mit viel Sachmittel- oder Zeitaufwand zu erreichen und andererseits gibt es keine ausreichende Infrastruktur (sozusagen eine infrastrukturelle Wertminderung) im näheren Wohnumfeld. Der städtische Alltag ist durch das scheinbare Schrumpfen der Distanzen deutlich großräumiger geworden, heutzutage sind die Orte deutlich weiter voneinander entfernt, als noch vor wenigen Jahrzehnten (DZA, 2007:8). Diese Problematik wird in der Literatur von einigen Autoren aufgegriffen, Scheiner und Holz-Rau (2002) sprechen sich in ihrer Publikation „Seniorenfreundliche Siedlungsstrukturen" für eine ausgewogene Nutzungsmischung von Wohnstandorten aus. Parameter für eine seniorenfreundliche Stadt sind ihrer Meinung nach: Einzelhandel, medizinische Versorgung mit Ärzten und Apotheken, Anbindung an das öffentliche Verkehrsnetz, Kirchen, Friedhöfe, Grünflächen sowie das Angebot „potenzieller Treffpunkte“ wie Cafés. Sie betonen außerdem die Wichtigkeit von informellen Einrichtungen wie Post oder Bank.

2.2 Graz als Seniorenstadt – Versuch einer Charakterisierung

Heute sind rund 250.000 Menschen in der Steiermark über sechzig Jahre alt, folgt man einschlägigen Prognosen werden es im Jahr 2030 fast 400.000 sein. Das bedeutet, dass der Bevölkerungsanteil der über 60jährigen von derzeit einem Fünftel auf ein Drittel ansteigen wird. Nachstehende Abbildung zeigt den Anteil der Senioren an der Gesamtbevölkerung in den politischen Bezirken der Steiermark. In Leoben (31,30%) und Bruck-Mürzzuschlag (30,41%) liegt der Anteil der über 60jährigen bereits bei über 30%, aber auch weitere rurale Bezirke wie Liezen, Voitsberg oder das Murtal weisen ebenfalls bereits Werte über 28% auf.

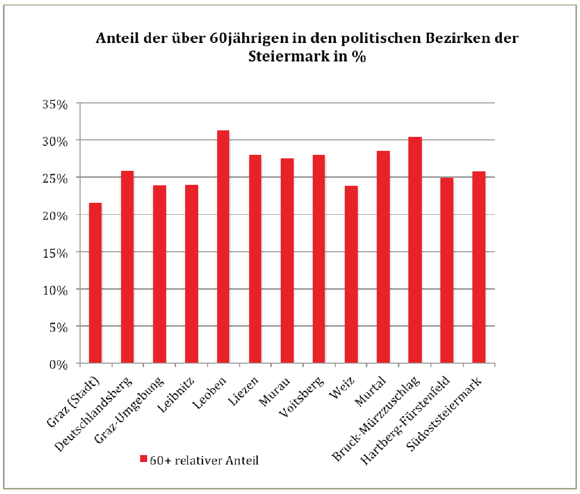

Abbildung 1: Anteil der Senioren an der Gesamtbevölkerung in den politischen Bezirken der Steiermark, Stand: 11.06.2015 (Quelle: Statistik Austria; eigene Darstellung)

In Graz ist der Seniorenanteil mit 21,64% verhältnismäßig noch relativ niedrig, da sich der urbane Raum als sehr dynamisch präsentiert und von hohen Wachstumsraten geprägt ist. Während die Einwohnerzahl der Steiermark zwischen 2006 und 2010 um nur 0,7% anstieg, nahm die Bevölkerung in der Stadt Graz um 5,6% zu (VERHOUNIG & STEINEGGER, 2013:17-18). Derzeit leben rund ein Drittel aller Einwohner der Steiermark in Graz und Umgebung. Trotz der Annahme, dass Graz, durch die Zahl der Zuzüge, auch in Zukunft eine „junge“ Stadt bleiben wird, scheint das Phänomen einer proportional zunehmend alternden Bevölkerung auch für Graz unausweichlich. Durch diesen tiefgreifenden Wandel unserer Gesellschaft werden infrastrukturelle Anpassungen in den nächsten Jahren notwendig sein (VERHOUNIG & STEINEGGER, 2013:17). Laut österreichischem Sozialministerium sind derzeit rund 18% der Grazer 60 Jahre oder älter und gelten damit als Senioren. Bis 2050 soll der Seniorenanteil weiter zunehmen und bereits bei knapp über 30% liegen. Es wird somit bereits jeder dritte Einwohner von Graz im Pensionsalter sein (Statistik Austria, 2015). Außerdem lässt sich – entgegen bundesweiter Beobachtungen – für Graz ein Trend erkennen, nach dem die Einwohnerzahl der Stadt auch in den nächsten Jahren durch ansteigende Zuzüge immer mehr zunehmen wird. Dies gilt sowohl für ganze Stadt, als auch für jeden einzelnen der 17 Bezirke und unterstreicht damit die stadtplanerische Relevanz dieser Altersgruppe und ihrer Lebensbedingungen (Amt der Statistik Graz, 2015). Nachstehendes Diagramm zeigt den Anteil der über 60jährigen an der Gesamteinwohnerzahl pro Bezirk. Dabei lässt sich erkennen, dass die absolute Zahl der Senioren in den Bezirken Geidorf, Lend und Jakomini besonders hoch ist.

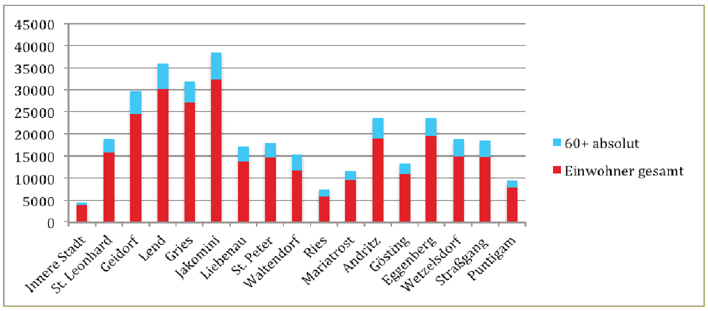

Abbildung 2: Anteil an Senioren an der Gesamteinwohnerzahl jedes Bezirkes (Quelle: Statistik Graz; eigene Darstellung)

2.3 Abgrenzung und allgemeine Beschreibung des Untersuchungsgebietes

Insgesamt betrachtet erweist sich das Fehlen ausreichend dichter und vor allem thematisch relevanter Primärdaten als besonders einflussnehmend auf die Methodik der vorliegenden Untersuchung. Dieser fast vollständige Mangel an als wichtig erachteten Geoinformationen erzwingt gleichsam eine Totalerhebung, die allerdings angesichts der Größe des eigentlich interessierenden Gebietes im gegebenen Rahmen als illusorisch angesehen werden muss. Als naheliegende Lösung bietet sich daher die einstweilige Fokussierung auf ein Teilgebiet der Stadt an, das sowohl repräsentativ ist als auch über ausreichende thematische Relevanz verfügt. Unter diesen Bedingungen fiel die Wahl auf den dritten Stadtbezirk bzw. – für die Detailstudien – auf einzelne Sprengel davon, die im Übrigen nach denselben Kriterien ausgewählt wurden.

Räumlich gesehen liegt der Bezirk relativ zentral, nördlich und nordöstlich der Innenstadt. Diese historischen Vorortareale jenseits des Glacis gelten durch den Standort der Karl-Franzens-Universität und der Universitätsklinik (LKH-Ost) auch als „Universitäts-Quartier“ von Graz. Durch die Ansammlung vieler Unterkünfte und anderer Studierenden-bezogenen Einrichtungen, bzw. durch die Nähe zur Innenstadt ist Geidorf einerseits ein relativ „junger“ Bezirk mit dichter Besiedlung; die Bausubstanz besteht hauptsächlich aus einem kompakten Altbaugürtel entlang des Stadtparks, der nach außen hin in Geschoßzahl und Dichte abnimmt, andererseits handelt es sich jedoch – besonders weiter stadtauswärts - auch um ein relativ ruhiges, städtisches Wohnviertel mit Einfamilienhäusern ergänzt durch Villen. Die Grünflächen des Bereichs Rosenhain, gemeinsam mit dem Hilmteich und den Grünarealen des Universitätssportzentrums, zählen zu den besonders stark frequentierten Grünflächen der Grazer Bevölkerung. Der Bezirk ist durch die Straßenbahnlinien 1,4 und 5, sowie die Buslinien 30, 31, 41, 58/E, 62, 63, 81 und die Nachtlinien N1, N2 und N5 gut an das öffentliche Verkehrsnetz von Graz angebunden.

Der Seniorenanteil in Geidorf beträgt derzeit rund 22%, in den nächsten zwei Jahrzehnten kann im Bezirk jedoch mit einem relativ hohen Anstieg an älteren Menschen gerechnet werden. Er ist daher repäsentativ, sowohl für die Verteilung und Struktur, als auch für das Umfeld der Seniorinnen und Senioren und ermöglicht die Konstruktion einer „Topographie des Alters“. Geidorf besitzt insgesamt 28 Zählsprengel, die auf die absolute Zahl bezüglich Personen ab 60 Jahren analysiert wurden. Die weiterführenden Detailstudien (Infrastruktur und Accessibility) beziehen sich auf ein Sub-Sample aus 11 (von 28) Zählsprengeln des Bezirks für die zusätzliche Daten (seniorinnen- und seniorenrelevante Infrastruktureinrichtungen) kartiert und erhoben wurden, welche die höchsten Anteile an Seniorinnen und Senioren im Bezirk Geidorf enthalten. Nachstehende Abbildung zeigt die Lage des gesamten Bezirkes Geidorf, sowie das Sub-Sample in orange.

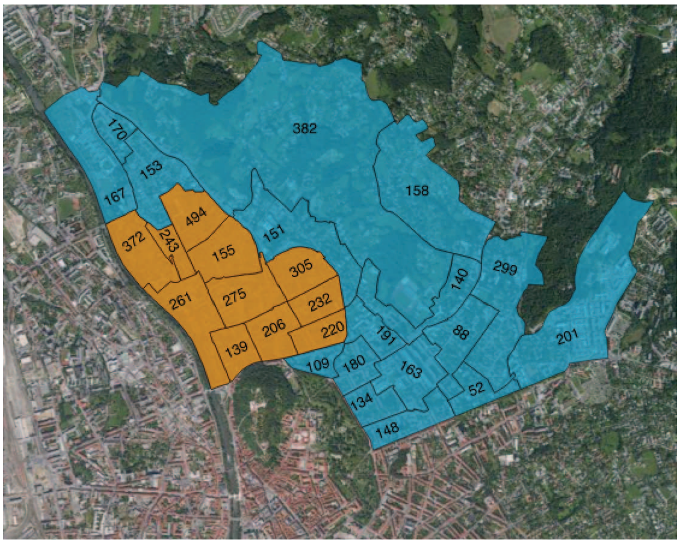

Abbildung 3: Lage des Untersuchungsgebietes und absolute Zahl der Senioren des jeweiligen Sprengels (Quelle: Geofabrik; eigene Darstellung)

3 DETAILSTUDIE

Um möglichst lange autonom und selbstständig leben zu können müssen bestimmte Bedingungen und Voraussetzungen, die bereits im vorherigen Kapitel näher beschrieben wurden, im Wohnumfeld gegeben

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sein, da mit zunehmendem Alter der Lebensmittelpunkt immer mehr in das nähere Wohnumfeld und die Wohnung selbst rückt. Das Untersuchungsgebiet umfasst auf Zählsprengel-Basis 11 Sprengel des Bezirkes Geidorf. Da die Infrastruktureinrichtungen des Gebietes im Feld kartiert wurden, wurde eine zusammenhängende Raumeinheit gewählt. Die Raumeinheit ergab sich durch die Gliederung aller Zählsprengel von Geidorf in fünf Klassen nach dem absoluten Seniorenanteil, bezogen auf den jeweiligen Zählsprengel. Die gewählte zusammenhängende Raumeinheit aus 11 Zählsprengeln, beinhaltet die höchsten vier Klassen, sowie jenen Zählsprengel mit der höchsten absoluten Zahl an Senioren und gibt daher einen repräsentativen Überblick von Geidorf.

ZSP-Nummer	Fläche in m²	Einwohner gesamt	Seniorenanteil absolut	Seniorenanteil relativ
056	71298,26	1.157	139	12,01%
094	101697,48	1.330	155	11,65%
055	73104,98	1.057	206	19,49%
054	140379,08	1.293	220	17,01%
091	73271,47	1.126	232	20,60%
100	97835,15	1.317	243	18,45%
110	139972,13	791	261	33,00%
090	56157,27	740	275	37,16%
092	108164,45	1.661	305	18,36%
111	187247,03	1.552	372	23,97%
101	141541,54	1.494	494	33,07%

Tabelle 1: Seniorenateil im jeweiligen Zählsprengel

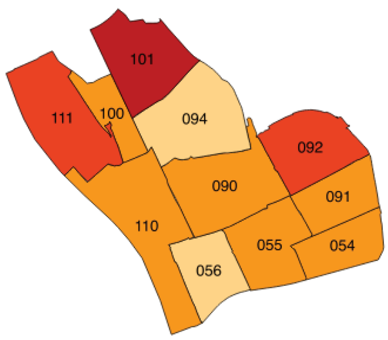

Abbildung 4: Darstellung der gewählten Zählsprengel

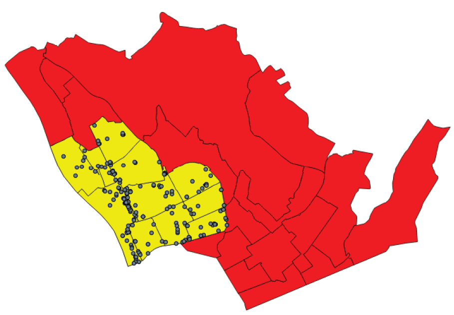

Abbildung 5: Darstellung der Infrastruktureinrichtungen im Untersuchungsgebiet (Quelle: Geofabrik, Open Street Map, Eigenerhebung; eigene Darstellung)

3.1 Infrastruktur im Untersuchungsgebiet (Eigenerhebung)

Es wurde bereits darauf hingewiesen, dass das aktuell verfügbare Datenmaterial im Hinblick auf das - zumindest mittelbare – Ziel der Untersuchung (i.e. eine detaillierte Beschreibung des status quo bzw. eine Analyse der Situation im gesamten Stadtgebiet von Graz) weder qualitativ noch quantitativ ausreicht. So zeigte sich bald, dass besonders im sensiblen Bereich der Infrastruktur herkömmliche Extrakte aus den sogenannten offenen Datenbeständen gravierende Lücken aufwiesen und daher eine wenn auch lokal begrenzte Vollerhebung unverzichtbar wurde. So wurden nicht vorhandene oder neu hinzugekommene

Einrichtungen kartiert, attributiert und anschließend als Punktlayer im GIS verspeichert. Wie bereits besprochen wurde daher ein Sub-Sample aus 11 (von 28) Zählsprengeln des Bezirks, dessen Raumeinheit eine Fäche von 1,19 km2 aufweist, näher analysiert. Zu den untersuchungsrelevanten Infrastruktureinrichtungen des Untersuchungsgebietes zählten dabei unter anderem: Medizinische Einrichtungen wie Apotheken und Ärzte, informelle Einrichtungen wie Postämter oder Banken, Lebensmittelgeschäfte, Cafés, Restaurants, Kirchen, Friedhöfe und Seniorenzentren. Abbildung 6 gibt einen Überblick über die Lage der Infrastruktureinrichtungen im Untersuchungsgebiet.

3.2 Grundlagen der Modellierung und Modellbildung

Prinzipiell wird bei der Modellierung der Tatsache Rechnung getragen, dass das Verständnis älterer Personen von Lebensqualität eng mit der Qualität der Wohnstätten – vornehmlich definiert über die Verfügbarkeit der benötigten Infrastruktur – geprägt wird. Dabei kommt diesem Aspekt der Persistenz im Sinne von „Tendenz zur Verbleib in einer vertraut gewordenen Umgebung“ relativ hohes Gewicht zu, was idealerweise in sogenannte „lifelong homes“ mündet, die durch eine Reihe von Charakteristiken definiert werden können (siehe Details dazu unter www.jrf.org.uk/housingandcare/lifetimehomes/table2.asp). Der Begriff verschleiert jedoch die Tatsache, dass „lebenslang“ in diesem Zusammenhang auch die Flexibilität dieser „lifetime homes“ impliziert, sich an die durch das menschliche Altern verursachten Veränderungen auch anpassen zu können und solcherart die Entwicklung von nachhaltigen Gemeinschaften zu gewährleisten; dabei steigt dieser Bedarf im selben Maße an in dem sich der Anteil der alternden Bevölkerung zu Ungunsten der jüngeren Einwohnern verschiebt oder aber durch die mit fortschreitendem Alter zunehmenden Erkrankungen. Wie bereits in den vorangehenden Abschnitten dargelegt, ist dieses Phänomen in vielen städtischen Kommunen zu beobachten, so auch in Graz und besonders im Bereich Geidorf bzw. dem engeren Untersuchungsgebiet der Studie, in dem die Seniorinnen und Senioren einen beachtlichen Teil der Einwohnerschaft und damit auch eine planerisch und politisch relevante Gruppe darstellen. Dabei sind insgesamt drei Themenkomplexe von Bedeutung: Zunächst interessiert die Antwort auf die Frage nach jenen Charakteristiken der Lebensumwelt, die diese für die Mitglieder der Zielgruppe attraktiv und lebenswert erscheinen lassen und die ihnen dadurch möglichst lange und in möglichst hohem Maße die Beibehaltung des gewohnten, weitestgehend selbstbestimmten Lebensstils ermöglichen. In weiterer Folge interessiert das Ausmaß in dem diese Charakteristiken gegenwärtig bereits realisiert sind bzw. wo und wie viele Mängel und Verbesserungsmöglichkeiten das bestehende Habitat aufweist. In einem letzten Schritt können die als relevanten erachteten Merkmale parametrisiert und in Modelle gegossen werden, um so später unterschiedlichste Entwicklungsperspektiven simulieren zu können. Besonders wesentlich für die Qualität dieses Modells und seiner Ergebnisse sind die Eigenschaften der Zielgruppe, die einerseits relativ einfach statistisch fassbar sein soll und zudem ein ausreichend hohes Maß an Mobilität aufweisen muss, um überhaupt mit ihrem urbanen Umfeld in nennenswertem Ausmaß in Interaktion treten zu können; hier bietet sich – so ohnehin keine Jahrgangsgruppen vorliegen - die Nutzung der 5 Jahres-Altersgruppen der österreichischen amtlichen Statistik an, mit denen sich unter anderem der Bereich von 60 bis 84 Lebensjahren problemlos abdecken lässt. Bezüglich des Mobilitätsverhalten dieser Gruppe unterstreichen zahlreiche einschlägige Studien die Bedeutung des fußläufigen und ÖPNV als bevorzugte Transportformen (zusammen 2/3 des Gesamtverkehrsaufkommens) der Senioren und identifizieren überdies Einkaufen (rund 43%), die gesundheitliche Versorgung (etwa 11%) und die Freizeitgestaltung und Kommunikation (rund 39%) als Hauptmotivationen für die täglichen Interaktionen mit der Umwelt. Vergleichbare internationale Studien liefern hier zwar ein differenzierteres insgesamt aber dennoch stimmiges Bild: Bei möglichen Mehrfachnennungen dominieren Einkaufen (100%), Arztbesuche (92%), Amtswege (80%), Kirchgänge (68%) und Spaziergänge ohne bestimmtes Ziel (68%) die Alltagsgestaltung der alten Menschen - im Durchschnitt werden dafür pro Tag zwischen 65 und 85 Minuten verbraucht. In - für die Analyse der Reichweite der Seniorinnen und Senioren bzw. für die daraus abzuleitenden Erreichbarkeitsverhältnisse interessanten Tageskilometern - ausgedrückt, ergibt sich dasselbe Bild: Die mittlere zurückgelegte Tagesentfernung liegt zwischen 23 und 11 Kilometern. Dabei soll in diesem Zusammenhang nicht unerwähnt bleiben, dass es sich dabei um Gesamtdistanzen handelt aus denen die zu Fuß zurückgelegte Strecke nicht abgeleitet werden kann. Aus Vergleichsstudien geht jedoch hervor, dass dieser Anteil am modal split zwischen 30% und 40% liegen dürfte. Dies entspräche einer Wegleistung von etwa 6 bis 7 Kilometern am Stück oder mehreren kürzeren Strecken. Vor diesem Hintergrund bestimmen körperliche und geistige Fitness bzw. gesundheitliche Beeinträchtigungen dabei nicht nur die Häufigkeit der

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täglichen Ausgänge und die dabei zurückgelegten Distanzen sondern auch die Fähigkeit, sich in der urbanen Umgebung zurecht finden zu können; und gerade letzteres ist zu einem wesentlichen Teil für das Wohlbefinden älterer Menschen in ihrer Lebenswelt mitverantwortlich. Als entscheidende Faktoren müssen in diesem Zusammenhang bestimmte Aspekte der körperlichen Leistungsfähigkeit (der physische Allgemeinzustand, die Beweglichkeit, allfällige Inkontinenz oder ähnliche Beschwerden, die mangelnde Fähigkeit zur angemessenen Reaktion auf optische oder akustische Reize) bzw. der mentalen Fitness (z.B. Demenz) angesprochen werden. Damit kommt – neben den Betroffenen selbst – auch dem lokalen Wegenetz als Medium für diese Aktivitäten und wichtigem Modellelement gesteigertes Interesse zu. Es gilt dabei, die bereits diskutierten Standardparameter „Entfernung“ bzw. „Wegzeit“ soweit zu modifizieren, dass es gelingt, damit das Verhalten der Senioren im oben dargestellten Sinn möglichst genau nachzubilden. Dies erfolgt prinzipiell auf zweierlei Weise, einerseits direkt durch die Einbeziehung zusätzlicher seniorenrelevanter Kriterien in die Attributierung des Netzwerkgraphen (Neigung des Geländes, Höhe der Bordsteinkanten, Schäden und Rauigkeit des Untergrunds, tatsächliche zurückzulegende Wegstrecken, Anzahl der Kreuzungen, Vorhandensein gesicherter Übergänge, Breite des Weges,…) selbst als auch indirekt durch Berücksichtigung ergänzender infrastruktureller Einrichtungen (Grünanlagen entlang des Weges, straßenbegleitende Baum-/Strauchvegetation, Straßenmobiliar, überdachte Unterstände, durchschnittliches Verkehrsaufkommen, Lärmbelästigung, konkurrierende Verkehrsteilnehmer, Hinweisschilder, Ausleuchtung des Raums, Offenheit des Geländes, Vorhandensein von leicht identifizierbaren „landmarks“, Verschmutzungsgrad, …). Tabelle 3 liefert eine Übersicht über die bisher berücksichtigten Modellparameter und ihre Merkmalsausprägungen.

Kategorie	Merkmal	Merkmalsausprägungen	Erläuterung	Wertigkeit
Environment	Begleitvegetation	keine Vorgärten Grünfläche (ungepflegt) Grünfläche (gepflegt) Blumenbeete Strauchhecke Bäume	Merkmal für den Erholungswert wobei gilt: Je mehr umso besser	Anteilswert an der Gesamt-länge des Weges
	Hütte/Unterstand	ja/nein	Öff. Wetterschutz, ggf. auch Halte-stellenhäuschen	Besatz 100m Weglänge
	Bänke/Strassenmobiliar	ja/nein	Öff. Einrichtungen zum zeitweiligen Ausruhen	Besatz 100m Weglänge
	Mistkübel	ja/nein	Öff. Einrichtungen zur Abfallvermeidung	Besatz 100m Weglänge
	Landmark	ja/nein	Spezifiziert Objekte mit hohem Wiederer-kennungswert	Vorhandensein entlang des Wegsegments
Fußgängernetzwerk	Nutzung	alleinig konkurrenzierend zusätzlich (mit Radweg)	-	-
	Nutzungsdichte	wenig mittel stark sehr stark	Geschätzte Passantenfrequenz	-
	Type	nur Fahrbahn Gehsteig Zebrastreifen ungeregelt Zebrastreifen geregelt	-	-
	Ausführung	inklusive Gestaltung (Bordsteinkante <5cm); Bordsteinkante 6-15cm Bordsteinkante >15cm	Höhe gemessen in Gehrichtung	Anzahl
	Breite	in cm	-	-
	Belag	glatt rau fehlerhaft unbefestigt	Beschreibt das Gefährdungspotential durch die Bodenbe-schaffenheit	Anteilswert an der Gesamtlänge bzw. Häufigkeit
	Funktion	Relevante Funktionen (ggf. auf unterschiedlichen Layern)	Anzahl	Besatz auf 100m Weglänge
	Beleuchtung	Kennwert für die Helligkeit des Strassenraumes; steht auch für die „Sicherheit“ des Areals	Lux	Logging des Wegnetzes
	Neigung	Grundlage zur Kalkulation der Neigungsverhältnisse bzw. des wahren Wegs	Abgeleitet aus dem 1m DGM von Graz	Grad/ Prozent

Tabelle 2: Modellparameter und ihre möglichen Ausprägungen

Grundsätzlich ist intendiert, mit Hilfe der hier aufgelisteten Merkmale ein möglichst vollständiges Szenario für eine Analyse der Präferrenzen und Interaktionsmuster der Seniorinnen und Senioren von Graz aufzubauen und es ist natürlich auch möglich, diese Parameter z.B. als Selektionskriterien in die Analysen einzubeziehen. Das weitgehende Fehlen einschlägiger lokaler/regionaler Untersuchungen macht es allerdings bis dato not-wendig, sich bei der Definition der Gewichtungsfaktoren auf eine der internationalen Arbeiten zum Thema zu verlassen; dabei muss jedoch akzeptiert werden, dass diese sich meist mit anderen Altersgruppen und Rahmenbedingungen in anderen Kulturkreisen auseinandersetzen.

Abschließend sei noch darauf verwiesen, dass die zur Verfügung stehenden (anonymisierten) Informationen über die räumliche Verteilung der Zielgruppe auf dieser Detailstufe schon irreführende Ergebnisse liefern; aus diesem Grund wurde hier die zählsprengelbasierte, unregelmäßige Bevölkerungsverortung durch die regelmäßige, rasterzellenbasierte Variante des regionalstatistischen Rasters der Statistik Austria (mit 250m * 250m Zellen) ersetzt. Dies bringt neben der zum Teil signifikanten Reduktion der Bezugsfläche auch eine realistischere Zuordnung der Bevölkerung zu potentiellen Wohnflächen was sich v.a. darin äußert, dass real unbewohnte Flächen deutlich weniger oft bzw. mit weniger Bevölkerung ausgestattet werden.

4 DIE ERREICHBARKEITSANALYSEN

Um die beschriebenen Probleme mit der Gewichtung der implementierten Faktoren zu umgehen wurden - als erste Näherung - die Ergebnisse ähnlich gelagerter Studien verwertet (WEINSTEIN AGRAWAL et. al., 2008); die Parameter beider Ansätze wurden abgeglichen und entsprechend der Häufigkeit der zu-stimmenden Antworten bei der Befragung gewichtet. Obwohl also das vorgestellte System den diskutierten Einschränkungen unterliegt, wird dadurch bereits eine große Zahl von verkehrsnetzbezogenen Analysen ermöglicht, deren umfassende Dokumentation aber den Umfang der vorliegenden Arbeit sprengen würde. Daher konzentrieren sich die hier präsentierten Ergebnisse auf einige wenige Erreichbarkeitsaspekte des Untersuchungsgebietes. Dabei folgt das Layout der Abbildungen 6, 7 und 8 einigen Grundprinzipien die die Orientierung bzw. Interpretation der Inhalte erleichtern sollen. Dargestellt wird immer derselbe Ausschnitt aus dem NE von Graz, das einen Überblick über die urbane Textur im Untersuchungsgebiet (markiert durch die rote Linie in der Bildmitte) ermöglicht; das Gebiet des nur teilweise sichbaren Bezirkes Geidorf wird von der gelben Linie eingeschlossen. Das überlagernde Gitter erfüllt zweierlei Funktion: Zum einen stellt die konstante Seitenlänge von 250m eine Art Maßstabsleiste dar, zum anderen symbolisieren die Zellen auch die Referenzflächen zur Lokalisierung der Seniorinnen und Senioren. Die jeweiligen Erreichbarkeitsverhältnisse werden durch die Kolorierung dokumentiert, wobei die rote Fläche die 500m-Zone und die blaue Fläche die 1000m-Zone symbolisiert. Die Grenzlinien der einzelnen Zonen wurden dabei entsprechend den Möglichkeiten der verwendeten Software geringfügig generalisiert.

Abbildung 6: Erreichbarkeit der Arztpraxen, dargestellt durch türkise Punkte (Quelle: ESRI, Stadt Graz, Eigenerhebung; eigene Darstellung)

Abb. 6 zeigt – stellvertretend für alle übrigen Bereiche des Sanitätswesens – die Erreichbarkeit der Arztpraxen im Untersuchungsgebiet selbst und in dessen Nahbereich. Dabei fällt zunächst die an sich verhältnismäßig ausgewogene Verteilung der Praxen auf. Dieses – wahrscheinlich der Nähe des Vorklinikums und besonderen baulichen Gegebenheiten geschuldete Phänomen zeigt sich mitverantwortlich dafür, dass weite Teile des Testgebietes als sehr gut erreichbar (unter 500m entfernt) eingestuft wurden und

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der größte Teil des übrigen Gebietes (etwa 15%) deutlich näher als 1000m liegt. Unter Einbeziehung der Verteilung der Seniorinnen und Senioren kann also davon ausgegangen werden, dass damit der stark überwiegende Teil der Zielgruppe als sehr gut versorgt eingestuft werden kann, zumal – unabhängig vom Bebauungsalter, -typ oder -dichte – die Lage der Arztpraxen auch mit den „Seniorinnen- und Seniorenkonzentrationen“ korreliert.

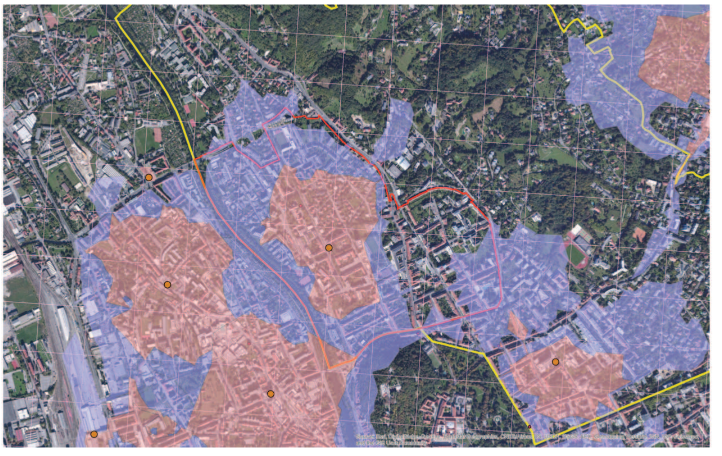

Abbildung 7: Erreichbarkeit von Bankfilialen, dargestellt durch braune Punkte (Quelle: ESRI, Stadt Graz, Eigenerhebung; eigene Darstellung)

Im Gegensatz zum vorigen Beispiel zeigt die Erreichbarkeit von Bankfilialen in Abb. 7 ein deutlich differenzierteres Bild, was zum einen an der geringeren Filialdichte liegt, zum anderen aber daran, dass hinsichtlich der zurückzulegenden Wege offensichtlich eine suboptimale Verteilung vorliegt, die gerade im Osten des Untersuchungsgebietes größere unversorgte Bereiche hinterlässt; erschwerend kommt hier noch hinzu, dass es sich bei den Lücken im Versorgungsnetz um Areale handelt, die durch eine hohe Zahl an alten Menschen gekennzeichnet sind; schätzungsweise sind hier knapp 900 Personen betroffen. Weniger dramatisch aber immerhin noch spürbar ist die Situation in den westlichen und nordwestlichen Bereichen des Testgebietes. Auch hier ist die Versorgung deutlich schlechter, kann aber durch die Bereitschaft größere Distanzen zu überwinden, kompensiert werden.

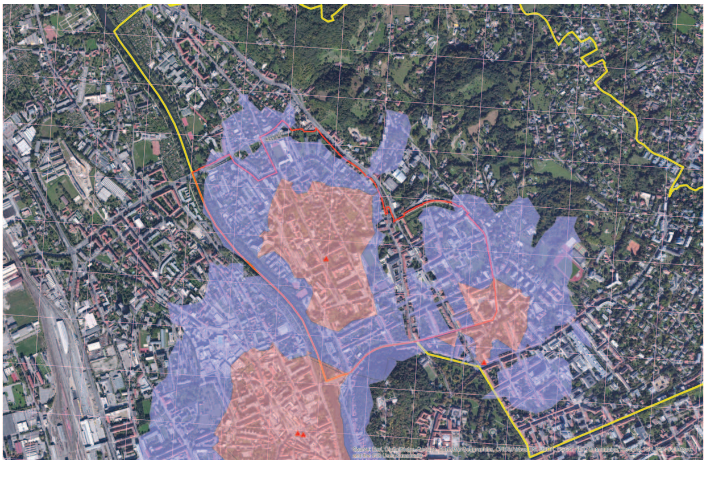

Abbildung 8: Erreichbarkeit von Märkten, dargestellt durch rote Dreiecke (Quelle: ESRI, Stadt Graz, Eigenerhebung; eigene Darstellung)

Die Ereichbarkei von Märkten (Abb. 8) wurde gewählt, da der Besuch der zahlreichen Märkte einerseits ein essentieller Aktivitätsbestandteil vieler Grazer Seniorinnen und Senioren ist und andererseits, da diese Marktstätten historisch bedingt, relativ weitläufig über das Stadtgebiet gestreut vorliegen. Es wäre naheliegend wenn sich bei dieser Konstellation (d.h. auch zahlenmäßig weniger Standorte als etwa Bankfilialen) deutliche Mängelgebiete oder „Versorgungslöcher“ nachweisen hätten lassen. Stattdessen manifestiert sich diese mangelnde Dichte lediglich in der Notwendigkeit des Zurücklegens weiterer Strecken unter 1000m; davon abgesehen erscheint das Untersuchungsgebiet beinahe lückenlos als zumindest durchschnittlich versorgt. Aus dem Blickwinkel dieser Studie wird die an sich erfreuliche Situation zudem noch dadurch verbessert, dass in den schlechter versorgten Gebieten auch nur verhältnismäßig wenige alte Menschen leben dürften.

5 ZUSAMMENFASSUNG UND AUSBLICK

Eine „kompakte Stadt der kurzen Wege“ mit großer Infrastruktur-Nahräumlichkeit wäre gerade für Senioren besonders wichtig, denn mit dem Alter nimmt die Distanzempfindlichkeit immer mehr zu. Die neuen Einzelhandelsstrukturen in Städten weisen veränderte Erreichbarkeiten auf, verlangen daher einen Anpassungsprozess, was eine Herausforderungen an die Sozialpolitik und Raumplanung darstellt.

Der Erhalt der Mobilität im eigenen Wohnumfeld ist nicht nur aus sozialer, subjektiver und gesundheitlicher Sicht wichtig für Senioren. Insgesamt unterstreichen die bisherigen Ergebnisse der vorliegenden Untersuchung in jedem Fall die Bedeutung und Planungsrelevanz des dargestellten umfassenden Zuganges. Trotzdem werden bei einzelnen Fragestellungen auch die Schwachstellen des aktuellen Konzeptes deutlich; so wird in diesem Kontext die Notwendigkeit zur Erarbeitung von Eichparametern offensichtlich, sei es wie vielfach praktiziert über eine repräsentative Befragung oder aber auf anderem Wege. Erst mit den daraus gewonnenen Erkenntnissen kann das Analysemodell optimal auf die Grazer Verhältnisse abgestimmt werden. Zudem sollte künftig – weil besonders relevant für die Interpretation der Ergebnisse – auch die Verortung der Seniorinnen und Senioren verbessert werden, um auch in weitläufigeren und weniger dicht besiedelten Gebieten sinnvolle Ergebnisse zu bringen. Nachdem aber nicht zu erwarten ist, dass die Anonymisierungsbestimmungen in nächster Zeit gelockert werden, kann dies nur über eine Verbesserung des Zuordnungsmodells erfolgen. Schlussendlich sollte im Sinne einer besseren Differenzierbarkeit der Ergebnisse unter Umständen auch eine Abkehr von der (literaturmäßig abgesicherten) Einteilung in 500m- und 1000m-Zonen überlegt werden. Obwohl die bisherigen Analysen durchwegs räumlich gut interpretierbare Resultate erbracht haben hat sich dennoch herausgestellt, dass die bisher angewandte Methode gerade engräumige Untersuchungsgebiete nur in zwei oder drei Bereiche zerlegt; dies könnte in weiterer Folge dazu führen, dass nach dem komplexen Datenmodell prinzipiell mögliche Unterscheidungen wieder verloren gingen.

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An Approach to Adapt the Paradigm of Integral Planning to Urban Development

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1 ABSTRACT

The paper presents results of an examination of planning processes and situations of urban development in Germany. The paradigm of Integral Planning is currently located in a few disciplines, e.g. in the context of energy efficient and sustainable building design, or in the field of organizational development. There has been an attempt to define the term of "Integral Planning" in a generic manner to use the concept across different levels of system boundaries and planning disciplines that were met in this context. Further, an attempt was made to distinguish several characteristics of urban development that can be used to configure an integral planning process more specifically according to the planning situation at hand.

The work is part of an accompanying research programme concerning the participating cities in the "Energy Efficient City Contest" (https://www.wettbewerb-energieeffiziente-stadt.de/), awarded by the German Federal Ministry of Education and Research. The contribution should lead to an improved insight in the paradigm of Integral Planning, and an improvement that breaks this approach down into a practical value in communal administration.

Keywords: Integral Planning, Methodology, Planning Method, Strategy, Urban Development

2 CONCEPTUALIZING A RANGE OF PLANNING APPROACHES

Currently the approach of Integral Planning is well known in the field of sustainable building design (e.g. Xia 2011). In Germany it is also increasingly claimed to use it in the topic of energy efficient urban development (cf. BMVBS 2011, DIFU 2011, STMUV 2011). The terms "integral", "integrative", "integrated" and "holistic" are often used interchangeably. But they could also be used to distinguish several options to adapt the approach in a more specific way to the different situations in urban development. This would make it easier to operationalize the approach regarding local constraints and usefulness.

The term "Integral Planning/Design" (lat. *integrare* = to restore, to complete) is used with different emphasis and meaning in several disciplines. In the field of sustainable building design, it initially became an approach to significantly improve the energy performance of buildings, corresponding to an inreased ecological awareness since the 1970s. Furthermore, additional requirements for todays' buildings led to an extention of "horizontal integration" (stakeholder and disciplines) and "vertical integration" (lifecycle).

Beyond its application in civil engineering and facility management, "integral" means in general a characteristic like "belonging to and constituting a whole" (Duden 2016, transl.). The term adresses a cross-linkage and interaction of elements as well as the emergence of qualities that do not exist on a basic level of systems' elements. From such a systemic view, like in the field of spatial and urban planning, and following a general approach of Integral Planning, the subject "city" is seen as a specific present mode of urbanized human life. Its physical manifestation is considered as a result of spatial dynamics and decisions in humans' daily actions. Changes and dynamics are ongoing aspects of cities' life and in the long term cities show no stability (cf. Portugali 2012). The process of integration of stakeholders and various aspects into early planning stages changes. Currently these changes in planning processes are even drawn up in normative guidelines (e.g. VDI 7000). These are necessary changes to become and to stay a "Smart City", too.

2.1 Nested Structure of Subjects of Planning

Energy efficient urban development includes some concurrent understandings of the possible subjects of planning that are contributed by various disciplines in this area. In the context of the German "Energy Efficient City Contest" a broad range of diciplines were involved, e.g. from building physics, utility engineering, energy economy to urban planning, sociology or political science. Hence, there is also a broad range of measures, that are discussed in the topic of energy efficient urban development. These vary for example from "first aid" measures without larger public expenditure to technical improvements in communal facilities, or from approaches increasing private expenditure for energy-efficient building refurbishments to improved multimodal transport systems (cf. Rexroth et al. 2016).

Figure 1 exemplarily illustrates some distinct system views, from a narrow notion of technological issues to a broader socio-spatial notion. The model shows a nested structure that reveals that different understandings do not necessarily exclude each other, but they rather refer in each case to a specific selection of interactions and aggregation in a chain of humans-environment-technology. Each selection adresses a different prior concern, exemplarily and in short: Selecting a technical object will create a focus on product-specific properties (e.g. performance of a heater, range of an electric car). Regarding a technical system brings the interaction of objects into focus (e.g. improvements in control and regulation technology). An eco-technical perspective concerns the interaction between a man-made environment and its ecological impact on nature (e.g. emissions, consumtion and regeneration of ressources). A socio-technical view adresses the behavior of humans in a technical environment (e.g. acceptance and usage of innovative products, private expenses on thermal insulation, individuals' ventilation behaviour). And finally, a socio-spatial perception includes questions about the humans' uses of space, their concurrence in a limited spatial capacity or changes in spatial structures (e.g. caused by social, economic or technical transformations). The often used term "system" to describe a city or urban area includes different subjects of planning that vary in quality corresponding to the prior concern: An artefact (physical or technical objects) or a cultural practice (specific mode of human life). Each of them leads to different sets of planning instruments, handling of participation and intended improvements.

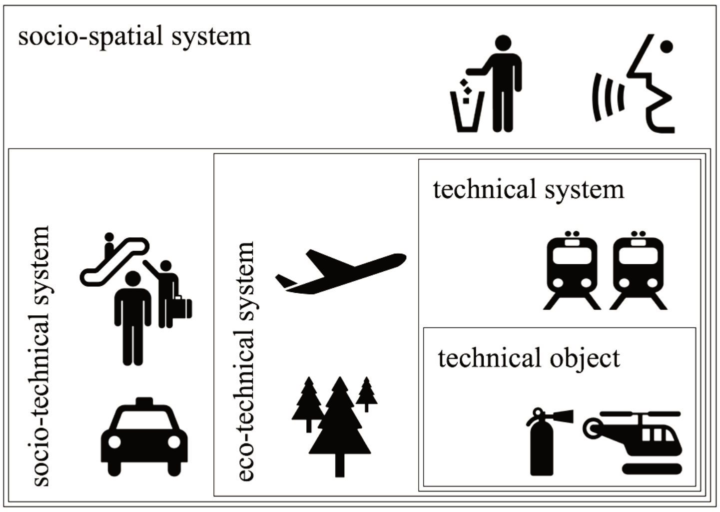

Figure 1: Nested Structure of exemplary Subjects of Planning.

2.2 Two Dimensions to distinguish Planning Approaches

In the field of organizational development, there are two dimensions to be considered for setting up a process structure in change management projects: the topical and the organizational dimension (cf. Schiersmann & Thiel 2014). The previously described understandings show also two comparable dimensions to distinguish planning approaches: (a) the range of issues to be considered, and (b) the range of participants or actors to be involved in the planning process.

Following a definition by Glasl who labeled organizational projects that include all topics and a whole organization as "Integral" (cf. Glasl 2000, p. 4), we define subsequently such an ideal openness in planning as "integral planning". A delimited approach that is narrowed to one issue and one actor can be opposed to this as "focused planning". To complete between these cases we define planning approaches that handle a broader range of issues as "integrated planning" and a broader range of actors as "integrative planning". Table 1 was derived from Glasl's classification (ib.) and modified to the topic of energy efficient urban development. It proposes a two dimensional classification scheme including nine arrays with distinct planning approaches. Examples of projects and actors were added to illustrade the concept.

The ideal concept of "Integral Planning" is defined as an unlimited openness in both directions, the direction of issues and the direction of actors. Reality will limit this to a practical extent, but it should be aimed to reduce a premature limitation as much as possible. On the other side, focused approaches have to be derived from more integral approaches to operationalize their implementation to the level of particular measures and responsible actors.

Range of Issues / Range of Actors	(A) One Primary Issue	(B) Several Equal Issues	(C) Open to all Issues
(1) One Primary Actor	**mono-topical / uni-sectoral** e.g. energetic modernization of communal buildings building department	**pluri-topical / uni-sectoral** e.g. local energy and climate concept environmental agency	**integrated / uni-sectoral** e.g. mayor's five-year plan regarding an integrated urban development mayor
(2) Several Communal and Local Actors	**mono-topical / multi-sectoral** e.g. industrial local heating supply to a municipal sports center building department, public utility, industrial enterprise	**pluri-topical / multi-sectoral** e.g. energy-efficient and functional urban refurbishment planning authority, energy consultants, redevelopment agency, homeowners	**integrated / multi-sectoral** e.g. urban development strategy with an included energy and climate concept city council, city administration, local initiative for climate protection
(3) Open to all Local and Interested Actors	**mono-topical / integrative** e.g. communalized power supply shared with a citizens' cooperative citizens, public utility, enterprises, (...)	**pluri-topical / integrative** e.g. urban redevelopment including energetic, functional and social transformation residents, shop owners, planning authority, housing companies, public utility, (...)	**integral** e.g. open strategy formation regarding spatial, social, (...) and energetic development citizens, city administration, public utility, local economy, public transport enterprices, NGOs, (...)

Table 1: Classification of Planning Approaches in the Area of Energy-Efficient Urban Development. (Source: Glasl 2000, modified)

City	Dimension A: „Attractivity“	Dimension B: „Value Added“
	Educationally Motivated Immigration [Persons per 1.000 residents]	Welfare Recipients [Percent of residents < 65 years]
Aachen	114	11,7
Delitzsch	-45	21,6
Duisburg	15	18,1
Düsseldorf	61	13,3
Essen	32	17,9
Göda (data of rural district)	-70	14,0
Hamburg	66	13,3
Landau	65	6,9
Leipzig	106	19,6
Magdeburg	92	19,8
München	110	6,6
Oldenburg	63	13,4
Rosenheim	56	6,9
Schneeberg	-64	17,9
Schwäbisch Gmünd	7	7,9
Stuttgart	80	8,2
Wolfhagen	-38	8,2

Table 2: Cities participating in the first stage of the Energy-Efficient City Contest (Data: Bertelsmann Stiftung)

3 SELECTION OF CASE EXAMPLES AND EXAMINATION OF CHALLENGES

3.1 Selection of Case Examples

Within the context of the Energy-Efficient City Contest, in 2008 about 70 German cities and communities applied for a funding of a customized energy-efficiency strategy including a first concept-stage and a subsequent implementation-stage (continuing). A body of experts selected 15 projects (concerning 17 cities) for the first stage. Among these, the cities of *Delitzsch, Essen, Magdeburg, Stuttgart and Wolfhagen* were

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awarded for their concepts and funded for the second stage – to implement their concepts on local level over a five years period.

For our work the field of 17 cities was examined to select cities with distinguishable challenges in development. A classification based on number of inhabitants or demographic aging was not appropriate for this purposes. So the cities were classified according to two dimensions: (a) The attractivity for young people as a requirement for regeneration – measured by educationally motivated (im)migration. And (b) the possibility for the residents to achieve a value added as a requirement to settle down and raise a family – measured in welfare recipients. The statistical data is based on the communal information system "Wegweiser Kommune" provided by the private operating foundation "Bertelsmann Stifung". To compensate single peaks, the data was averaged over a five years period (2007-2011). Table 2 contains an overview about the 17 cities.

To illustrade the gaps in dynamics between the cities, the data were normalized and in case of "Dimension B" subsequently inverted. The data were transferred to a graph that shows following results (cf. Figure 2):

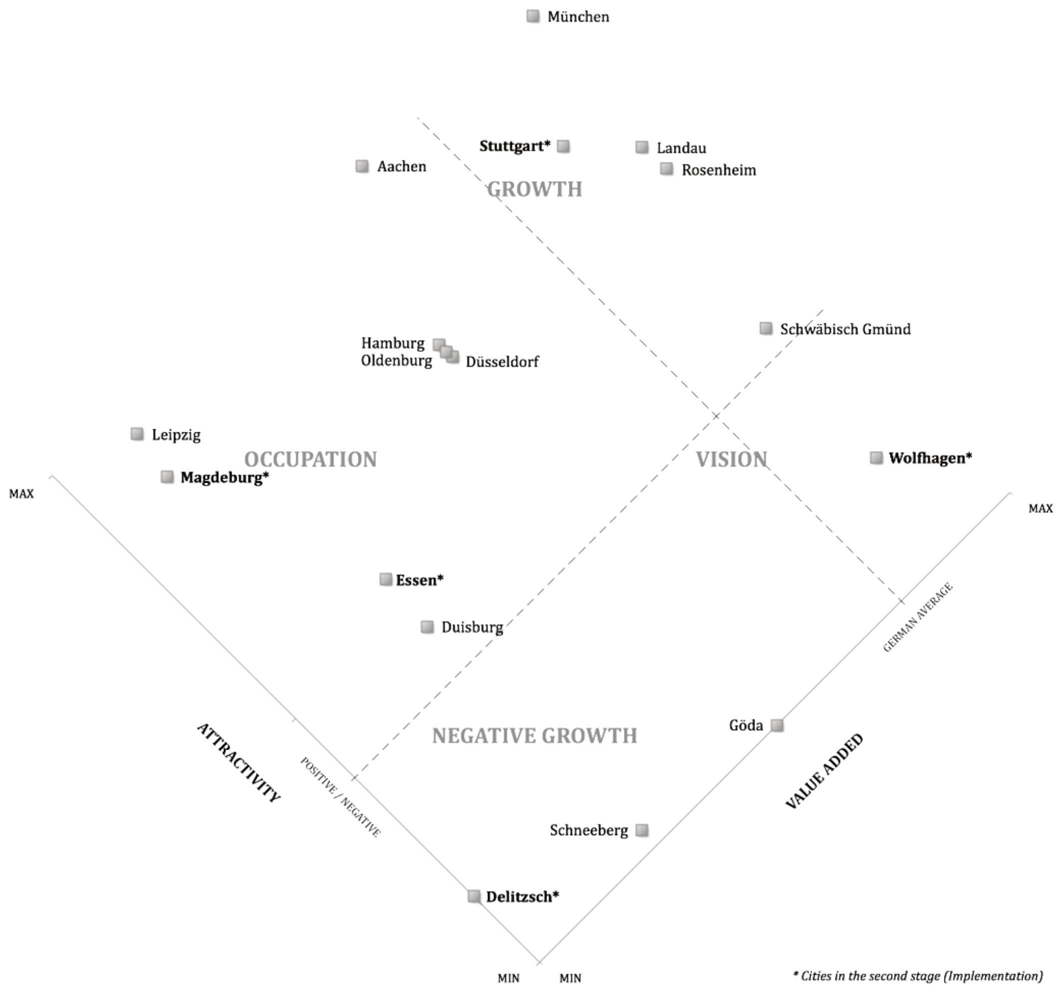

Figure 2: Cities participating in the Energy-Efficient City Contest and their Concerns in Urban Development

(The interpretations are just characteristics in relation to the other cities under examination and in the range of these values!) The distribution shows that most of the cities are concerned with a specific topic of spatial dynamics that influences their current development. We labeled the fields following as "constrained by …" cases. Five cities tend to a rather moderate development (closer to the center). The vertical height is interpreted as a level of global prosperity (population and economy). The horizontal position shows its sources: In the left section we find cities that are attractive for educational purposes (e.g. university or college town). In the right section we find cities that benefit from employed people (e.g. residential town). Prospering cities like Munich and Stuttgart show high values in both dimensions.

The cities of *Delitzsch, Magdeburg, Stuttgart and Wolfhagen* are clearly located at a specific challenge. So they are appropriate case examples for further reflections following behind. Additionally the city of *Essen* is concidered as a case example of moderate dynamic. All selected cities are part of the second stage of the contest (Implementation Stage) and thus a part of an ongoing accompanying research programme.

3.2 Examination of Challenges

The challenges of the cities were examinated by several studies in the context of the accompanying research programme. There were comparisons of statistical data (e.g. local budget, population, mobility, energy), spatial connection to regional centers, interviews of project staff, interviews of residents and descriptions of the appearance of the cites from an external view (cf. Rexroth & Both 2015, 2016). Some results that will be necessary for further reflections are resumed in short:

3.2.1 Constrained by Negative Growth: Case Example Delitzsch

Delitzsch is located in eastern Germany about 25 km to the north of Leipzig. For Delitzsch the challenge is to ensure basic public services and preserve the ability to act despite a stagnating or declining number of inhabitants. Important concerns will be economic promotion to maintain and locate businesses (production, services, retail). Further, the development of the nearby city of Leipzig will influence the development of Delitzsch and the region of northern Saxony. Due to the proximity to Leipzig a relevant concern will be the residential function. Delitzsch can play an important role as an attractive living environment for families and seniors – close to a capital city but for itself featured with attractive and high quality urban spaces and parks in a middle-sized scale. But a limited local budget needs the critical anticipation of the regional development and its “main force” Leipzig in relation to all local public investments (cf. Rexroth & Both 2015, 2016).

3.2.2 Constrained by Limited Occupation: Case Example Magdeburg

Magdeburg is the state capital of Saxony-Anhalt and located in eastern Germany between Hannover and Berlin. As in other industrial cities in former East Germany, after the German reunification in Magdeburg a large number of residents emigrated to prospering regions in former West Germany. Today these negative dynamics seem to be overcome. In relation to the other case examples Magdeburg shows the highest number of educationally motivated immigration of young people, which means a high potential for the city. What lacks is the “cohesion” to make these people settle down beyond their graduations. So the dominating concerns are the economic promotion followed by marketing efforts to increase the visability as a state capital and as an important German waterway intersection (ib.).

3.2.3 Constrained by Growth: Case Example Stuttgart

Stuttgart is the state capital of Baden-Württemberg and urban center of a densely populated and prospering region in southern Germany. Unlike the other case examples, Stuttgart faces challenges to control and channel a process of growing in the context of limited spatial capacity. The current dynamics lead for example to gentrification, segregation, rising costs of living or rising land and real estate prices. Amplified by its particular topography of landscape and micro climate (location in a basin), increasing automobile traffic and other pollutions significantly harm the air quality. Hence, there is an immediate demand for private and public investment into a energy-efficient, zero-emission and high-performance infrastructure (ib.).

3.2.4 Constrained by Lack of Vision: Case Example Wolfhagen

Wolfhagen is a medievally founded town about 30 km to the east of Kassel, the regional center in northern Hesse. Like for other small and middle sized towns in rural areas, one challenge is to preserve attractivity for young people and young families. Due to a close connection to a former German military base, the recent closure of these barracks generated a big conversion area and a functional recession to be handled by the administration as well as by the population. The connections to Kassel and regional labor markets enables the residents to live a relatively affluent life. But for younger, not motorized or elderly mobility-impaired people the access to public services, retail, education or cultural events means a challenge. The people of Wolfhagen are faced with an overarching task to commonly develop a long term vision of what will distinguish and characterize the town itself, the use of timber-framed buildings in the center district, and the foundations of the local economy. Physically there is a need for decentralized and modular infrastructure, that can operate in an efficient way regardless of population dynamics, vacancy or direct local energy demand (ib.).

3.2.5 Constrained by Moderate Dynamics: Case Example Essen

Essen is located in western Germany in the center of the Ruhr Valley – currently the largest agglomeration in Germany and historically the main area in the development of the German steel and coal industry. During the 19th century the population grew up about 26 times as a result of industrialisation. The neighborhood of many large cities is a particular characteristic of the Ruhr Valley that effects local efforts. Today the Ruhr Valley cities, as former industrial cities, share the same challenges and an ongoing post-industrial transformation process that dates back more than 50 years. As Delitzsch and Magdeburg, for Essen the challenge is to ensure basic public services. The utilization of local budget and economic promotion is a main concern for local development. But in contrast to the case example Stuttgart, the economic structure of Essen is characterized by large (former industrial, now technology & services) enterprises and less small or medium-sized businesses. The regional networking and the coordination of public investments and infrastructure is an important concern. The bugetary situation needs to generate intercommunal synergies and to avoid individual investments that generate countervailing effects for neighboring cities and vice versa. Also it is necessary to capture private and commercial engagement (ib.).

4 GENERALIZATION OF APPROPRIATE PLANNING APPROACHES

The selection of a planning approach that is appropriate for the situation and practical circumstances is regarded as crutial for the success of a project. To claim the approach of Integral Planning in a dogmatic way without taking into account the specific local needs is regarded as a contradiction in itself. The case examples show some starting points to generalize relations between the characteristics of the dynamic and the appropriate planning approach as a "gradual configuration" of Integral Planning. So the specific configuration is seen as a necessary operationalization in a general and subordinated setting of an "integral awareness".

A *"Constrained by Negative Growth"* case forces a city, like the example of Delitzsch, to subordinate all public measures to the consolidation of the local budget. Therefore measures are preferred to save energy and operating costs in municipal real estate and facilities. Furthermore inevitable public investments should generate significant positive effects for the local economy and consider the local effects out of regional dynamics. The strategic objectives are focused clearly. Therefore an appropriate planning approach needs to be open and flexible to opportunities, but handle the process in an efficient and quick way like approach B-1 or B-2 (Table 1).

A *"Constrained by Limited Occupation"* case forces a city, like the example of Magdeburg, to make high efforts to economic promotion. Especially cooperations between local institutions in the sectors education and research, regional businesses and entrepreneurs can offer perspectives for the students that arrive every year at the town. The strategic objectives are also focused clearly, even more than in the previous case. Therefore an appropriate planning approach is focused on specific topics, but open and flexible to the range of actors and efficient and quick in the process handling – an approach like A-2 or B-2 (Table 1).

A *"Constrained by Growth"* case forces a city, like the example of Stuttgart, to handle the dynamics in a way that the quality of living is preserved and living in city is still affordable for the inhabitants. There are high demands to the systemic and interdisciplinary thinking. An appropriate planning approach is open to all issues that have to be considered. However, there is a needs for specific expertise and efficient process handling, which suggests a selection of actors – an approach like C-1 or C-2 (Table 1).

A *"Constrained by Lack of Vision"* case forces a town, like the example of Wolfhagen, to a realingnment in many scopes. This realignment has to be founded on a broad commitment by the whole community and needs efforts in communication and transparency. Many concerns and routines from "golden days" are obsolete, which causes a need for new and individual approaches in public administration. An appropriate planning approach is open from the beginning to all topics and actors. In the range of case examples it is nearly an ideal case of "Integral Planning" – an approach like C-3 (Table 1).

A *"Constrained by Moderate Dynamic"* case forces a city, like the example of Essen, to focus on local budget discipline, capture opportunities in the field of private and economic engagement, and encourage regional networking. Due to this an appropriate approach is focused on urgent topics and on networking efforts, thereby open to a range of actors. These are approaches like the arrays A-3 or B-3 (Table 1).

5 MATCHING CHALLENGES AND PLANNING APPROACHES

To combine and illustrate the previous reflections we overlayed the characteristics of the theoretical defined planning approaches with the generalized challenges found in the case examples (cf. Figure 3):

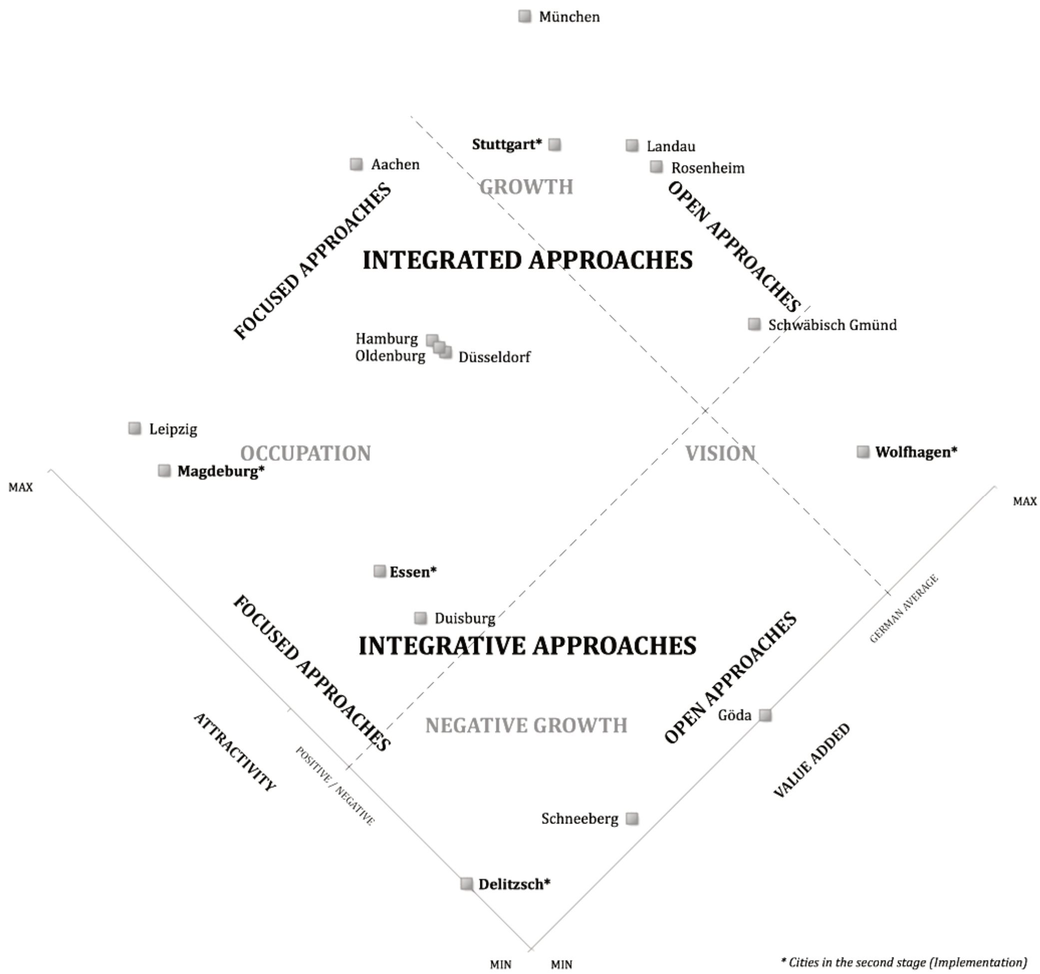

Figure 3: The Field of Integral Planning Approaches regarding different Dynamics

In direction of the vertical distribution, the dynamic of growth (top) requires an efficient use of limited spatial capacity, what means a sophisticated coordination for example of infrastructure, density, quality of build and green spaces, and cost of living. Integrated approaches will take a broad range of topics into account. In contrast, the dynamic of stagnation or negative growth (down) effects public budgets and services, what means losses in many parts of the former level of living. Inevitable changes and necessary measures have to be based on a common awareness by the local actors. Integrative approaches aim for an openness from the beginning and try to include private engagement.

In direction of the horizontal distribution, a vision (right) that is necessary for a realignment needs an open minded process in many ways. In the foresight it cannot be excluded that initially unimposing ideas make an important contribution to the further development. Open approaches concerning the range of issues and actors are necessary. In contrast, a limited occupation (left) forces to focus all efforts to generate a basis of existance for businesses and inhabitants in an accessible distance. Focused approaches are an appropriate way.

6 CONCLUSION

The model points to a field (middle right section) where the ideal of an Integral Planning really makes sense for local administrations, based on the general dynamic and independent from individual or politcal preferences. Further the model also points to fields where related but more limited or focused configurations of planning approaches are appropriate to the respective dynamic situation. But these suggestion should

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rather be understood in a heuristic manner, because it bases on a relative valuation of dynamic characteristics. The common local traditions, experiences and interests have also to be considered.

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Behaviour Analysis of Interdependent Critical Infrastructure Components upon Failure

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1 ABSTRACT

Urban life increasingly depends on intact critical infrastructures (CIs). For this reason, protecting critical infrastructure systems from natural disasters and man-made hazards has become an important topic in urban development research in recent years as a prerequisite for building and optimizing smart cities. To increase efficiency, the connections between CIs have been strengthened increasingly, resulting in highly interdependent large-scale infrastructure systems that are vulnerable to cascading failures. Hence, studying the cascading and feedback effects caused by the failure of a CI component in a given system can help strengthen this system. Understanding the response of the system in the event of a disaster can lead to better disaster management and better planning of critical infrastructures in the future. The population heavily depends on water, electricity, and the transportation network. These three components also depend on each other to function individually. This complex nature of interdependencies must be studied in order to understand the effects induced in one system due to the failure of another.

The three systems (water, transport, and electricity) and their interdependencies can be modeled using graph theory. Water, transport, and electricity networks can be further broken down into smaller components. For example, the water network comprises water treatment plants, water storage tanks, pumping stations, sewage treatment, etc. interdependency factors into the model when, for instance, a pumping station depends on electricity. Graph theory can be used to depict the pairwise relationship between the individual components. Each node in the graph represents a critical infrastructure and the edges between these critical infrastructures represent their dependency. The modeled graph is a multigraph (inter-network dependency) and multidirectional (mutual dependence of two or more components). The idea behind building this model is to simulate the response of the interdependent systems upon failure. Building a simulation tool with an underlying interdependency graph model can not only help in understanding the failure response, but can also help in building a robust system for preserving the infrastructures. The data obtained from the simulation results will contribute to a better emergency response in the event of a disaster.

The failure response of a system depends largely on the failed component. Hence, three cases are considered to simulate and identify the state of the system upon failure of a component: The failed component can be a node with maximum outward dependencies, a node with maximum inward dependencies, or a random failure of a component. If a component has the maximum number of outward edges, the simulation tool will help visualize the cascading effects, whereas a system with the maximum number of incoming edges will contribute to the understanding of the feedback response as the outward nodes are not affected immediately. Another goal of CI failure analysis is to develop an algorithm for the partial restoration of specific critical services when a CI is not working at full capacity. The selection of critical infrastructure components for restoration is based on the number of people being affected.

Keywords: Critical Infrastructure, Emergency Response, Graph Theory, Smart City, System Failure

2 INTRODUCTION

Maintaining essential public services such as access to mobility, electricity, and water is directly connected to the intact function of the necessary CIs. CIs are technologically complex systems with numerous intersectoral interdependencies. Damaging events within an infrastructure system or sector can lead to failures cascading onto connected systems and sectors. This causes hard-to-predict damage propagation which endangers the population's security of supply. We have therefore developed a framework of systemic and intersectoral dependencies between linked infrastructures for the sectors water, transport, and power supply. This framework combines input-output modeling with graph theory techniques to simulate cascading failures, to support policy makers and infrastructure operators, and to make large-scale systems more resilient towards natural, technological, and man-made disasters.

Our framework is a prototype that can be expanded by additional CI sectors. The definition of critical infrastructure sectors is slightly different for different countries, but most lists of critical systems include telecommunications, electric power systems, natural gas and oil, banking and finance, transportation, water supply systems, government services, and emergency services [OUANG 2014]. In an ideal model, all sectors should be depicted, but due to the high connectivity of each sector, the complexity of the model rises fast with every added infrastructure component, which is why the presented framework is limited to three sectors.

So far, several techniques for modeling and simulating interdependent CI networks exist that EUSGELD ET AL. grouped into eight categories [EUSGELD ET AL. 2008]: agent-based modeling, system dynamics, hybrid system modeling, critical path method, high-level architecture and petri nets. OUANG proposed a different subdivision in a more recent publication and divides existing modeling and simulation techniques into empirical approaches, agent-based approaches, economic-theory-based approaches, network-based approaches, and other approaches [OUANG 2014].

The model approaches differ both in their requirements regarding the accuracy of the data and in the scale at which the networks and cascading failures are depicted. We decided on a network-based approach since acquiring usable data to validate the model posed a significant problem during the development of the model, as is described in more detail below. The model approach was therefore chosen for its great intrinsic validity, as is common for graph models depicting networks. The network topologies which constitute the basis are known in detail and can be reconstructed without access to confidential data. Graph-based models furthermore come with the advantage that they can simply depict complex systems at a large scale through a multigraph. The largely hierarchical structure of infrastructure systems which produce their output centrally and then supply their product to local consumers via a wide distribution network can be depicted accurately through directed acyclic graphs which are connected at intersectorally dependent nodes. In addition, a software-based simulation of the “system of systems” of critical infrastructure sectors can be realized as a multigraph at much lower memory capacity and computing time than with more data-intensive solutions such as agent-based models. Models explained in the following sections were researched, simulated and analyzed in cooperation with Siemens AG. We thank them for the resourceful support they offered in taking this work forward.”

3 GRAPH-BASED MODELING OF CASCADING FAILURES

According to a widespread definition by RINALDI, CIs are highly connected in multiple ways that can be classified as physical, cyber, geographic, and logical interdependencies [RINALDI 2001]. Physical interdependencies describe the dependency of one infrastructure on the material outputs of other infrastructures. Cyber-interdependencies occur whenever one infrastructure depends on information from another infrastructure. Interdependencies on information technology exist in all computer-aided infrastructures. Geographic interdependencies are created by the physical proximity of several infrastructures to one another, for example two transport infrastructures overlapping, such as a railway bridge and a road. Damage to the railway bridge may lead to road closure, which would cancel the redundancy of the two physically close systems even though they do not depend on one another physically or in terms of information technology. Logical interdependencies describe interdependencies of mechanisms other than physical, cyber, or geographic, such as dependencies caused by political or financial circumstances.

ZIMMERMANN proposes a different approach and groups interdependencies into the categories functional and spatial. Functional interdependencies occur where the operation of one infrastructure is necessary for the operation of the dependent infrastructure, while spatial interdependencies refer to the proximity between infrastructures [ZIMMERMANN 2001]. We refer to this definition as we see physical, cyber-, and logical interdependencies as three different types of functional interdependencies that can be modeled the same way, while geographical and spatial interdependencies are synonymous and appear fundamentally different in our framework.

Analyzing the fragility of interdependent networks is extremely relevant when it comes to planning resilient infrastructures. One fundamental characteristic of interdependent networks is cross-system damage propagation. Concerning this issue, BULDYREV ET AL. studied abstract systems. The main result of their research was the analytical proof that broad-scale degree distributions that confer resilience in individual networks increase the vulnerability of interdependent networks to random failures [BULDYREV ET AL. 2010].

The issue of fragile infrastructure systems was already covered in 2003 in FIKSEL's study. The author focuses on planning inherent resilience in the system design, which is achieved through diversity, efficiency, adaptivity and cohesion [FIKSEL 2003].

In 2006, HOLMGREN suggested using graph theory to model large infrastructure networks. However, he limited the application of graph theory to modeling power supply, the structure of which is strictly hierarchical [HOLMGREN 2006]. The researchers SVENDSEN and WOLTHUSEN modeled an interdependent system using graph-theoretical methods in 2007. Their approach is suitable for assessing the stability of a municipal supply system quantitatively. By removing edges from a multigraph, system failures at all supply levels can be simulated, allowing users to estimate the damages caused by component failures. Since then, graph-theoretical models have continuously been adapted and developed further. In 2015, CHOPRA AND KHANNA published a model to predict disruptions in CI for the economy of the USA [CHOPRA AND KHANNA 2015]. GIORGIO AND LIBERATI developed a bayesian network-based approach as a continuation of the basic graph-theoretical model [GIORGIO AND LIBERATI 2011, GIORGIO AND LIBERATI 2012].

Interdependency graph models depict infrastructure components as directed multigraphs which can be expanded by additional functions to define the relation between the components [SVENDSEN AND WOLTHUSEN 2007]. Each of the components is represented as a node and produces one output each, for which it requires the input of another component. If a component is unable to create the required input itself, it depends on the higher-ranking, input-providing component. This dependency is depicted as an edge. If the input-giving component fails, this causes a failure or impediment of all successive dependent components, which is modeled by removing the edge that failed initially and all successive dependent edges.

Depending on the damage event, a single edge can be removed (e.g. because of an isolated terrorist attack), or a geographic area can be defined in which all output fails (e.g. due to floods or fires). One way to stop the cascading failures are buffers, i.e. local utilities such as standby generators, or local utilities working independently, e.g. water treatment plans generating energy from sewage. In addition, damage propagation during a component failure can be prevented. In order to do so, redundant connections to other components can be set up, as is the case with the n-1 rule in power transmission.

Inputs and outputs can be services as well as physical products. Each output constitutes the input for at least one other component of the system and must be assigned as the input of a geographic location accordingly. When a component is supplied with all its required inputs, it operates normally. If one of the supplying components fails, which can be modelled by removing an edge, the component now enters an irregular mode of operation, which includes both limited operation and failure. Outputs are provided for geographically defined supply areas. The number of people that live or work in each supply area and are affected by a cascading failure determines the criticality of the system.

A general weakness of our model, as well as of all existing infrastructure-interdependency-modeling approaches, is that validation is difficult, which is the result of a lack of data available. Three types of data are required in order to develop and validate a framework for the depiction of cross-sector infrastructure interdependencies and the resulting damage propagation in the event of a failure:

- Geo-referenced data to depict the position of all infrastructure components to be covered
- Data about the capacities each infrastructure has, including existing buffers and redundancies that exist in the system
- Data recorded during disasters depicting the actual spread of damages

Geo-referenced data and infrastructure capacity data for the depiction of local technical infrastructure systems is recorded by operators and municipalities, but is highly confidential. Non-confidential geo data such as the position of buildings is available from the municipalities, but often at high costs. The third data type required for infrastructure system modeling, data on the effects of real disasters, is difficult to generate since electronic systems recording such data may be affected by the failure themselves, scientific data collection is a low priority in the event of disasters, and conducting experiments on urban infrastructure systems essential to supply is impossible [SIMPSON ET AL. 2010].

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4 TOPOLOGY OF THE ELECTRIC POWERSUPPLY NETWORK

To explain our framework in detail, we have chosen an exemplary part of the electricity supply network topology that is linked with parts of the transport sector and industrial facilities, as shown in Figure 1. The model has been kept abstract in order to illustrate the dependencies and lay a framework for further analysis.

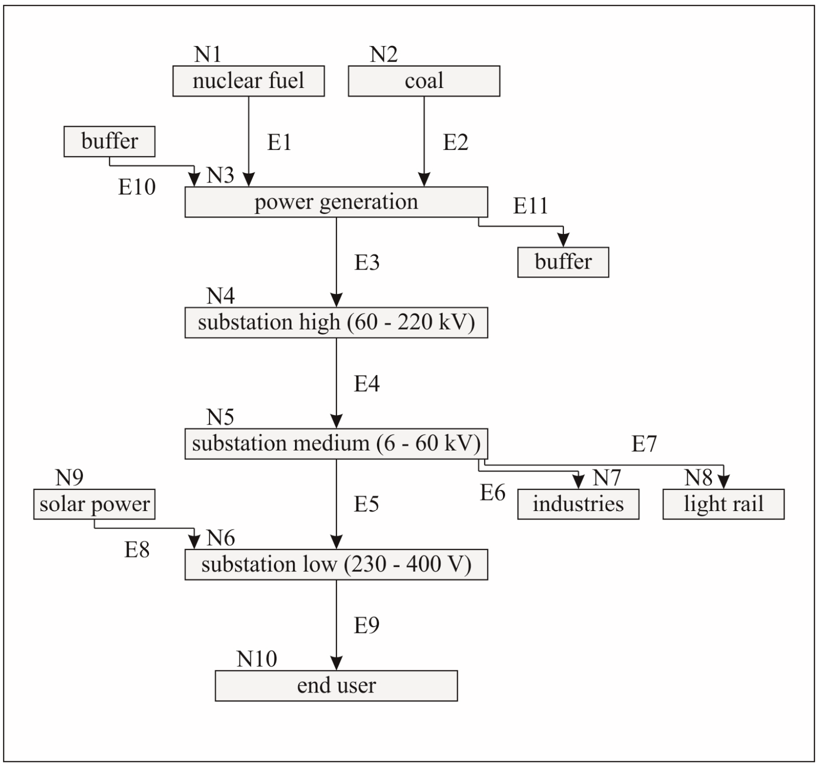

Figure 1: Illustration of electric power supply network using graph model (Source: Author's own)

Complex models can be built further for a comprehensive analysis. As the model is hiearchical, nuclear fuel and coal sit on top of the graph model because of their major contribution to the electric power generation in Germany [GRAUS AND WORRELL 2009]. Electricity generated from coal or nuclear fuel, is sent to the substations for stepping down the voltage for various purposes.

Although the fuels consumed for power generation is not limited only to nuclear and coal, to keep the model simple and understandable we have neglected the remaining fuel sources. Buffers in the graph model increase the resilience of the system in times of emergency. The edge connecting the buffer unit and power generation unit is bidirectional. The bi-directional nature of the buffer is owed to the fact that the buffer is utilized for power generation during emergencies and subsequently restored back when the power generation unit is working to its full capacity. The high-voltage lines are stepped down at subsequent substations for power distribution. For example, substations which handle high voltage (60 kV to 220 kV) distribute power to large-scale industries and to medium voltage substations. Medium-voltage substations handle voltage between 6 kV to 60 kV. They distribute electricity to medium-scale industries, light rail transit systems and to regional low-voltage substations. Low-voltage substations (230 V to 400 V) are partly also fed by solar power generation units. Solar power is fed to the low-voltage substations which consequently feed the end users. End users comprise public facilities, commercial enterprises, private households, etc. This completes the description of our abstract model representing electrical power supply network. However, it is important to note that the network described above is only a small part of the complete multi-graph model. The complete multi-graph model describing the network topologies of electricity, transport and water networks is a lot more complex. For the graph model described we developed three algorithms to simulate cascading failures that will be discussed in the following sub sections.

4.1 Discrete simulation of disruptions

For a complex infrastructure system with several interdependencies, initially it is important to understand the ramifications. Every interdependent system has few nodes which are majorly responsible for the smooth functioning of the system. SHUAI ET AL. and HAVLIN AND KENETT suggested methods for analysis of complex interdependent systems from a network analysis perspective [SHUAI ET AL. 2015, HAVLIN AND KENETT 2015]. While SHUAI ET AL. suggested generalized model for understaning the cascading effects with changing network topology, degree of nodes and number of nodes, Havlin and Kenett 2015 focused on the application of the model suggested by Shuai et al. in economic sector. The insight gained from these methods is to identify the size of largest functioning interdependent cluster with changing influential parameters (network topology, degree of nodes, and number of nodes) upon failure of a fraction of nodes in the model. Cluster is defined as the formation of independent interdependent system upon fragmentation of network due to failure. The information obtained from the analysis can be used to model the system based on network theory, such that even upon disruption, large part of the network is still functional. But our approach is not based on redesigning the existing network topology but making it robust by identifying the nodes which carry maximum significance for the uninterrupted running of the major part of our model. This in turn can be used to minimize the number of people affected due to cascading failure. As a simple example, failure or disruption of a power generation unit would affect all the dependent nodes lying in the same sector as well as the transport sector which would not be the case upon failure of a low-voltage substation. Hence, to discern and distinguish between the nodes of our complex interdependent model we work with a discrete status model. In the discrete model every node has discrete state of operation, either “Running” or “Failed”. In the graph model every node has an attribute describing its running status and name. Initially the running statuses of all the nodes are marked as “Running”.

The graph model can be read by the program using GraphML file format. The GraphML parser reads the edges, nodes, and their attributes, which can be used for further computation and analysis. The direction of an edge is always from head node to tail node as the former is higher in the hierarchical model than the later. The program starts by looping over the edges of the graph model. Attributes of the current edge, its head node and tail node are stored. If the status attribute of the head node is equal to “Failed” then the attribute of the tail node is changed to “Failed”. The program comes to an end with the last edge of the graph model. As explained, the rationale behind this approach is to find the critical nodes in the system. Failure criteria such as failure of random node, failure of node with maximum-minimum outgoing edges, or failure of maximum-minimum incoming edges can be selected for the failure of the head node. Vulnerability of an infrastructure component can be determined and studied in multiple ways, as has been suggested in several papers [EINARSSON AND RAUSAND 1998, GEORGE AND DOUGLAS 2005]. EINARSSON AND RAUSAND defined vulnerability of the industrial system as the ability to endure threats and survive accidental events that originate from within and outside the system boundaries. GEORGE AND DOUGLAS proposed a methodology for ranking the infrastructure components based on performance index, which is the sum of the weights of individual performance measures (PM) multiplied by the disutilities of each component for that particular PM. Methodology proposed by EINARSSON AND RAUSAND is theoretical and can be applied only to industrial systems, whereas GEORGE AND DOUGLAS’s approach is based on weight and disutility of performance measures through deliberation in workshops. The approach we chose for the graph model analysis is closer to what has been described by JÖNSSON, JOHANSSON AND JOHANSSON [JÖNSSON, JOHANSSON AND JOHANSSON 2008]. JÖNSSON, JOHANSSON AND JOHANSSON defined criticality or vulnerability of an infrastructure as the magnitude to which the complete interdependent model will be affected upon failure. They focussed more on the affect of failure sets rather than individual component failures. We divide the total number of nodes (NF_i) affected by the failure of a node (C_i) by the total number of nodes in the system (N), which indicates the criticality of the failed node. Here, i denotes the infrastructure node of interest spanning from *1* to N.

$$C_i = \frac{NF_i}{N}$$

The range of C_i is between $1/N$ and 1.0 as NF_i cannot be greater than N. An analysis can be performed for the whole model by iteratively choosing one node after the other. If the criticality of a selected node is ($1/N$), that shows that no other node is dependent on the selected node. A criticality of 1.0 would mean that all the other nodes in the system are dependent on the selected node. Table 1 shows the criticality of the nodes in our graph model (Figure 1). As the graph model is hierarchical, it can be observed that criticality of node reduces as we move down the graph. Node set {N7, N8, N10} has no dependent nodes and hence their criticalities are 0.1. This means no further failures in the system takes place due to the failure of these nodes. Although

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this model is a good starting point for analyzing the graph model, the major drawback is equal weights for all the edges. This disadvantage is covered in the continuum model for the simulation of disruptions.

Failed node number	Criticality of node (C_i)
N1	0.8
N2	0.8
N3	0.7
N4	0.6
N5	0.5
N6	0.2
N7	0.1
N8	0.1
N9	0.3
N10	0.1

Table 1: Criticality of failed nodes (Source: Author's own)

4.2 Continuum model for the simulation of disruptions

The discrete model discussed above describes the dependency of one infrastructure component on others with unweighted edges and a discrete state of operation. But in reality the complete interdependent system works dynamically on the basis of many factors as described by BROWN [BROWN 2007]. MIN ET AL. described a system dynamic methodology for identifying and quantifying risky nodes and edges and, evaluating the effects of system redundancies, the impact of buffers, and the positive/negative impact created due to interdependencies [MIN ET AL. 2007]. In general an infrastructure node comprises many independent components which are clubbed into one. Power generation node contains power generated from different fuels. The nodes can either be split into many individual components or additional edges can be added describing the input feed type. If a city generates 10% of the total electricity using renewable resources and rest using coal or gas, this means that the edge between power generation and the end user will not have the weight same as the edge between solar power and low-voltage substation. In this approach we work with unit less working status. The working status (WS_i) of a node is always between 0.0 and 1.0. If a node's working status (WS_i) is equal to 1.0 that means all the nodes are functioning to full capacity. Here, *i* denotes the infrastructure node of interest spanning from *1* to total number of nodes in the model (*N*).

Edge number	Weight of Edge (W_j)
E1	0.5
E2	0.5
E3	1.0
E4	1.0
E5	0.9
E6	1.0
E7	1.0
E8	0.1
E9	1.0

Table 2: Weights of edges (Source: Author's own)

To ensure that the maximum WS_i at which a node can work is 1.0, sum of weights of all the incident edges on a node must be equal to 1.0. This means that edge E8 would have a weight of 0.1 and edge E5 would have a weight of 0.9, under the assumption that 10% of electricity is generated from solar power and 90% from coal, gas etc.The criticality approach chosen for the continuum model is slightly different from the discrete model. In this approach, the failure of a node is described by the weight of the edge. **Fehler! Verweisquelle konnte nicht gefunden werden.** Table 2 describes the weights of all the edges when the system is working at full capacity. The working status of a node is calculated by multiplying the weight of the edge with the working status of its head node. If a node has failed completely, we mark the working status of the node as 0.0 and iterate over all the remaining nodes to calculate the working status of every other node based on the formula:

$$WS_i = \sum_{j=1}^{M} W_j * WS_k$$

Here, j is the index of the edge connecting the i^{th} node to the k^{th} node where the i^{th} node is dependent on the k^{th} node and M is the total number of edges incident on the i^{th} node. After the calculation of the working status of all the nodes upon failure of a node, the criticality of a node is calculated on the basis of the following formula:

$$C_i = 1.0 - \frac{\sum_{j=1}^{N} WS_j}{N}$$

A failure analysis for every node is performed and the criticality of every node is noted in Table 3. An adjacency matrix with working status can be constructed as described by CHOPRA AND KHANNA [CHOPRA AND KHANNA 2015]. Such an approach is used mainly in supply-demand models for identifying final demand due to a disruption. The criticality of nodes calculated using the continuum model is a better approximation than the discrete model due to its ability to analyse partial failure along with complete failure. It is possible that a fraction of infrastructure has failed unlike the test case we chose. In such a scenario the weights of the edges will help in identifying the current state of operation of dependent nodes.

Failed node number	Criticality of node (C_i)
N1	0.44
N2	0.44
N3	0.68
N4	0.58
N5	0.48
N6	0.2
N7	0.1
N8	0.1
N9	0.12
N10	0.1

Table 3: Criticality of failed nodes (Source: Author's own)

Table 3 shows that N4 (power generation) is the most critical node in our model. This establishes the rationale behind adding buffers to N4. The present continuum model establishes a good strategy for analysing the functional dependency.

4.3 Spatial dependency coupled with functional dependency

The models discussed above describe the functional dependence of one infrastructure on the other. In this model we satisfy spatial dependence on the basis of proximity between infrastructures. Different methods for risk assessment of georeferenced data have been proposed by SUMATHIPALA AND WIJESEKERA, STEPNOWSKI AND KULAWIAK, KULAWIAK AND LUBNIEWSKI [SUMATHIPALA AND WIJESEKERA 2008, STEPNOWSKI AND KULAWIAK 2010, KULAWIAK AND LUBNIEWSKI 2014, RIEGEL ET AL. 2015]. Based on the criticality or vulnerability of an infrastructure, a distance based function can be defined to assess the spatial impact. Such an analysis has already been suggested by STEPNOWSKI AND KULAWIAK. The model they proposed can be used for understanding independent infrastructure components upon attack but not for interdependent infrastructures. We have chosen a different approach for identifying cascading effects as STEPNOWSKI AND KULAWIAK do not take functional dependency into account. The functional dependence describes the relationships between infrastructures. Spatial data can be visualized using geo referenced data pointing to the infrastructures on the real map. The

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graph model is a layer describing the functional dependence which is supplied to the georeferenced layer in order to satisfy spatial dependence. Spatial dependence gives an in detail understanding of one to many relationships. This kind of relationship is important because in principle a high-voltage substation node can have many high-voltage substation infrastructures on the georeferenced map which are dependent on a single power generation infrastructure. Actually we move on from a macro model to a micro model using the relationships.

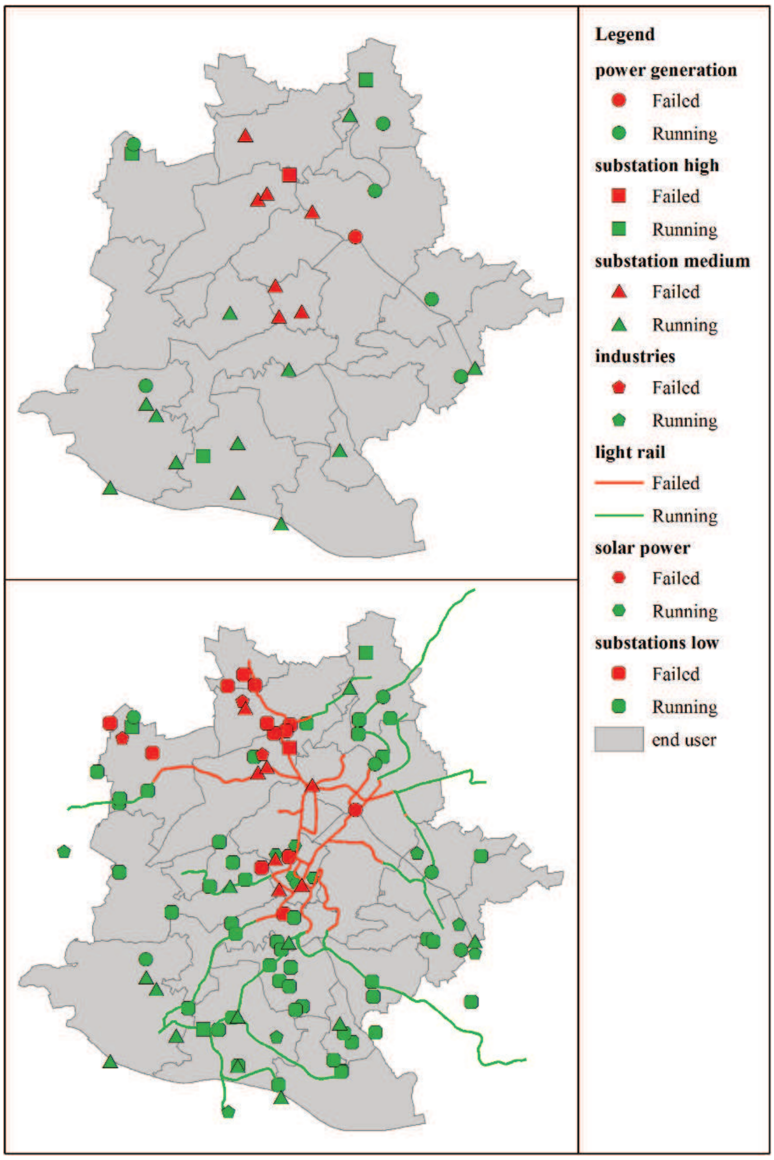

Figure 2: Visualization of cascading failure due to failure of a power generation component (Source: Author's own)

For the macro model and functional dependence model, we work with the graph model. In the case of functional dependence model coupled with the spatial dependence model, we work with shapefiles along with the graph model. Shapefiles contain the georeferenced data for every infrastructure with spatial coordinates. We are dealing with a relatively simple interdependent system. Hence, dependence between the components of an infrastructure and another can be obtained through survey. Moving on to a complex model would require us to establish a framework for the tail node component to identify its head node. A distance based approach can be used to identify the head infrastructure for each dependent infrastructure. This one-to-many relationship is achieved by finding out the nearest head node for every tail node.

A shapefile is used for storing the geographic coordinates, shapes, and attributes of geographic features. Shapes represent the physical form of the geographic infrastructure component for visualization. A simple example is representation of light rail using lines, municipalities using polygons and industries using points. The end goal is to identify the number of people affected by the cascading failures induced upon failure of a particular infrastructure. The number of people affected is directly proportional to the criticality of failed infrastructure. Figure 2 shows the cascading effects induced in the interdependent model due to functional and spatial dependency. When running the model, the disruption starts with the failure of a component in the power generation unit. All the high-voltage substation components dependent on the failed power generation infrastructure fail. This leads to the selective failure of medium-voltage substations, industries, light rail and low-voltage substation on the basis of spatial proximity. Figure 2 (top) shows the georeferenced infrastructures up until medium-voltage substations and Figure 2 (bottom) shows all the georeferenced infrastructures in our model. In order to satisfy functional dependency, we have worked with the discrete model as we want to establish a simple framework which can be later extended to the continuum model.

5 CONCLUSION

Understanding and analysing interdependent critical infrastructures has become an area of interest for minimizing the number of people affected by infrastructure failures. The methods proposed facilitate the identification of vulnerable interdependent technical infrastructures. A discrete simulation model was explained initially to underline the importance of edge weights in the interdependent graph model. The discrete model is not a precise method for analysis of critical nodes due to the assumptions that edges do not carry any weight and state of operation is discrete. This led to development of continuum model where we analyse the system to a greater detail by understanding the constituents of infrastructures and their supply of resources to the dependent nodes. The continuum model ensures that the weights of the edges are accounted for the calculation of working status. The working status in turn would help us in calculating criticality of the nodes. Criticality of the nodes was considered for ranking the critical infrastructure components. The identified critical infrastructure was connected to a buffer to increase the resilience of system upon failure. Discrete and continuum models explain the dynamics of cascading failure based on the functional dependency. Continuum model can be extended from single infrastructure failure to multi infrastructure failure based on spatial proximity. This would help us in gaining insight not only from a functional failure perspective but also on an attack based failure perspective.

To quantify the number of people affected by an infrastructure failure, spatial dependence model was introduced. RIEGEL ET AL. proposed an approach to determine the number of people affected due to an infrastructure failure based on spatial proximity but the coupled model proposed by us defines a relationship between the functional dependency model and spatial dependency model using the real geographical co-ordinates of the infrastructures. This coupling enables us to identify the cascading effects on infrastructures at a micro level, pointing to their real geographical coordinates. Functional dependence model and spatial dependence model is one way coupled. Changes made to functional dependence model would reflect in the micro level but the vice versa is not true. Need for a two way coupled model does not arise as functional model does not depend on the micro level model for its operation. Micro level model can be used to identify and strengthen weak links at micro level. Analysing and strengthening weak links at macro level would add unoptimized redundancy to the system. The models proposed can be used for strategic analysis and urban planning so that the number of people affected by such failures is kept at minimum. In the future work, we will investigate the conceptual Bayesian network, which will help in the bottom up analysis of the hierarchical model. Another scope for future work would be, to establish a framework in order to identify shortest path between two critical infrastructures in multi graph model based on DIJKSTRA's algorithm [DIJKSTRA 1959]. The information gained from this framework can be used in restoration of critical infrastructures falling in the shortest path first upon disruption.

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Belgrade: Smart Solutions for the Climate Change Challenges?

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1 ABSTRACT

Facing the multiplying challenges generated by contemporary processes, cities continuously redefine their physical and functional structure in order to improve their performances. The concept of smart city, targeting efficiency, liveability and sustainability of urban systems, has become one of preferred options for urban development based on the benefits of the latest technologies. However, the diversity of local circumstances often questions universal 'smartness' and applicability of the general model, demanding continuous modifications and high level of flexibility. Considering the environmental, socio-economic and technological elements of urban setting of Belgrade (Serbia), this paper will analyze the current state of 'smart' upgrading and suggest possibilities for its improvement, especially in the context of detected climate shift. The theoretical background of the problem, as well as the successful global examples, will be used as a starting point - both for the evaluation of the existing condition and the proposed guidelines for the 'smart' development.

Keywords: Belgrade, climate changes, development, evaluation, evaluation

2 INTRODUCTION

Modern cities, as the nodes of highest concentration of people and activities, represent both the generators of environmental problems, as well as the innovative hubs addressing their solution. Adjusting to climate shift and reducing effects of carbon-intensive life are not easy tasks, but it is obvious that urban areas have to modify their performances and development priorities in order to mitigate the accumulated negative effects of global warming and ecological degradation, creating improved models of urban life and its setting - material and virtual, artificial and natural.

The increasing number of contemporary urban concepts targets different aspects of environmental sustainability and energy transition - from low-carbon, carbon-neutral, zero-carbon cities, to eco-smart and ubiquitous-eco sustainable cities - while their catchy names, proposed elements and accompanying visual material suggest new modes of future urban existence. Based on the extensive use of Information Communication Technology (ICT) they all envision a high-quality urban environment which interacts with its users via electronic infrastructure, enabling an increased efficiency, adjustability and higher level of environmental awareness. The concept of smart city integrates all these elements but the level of its application still depends on the potentials, awareness and/or preferences of local contexts - in technological, economic and social sense.

Focusing on the relationship between the smart city concept and increasing environmental challenges triggered by climate changes, this paper will discuss recent global trends and consider their application (current and future) in Belgrade. Distinguishing two main areas of 'smart' upgrading - urban efficiency and environmental awareness, the analysis will identify the preferred channels of ICT support - directed both to personal and public interfaces.

3 GLOBAL WARMING AND SMART RESPONSES

Climate change, with its direct and indirect impacts on living environment, have generated numerous problems in cities affecting their activities, spatial typologies, urban systems and public health. Considering the scale and intensity of these changes the contemporary society has launched a number of formal and informal initiatives in order to mitigate the effects of global warming, but also to increase the level of adjustability and resilience of cities. The European cities face similar problems, additionally complicated by the inherited urban structure. The 'smart approach' has been recognized as one of possibilities, especially in a domain of efficiency (energy consumption and public services), general sustainability and quality of life, but also as a tool for urban renewal and an element of urban competitiveness. Therefore, it is not surprising that during the last decade a number of European cities have initiated application of the Smart city concept in order to decrease unemployment by increasing the accessibility of services, to synchronize public investments in innovative technologies and to balance the use of available resources (EC, 2013). The smart support has also been used for the protection of living environment - on the level of energy consumption/transition and pollution control. For example, the concept of smart city represents one of the EU measures embedded in important documents and strategies aiming at the increase of renewable energy resources (20%), the decrease of GHG emissions (20%) and the increase of energy efficiency (20%) (EC, 2010). The relationship between the sustainability of cities and their level of 'smartness' is enabled by the ICT, and its role in climate change mitigation and adaptation becomes more important every day.

The definitions describing the concept of smart city are numerous, but they mostly underline its importance for the quality of life (Kuffner, 2012), economical development and general progress (Giffinger at al., 2007; Pike Research, 2011), connectivity and integration between different infrastructural levels (Hall, 2000; Harrison at al., 2010). The smart elements introduced in cities are not only related to local development, but also influence regional networks and their functioning. One of the main features of this concept is the bottom-up approach in implementation process (directly targeting local communities), while city government mainly conducts large-scale projects (e.g. Greenfield investments - CAICT, 2014) and has to be included in more sensitive urban interventions, especially in old historical cores. The application of 'smart' concept can be described as a process, continuously implemented on different levels, in order to enable an adequate response to urban problems and challenges, while simultaneously providing high-quality and resilient environment (DBIS UK, 2013). However, each city has to established so-called 'open model' of governance which needs the appropriate tools and technical support. This model should provide easily accessible open information networks with open data, their visualisation, as well as the possibility for the simulation of governing/management process, participation of citizens and good connectivity on general level of governance (CAICT, 2014). ICT infrastructure facilitates this process, providing better accessibility to all urban services, for all groups of users. Simultaneously, the digitalization enables immediate identification of changes, the transmission and processing of data is efficient, which creates an accurate report on all urban modifications and threats generated by the carbon intensive way of life and climate shift. Consequently, due to application of readily-available technologies and real-time systems via various e-networks and platforms, gadgets and applications, the (re)action becomes faster leading to the reduction of carbon-footprint.

Nowadays, the range of 'smart' projects covers different activities and types of urban spaces and systems - from technological centres, green urban areas, smart electric grids, to electric vehicles (busses, cars) and networks of public transportation (bicycles, trains, taxis etc.), but there are six key factors which define level of urban 'smartness' - smart economy, smart citizens, smart city government, smart mobility, smart environment and smart living (Giffinger et al, 2007). All of them could be used for climate change adaptation and mitigation, as carriers and transmitters of ideas, knowledge and experiences - on local, regional and global level. CAICT (2014) also emphasizes the list of 'smart' services which could have a direct and indirect impact on the condition of living environment and, consequently, provide some efficient solutions for climate change challenges targeting systems of traffic, public safety, health monitoring, consumption of water and energy, as well as virtual learning.

There are a number of cities which implement the smart city concept on the level of planning documents and strategies, but also in real space (Barcelona, Stockholm, Copenhagen, Amsterdam, Vienna etc.). Simultaneously, there is a parallel level of action related to research, modes of application and support, especially in the sphere of 'smart living environment' which tackles the issue of climate change, pollution, rational and sustainable management of resources and environmental protection. One of good examples is the city of Vienna, the most advanced city in 2012/2013 according to the report of UN Habitat (2013) and ranked as the first one (seven years in a row) on the list which evaluates quality of life (Mercer, 2015). The initiative ‘Smart City Vienna’ was launched in 2011 and its main idea was to use advanced technological support in order to decrease consumption and production of energy until 2050, but without limiting any mode of mobility and consumption (VCA, 2014: 7). It is also important to notice that the objectives of this initiative are related to the problems of global warming aiming at the decrease of CO2 emission (in accordance with EU strategies), the reduction of energy consumption via use of renewable resources and the promotion of multimodal transportation (and consequent reduction of car traffic). It simultaneously strengthens the position of the city as an important node of research and technological development. The initiative also emphasizes the role of public participation, as an important element for decision-making and implementation of related programs.

4 SERBIA – TOWARD THE SMART SOLUTIONS?

The general application of the smart city concept in Serbia is still in the initial phase, but the issues of global warming have been in the focus of professional and legislative attention during the last decade. However, the application of different documents related to climate change is still insufficient mostly due to weak administrative support unable to facilitate implementation of adopted strategies and measures on national, but also European level (Pucar, 2013; Bajić Brković, 2013). One of the main problems is low awareness of generated problems and environmental threats, but there are other limitations as well – the lack of the national GHG inventory and a slow pace of procedures focused on new strategic documents. Therefore, the integration of smart elements into the process of climate change adaptation and mitigation is still on hold although there are some attempts in this direction. For example, in 2015 the City of Novi Sad and its Office of local economical development have organized a meeting with entrepreneurs, presenting possible activities and benefits within the smart city concept (Novi Sad, 2015). Furthermore, several researches have been conducted considering selected 'smart' features, but without real integration into general development policies. An example of this practice was the analysis of 'smart' traffic networking between Belgrade and Pančevo conducted by Italian researchers (Bielsa, 2012). Currently, Serbian cities are not included into the European association 'Connected Smart Cities Network)' (CSCN, 2015), but the example of Novi Sad clearly demonstrates that this situation might be changed in near future.

The digital sphere is mostly used for information and knowledge exchange targeting the improvement of environmental consciousness. The institutionalized example of this practice is the web-site of the Serbian Environmental Protection Agency (SEPA), which also hosts Ecoregister - the National Metaregister for Environmental Information and the National Register of Pollution Sources. There are also digital platforms focused on available resources and services. They use GIS technology and available databases to provide up-to-date information about various urban systems (mostly traffic), but the level of their interactivity is very low. Nevertheless, some municipalities use simple web-platforms to interact with their citizens, mostly focusing on daily urban problems. On the other hand, the non-institutional flows are more open to environmental issues incorporated in different web-sites, web-services (e.g. BUDIEKOFINa.COM), portals, the digital editions of magazines (e.g. Ekologija magazin, Stakleno zvono), social media and mobile applications. Although most of them only transmit and disseminate information on environmental problems, raising environmental awareness and influencing eco-behaviour, there are some emerging e-platforms inspired by the trend of carpooling/rideshare, which directly and indirectly affect the level of traffic congestion, air pollution and fuel consumption (regional web-site Timskavoznja.com)

5 BELGRADE AS A SMART CITY?

Belgrade, the capital of Serbia, has introduced some elements, which could be recognized as 'smart', but most of them serve as information platforms for citizens and/or tourists or the portals oriented towards e-government. The first group includes internet sites and applications for more efficient coordination and orientation, but also for better experience of the city, while the second one provides different kind of information and allows issuing of online certificates for the citizens of Belgrade. In general, it could be said that these web-sites and mobile apps increase general efficiency of movement and certain urban services, but their impact of environmental issues (if any) is unintentional and mostly inexistent. However, sites and apps related to wayfinding (for ex. 'Airport Nikola Tesla Belgrade' site and app, applications 'Belgrade Talking', 'Belgrade Map', 'Belgrade City Guide', 'Belgrade Travel Guide' etc.), guiding users through the city and enabling their understanding and experience of urban space, could be upgraded with selected data-bases or specific instructions related to eco-awareness and some innovative approaches to environmental quality and safety. There are also several specific services - mobile apps (e.g. 'Osmatrač' - Observer and 'Beograd uživo' - Belgrade live) enabling continuous monitoring of different parts of Belgrade, such as the important traffic junctures, streets, squares and parks, which could be combined in the future with real-time data about the intensity, safety and environmental condition of selected spots.

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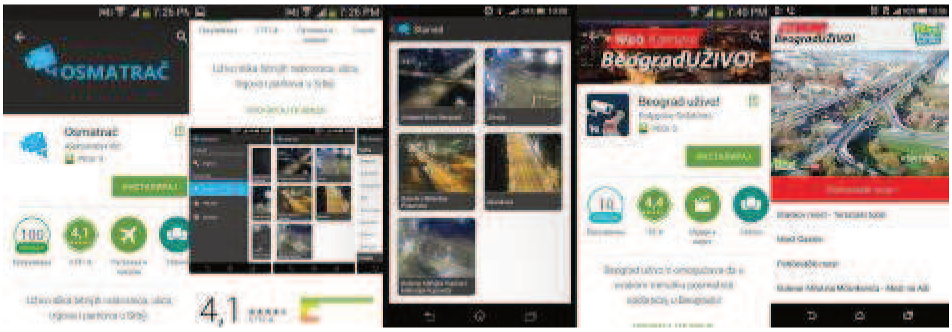

Fig. 1: Applications 'Observer' and 'Belgrade Live', a possible base for the future smart urban performances: the use of real-time data as a tool for improving the environmental quality and efficiency of urban services.

There are also several web-sites and mobile application more specialized and focused on urban mobility. 'Belgrade Plan Plus' represents the official and most used internet site for wayfinding in Belgrade. It offers a digital map with streets, connections and important places. 'Bus Plus', the internet site and mobile application is used as a payment tool for the public transport in Belgrade in the form of a smart ticket system in which consumer can upload money for transport fees, depending on the type of card (personalized, paper and electronic card). Simultaneously, there are several apps and sites concerning the public transportation in Belgrade and its timetable. For example, 'BG voz' is the internet site and mobile application about Belgrade train system. It offers information about arrivals, departures, nearest stations, or the progress of expected train. 'Red voznje - Beograd' has a similar content, but it covers all types of transportation.

Fig. 2: Applications 'Belgrade Talking', 'Belgrade Map', 'Belgrade City Guide', 'Belgrade Travel Guide' - providing a better experience and movement in the city.

Fig. 3: Applications dealing with public transportation, time-table and preferred connections.

Several apps in Belgrade offer information about parking places, zones, and capacity in different areas of the city (e.g. 'StartStop Parking Servis Beograd', 'BelParking', 'Parkiraj Beograd PS' and 'Moj Parking'). The application 'Moj Parking' (My parking) is especially interesting because it also provides information on parking capacity and places for disabled.

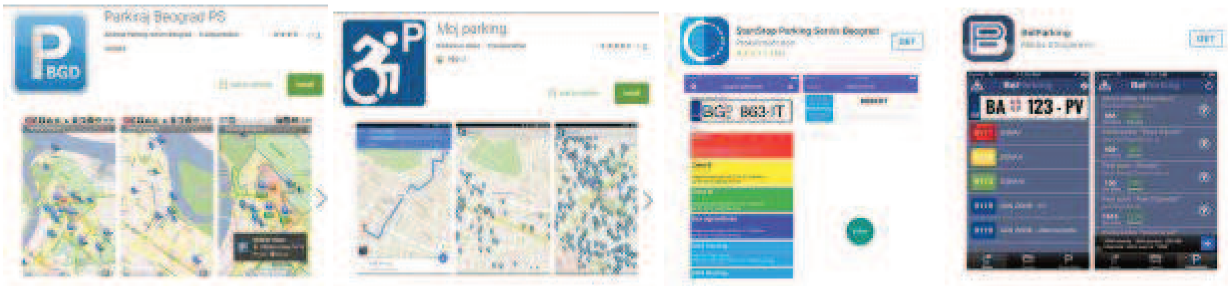

Fig. 4: Applications focused on the problem of parking - capacity, availability, routes and prices.

Obviously, the service provided by these interfaces does not link environmental effects of transportation and its efficiency (or mode), but it could be used as a starting point for the introduction of more integrated services and tools, which would connect different types of data and support synchronized management of urban systems. In that case, it would be possible to collect simultaneously data from both users and monitoring units, to process them, suggest alternative options, modify routes or time-tables, while decreasing congestion and pollution.

However, there is also one mobile application, initiated by a recent trend introduced in numerous cities, which could definitely have a direct impact on environmental quality. 'CAR:GO' is the first ride-sharing service/app in Belgrade, based on the user's location and preferences, with exclusive pre-payment system.

Fig. 5: The interface of the application 'CAR:GO' - the first ride-sharing service in Belgrade.

Apart from these interfaces which have to be further developed in order to include more environmental features, the Center for environemental improvement has developed several applications (e.g. 'MORECAST', 'UV indeks Srbija', 'Blue Green Map of Serbia') which include information about weather, precipitation, UV radiation, the ozone layer or natural resources. They provide another kind of information which could be used both by citizens and tourists, raising environmental awareness and stimulating trend of biophilia.

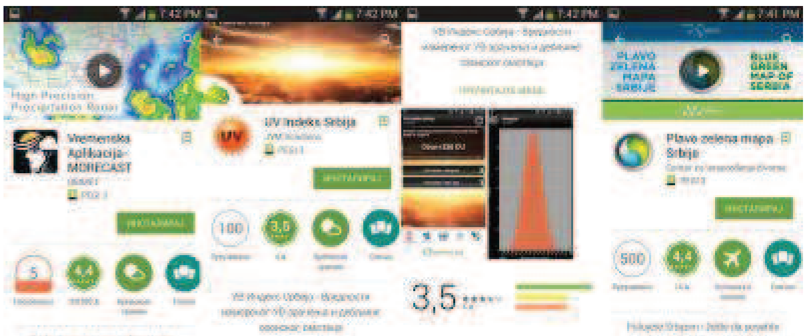

Fig. 6: The applications focused on weather data and natural resources - 'MORECAST', 'UV indeks Srbija', 'Blue Green Map of Serbia'.

Finally, there is an attempt to integrate an urban system (transportation) with environmental monitoring - 'Libelium World - EkoBus Project'. In this initiative, EkoBus system has been developed in collaboration with Ericsson, which has been deployed in the cities of Belgrade and Pančevo. The system utilizes public transportation vehicles to monitor a set of environmental parameters over a large area, as well as to provide additional information for the end-user - the location of the buses and estimated arrival time to bus stops.

EkoBus is a part of SmartSantander project which proposes a unique city-scale experimental research facility in support of typical applications and services for a smart city. This project is funded by the European Union through its Future Internet Research and Experimentation (FIRE) program. Project Consortium consists of different companies and universities such as: Telefonica, Alcatel-Lucent, Ericsson, the University of Cantabria and the University of Surrey. This unique experimental facility should be sufficiently large, open and flexible to enable horizontal and vertical grouping with other experimental facilities. It also stimulates development of new applications by different users including the experimental advanced research on IoT technologies and a realistic assessment of users' acceptability tests. The project uses Waspmote (which is also used to control public transportation and monitor environmental parameters in several other cities in Serbia and Europe) and it provides data on six parameters - temperature, relative humidity, Carbon Monoxide (CO), Carbon Dioxide (CO2), Nitrogen Dioxide (NO2) and GPS location. Sensor nodes make measurements and periodically send results to the server application for further analysis and database storage. Web and Android application collect information from the nodes and perform their visualization (location of the vehicles and atmospheric measurements). It is also possible to request information about the arrival time of the next bus on a certain line to a certain bus stop via SMS or USSD and to receive that information via SMS. The GPRS module is responsible for this feature. The analysis of the stored data is used for various traffic calculations and predictions (Libelium, 2012). However, this system still has to be fully developed, applied and integrated in other environmental programs on the city level in order to achieve the expected impact on environmental quality.

6 CONCLUSION

The integration of smart features into the process of urban development is still in its initial phase in Serbia and Belgrade, but some examples demonstrate a number of possibilities for their use, especially in the process of mitigation and adaptation to climate change. The advanced technology, particularly ICT, represents the basic foundation for the necessary upgrading, which should be conducted both on the institutional and non-institutional level, creating easily accessible and manageable interfaces oriented toward the public or personal users. Additionally, the link between the smart city concept and the anticipated aims of environmental adjustments could be established on all levels, allowing multidisciplinary targeting of environmental awareness, as well as the efficiency of urban systems and energy transition.

The international examples offer a large scale of emerging or already verified 'smart' platforms - web-sites, mobile apps, social media, public interfaces etc. - demonstrating a number of possibilities for the elaborated and well-conducted integration of digital features into urban spaces. However, their use has to be stimulated on all levels, via national strategies and programs, as well as by local governments and urban policies. Only a comprehensive approach could provide the expected benefits for the living environment, but it also represents a necessary condition for further innovation in this area, as well as a new feature of urban competitiveness.

One of the problems in the local context of Serbia represents a discrepancy between official documents targeting environmental issues (and their smart solutions) and actual actions leading to the improvement of the general situation. The aims are vaguely defined and it is necessary to formulate precise objectives and their (measurable) indicators. The list of locally applicable 'smart' measures and tools should be also developed, providing guidelines for the efficient implementation and monitoring of their outcomes.

Although Belgrade still has to develop the smart approach to its numerous environmental problems and use it for the greener management of urban systems, the existing applications and platforms could serve as a starting point for improving the content and accessibility of databases, their integration with other urban systems and synchronisation and instant processing of collected information. The introduction of more advances technological solutions is certainly a necessity in the next phase, but the raised ecological awareness, as well as the availability of smart responses to environmental problems, should lead to a better understanding of proposed measures and their efficient implementation.

7 ACKNOWLEDGEMENT

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Brownfields Information Brocker

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1 ABSTRACT

This paper discusses a possible solution for developing a virtual place for advertisement, investment and the harvesting, collecting and sharing of information concerning brownfields - now abundantly availabe land that was previously used for industrial, commercial or other uses.

The novelty of the proposed solution is an automated brownfield related information integration (brownfields data integrator or brownfields broker) from various sources and its further distribution for other purposes (reuse of collected information) in a machine readable format and that meets European requirements regarding the integration of spatial information (INSPIRE directive and its related activities).

This virtual place will provide services for brownfields related automated data harvesting, data update by local governments and citizens, as well as mechanisms for the reuse of this data through Application Protocol Interfaces and other „machine to machine "interfaces.

The brownfield broker should also help to improve the ratio between developments made on brownfields and greenfields, which are currently imbalanced and statistically unknown in the European Union (EU).

The beneficiaries from the brownfields data integrator will be very broad: owners, entrepreneurs (potential investors), municipalities (will be able to upload and then re-use relevant reliable, classified, updated information about brownfields and to advertise it through the application), planners, realtors (will be able to publicise the data using their web portals), financial institutions (for providing distance financial services), volunteers, scientists and the general public (for their personal interest, data creation, use, publishing and informing).

Keywords: brownfields, environmental spatial data, greenfields, information integration, spatial planning

2 INTRODUCTION

In the increasingly globalized twenty first century, urban renewal (redevelopment) is at the top of new global agenda of sustainability and a changed urban planning paradigm. Land is a finite resource and needs special care. [16] [23] Many countries world-wide (e.g. Germany, the Netherlands, the Middle East and North African countries) face an acute land use crisis: they are struggling to find land for new housing, commerce, food production. The amount of land required "to feed an ever-expanding Europe" makes rural land a precious commodity. Also cities face complex responsibilities to ensure global sustainability, e.g. responsibility to climate change (low emission, protection unspoiled habitats); to limit urban spawl; to ensure liveability and habitation; to monitor urban systems, etc. In 2015 United Nations reported, that there is a strong, but mostly still unacknowledged, global interest in ensuring productive urban economies, as they represent a disproportionate and growing share of nations' GDPs [3] [21] Until 2030 roughly $93 trillion will be invested to ensure climate-resilient urban infrastructure. [14] However, still in the Europen Union (EU) yearly more than 1000 km2 of undeveloped land is appropriated for new housing, industry, infrastructure and recreation without a full and comprehensive assessment of the diverse tangible and intangible services and values those soils provide. [3] [20]

For these reasons, redevelopment, as a method in urban design, is becoming one of the major environmental and social concerns in the EU, but the still less explored brownfield phenomena offer a competitive alternative to greenfield investment. [20] The EU wishes to place a new impetus also on sustainable economic reforms and ICT progress - especially on the question of how to make member states and their territories more competitive and sustainable from both an economical and technological aspect. Brownfields have gradually become a significant element of urban life simultaneusly presenting a barriere and potential for development to achieve long term development goals. The European Environment Agency (EEA) has estimated, as many as three million brownfield sites (more than 500 000 hectares) were estimated to be available for development across EU, many of which remain „under-used or even abandoned altogether“. Large, not fully assessed, portion of this stock is located in the new memberstates (post-soviet regime countries). The EU does not yet have a general brownfield policy, terminology, classification and complete statistics. Some EU countries (e.g. United Kingdom (UK), Belgium) already have well-operating national brownfield regeneration practices. However, the EU needs to act much faster in order to fully exploit this opportunity in land use. [15] [4] [17]

Industrial brownfields regeneration experience in the United State of America (U.S.) has shown, that „the resource based approach” in brownfields regeneration has great potential in regard to urban renewal, entrepreneurship, housing, recreation, greenfields, etc., if this information has been collected, published and delivered to potential investors. Sustainable land use planning also needs to follow a financially viable approach. For this reason, urban regeneration projects need to invite potential stakeholders (institutions, investors, owners, potential users and financial institutions) to partnership.[15]

Brownfield sites are less explored phenomenon also in regard to the use of ICT in brownfield related information integration and intelligent management. Despite the demands of stakeholders and the manner of information consumption, currently organizations (usually state-funded) mostly provide data about brownfields (e.g. Czech Republic) only in static images and texts in HTML format, which makes it difficult to combine with other information, advertise and reuse it (e.g. in a brownfield data broker). [17]

Until now brownfield related activities (e.g. INTERREG III REVIT, CABERNET - Concerted Action on Brownfield and Economic Regeneration Network) in the EU have only covered the issues of terminology, statistics, studies of best practices, generation of cross-border cooperation and identification of need in sustainable EU policies in brownfields regeneration. [] The Project „Regeneration of European Sites in Cities and Urban Environments” (RESCUE) observed, that brownfields stakeholders are aware of the great potential of brownfields and the complexity of their regeneration (especially for so-called „megasites“) in regard to the need for inolvement of a large number of stakeholders and the need for effective decision support systems (probably a platform of a broker) for managing such complex spatial information of such projects, providing transparent results for a range of stakeholders, and conveniently integrating an assessment of sustainability for different planning options.[13] [15] [24]

In the EU, spatial information is becoming more and more accessible for various purposes due to local, national and European policies, initiatives and legislation (e.g. EEA environmental policy, INSPIRE directive). In fact, ICT progress (particularly in geospatial technologies) that allow one “to do more with less” also provide attractive integrative approaches and supportive tools (e.g. workforce development, visualization, integration, collaboration, funding, information searching) for meeting the high requirements of brownfields stakeholders. [1] [17] Current accents are on „open“, „big“, „linked“ data (LOD), cross-border data integration initiatives and research activities concerning efforts to harmonize and explore the potential of land information data sets from various sources on different scales to monitor global environmental changes (loss of biodiversity, climate changes, food safety, etc.), to implement data standards on various scale spatial information (implementation of INSPIRE directive) and to support small and medium enterprises (SME), non-institutional groups of stakeholders (youth, citizens) in regard to accessing spatial information using mobile phones (e.g. use of mobile applications for various purposes). On the base of INSPIRE recommendation, Plan4business project introduced concept of OpenLandUse, which could be important base for analysis and assessment of brownfileds. [15] [17] This concept is now futher elaborated as part of SDI4Apps project.[15] From this point of view, brownfield information integration from various sources, its further distribution and the reuse of collected information in machine readable format is a novel solution. There is also new opportunity to cover some of the costs for the revitalization of brownfields from European Structural Funds (ESF), which will especially support SME and new memberstates. For example, for Latvia ESF will offer 278 million euros for the revitalization of industrial brownfields until 2023. [17]

3 WHAT DOES BROWNFIELD MEAN?

There is no universally accepted definition or classification of what constitutes „brownfield”.[6] [7] [8] [15] Brownfields are formed in any country as an expected result of restructuring of industrial or another kind (military, railway and transport, agricultural, institutional e.g. schools, hospitals, prisons, commercial e.g. shopping centers, offices, culture (any kind of historic heritage) objects, leisure time activities (sports ground, squares, free space) and lansdscape degradation. They may develop due to many simultaneus reasons: e.g. urban spawl; industrial modernization; land use changes (e.g. mixed use; illegal use; consumtion of greenfields); major transportation changes, economic changes (e.g. global crisis), ecological aspects (pollution), natural (hurricanes, tornados, earthquakes, flood) or human (wars, terror acts, fires) caused disasters.[] The term “brownfield” originally come from U.S., considering abandaned industrial objects. In the EU in different countries it can denote slightly different things. Complexity of brownfields and its related terminology was researched by CABERNET. CABERNET identified, that brownfields can be former different size abandoned or partly used industrial, infrastructure and residential objects (e.g. soviet period plants, factories, engineering infrastructure, large scale residential complexes) and abandaned farms and agricultural land (in the Eastern and Central Europe); unused cultural sites and landscapes (Eastern, Central and Western Europe), military objects (e.g. inheritance of WWII) in the United Kingdom, Poland and Germany. In some countries (Austria, Finland, Netherlands, Sweden) the official definition of a term “brownfield” does not exist or used offitial definition is too narrow and crucial deciding factor whether to regard abandoned site as a brownfield is whether it is contaminated or not (Bulgaria, Italy, Poland, Romania, Spain). [6] [8]

CABERNET offered the following definition of brownfield, which is also used in the concept for brownfield information brocker: “Sites that have been affected by the former uses of the site and surrounding land; are derelict and underused; may have real or perceived contamination problems; are mainly in developed urban areas; and require intervention to bring them back to beneficial use”. The project „Regeneration of European Sites in Cities and Urban Environments” (RESCUE) extended this robust definition with elements of sustainability: „The management, rehabilitation and return to beneficial use of the brownfield land resource base in such a manner as to ensure the attainment and continued satisfaction of human needs for present and future generations in environmentally non-degrading, economically viable, institutionally robust and socially accepted ways”. [18] [19]

4 IDENTIFIED PROBLEMS

One of the basic problem, adressed brownfields data integration is identification of a brownfield as an object.[] Current complex environmental, social, economic, cultural and governance context and problematic of brownfields can becomes cleare only through scurpulous analysis of places regarding economic potential (problems attracting new investors, decline of tax incomes, decrease in property values, unemployment rates), affect on social and cultural sphere on urban life (shrinkage, loss of liveability, crime, social conflicts, gentrification trends, changes in landscape, loss of cultural values and landmarks), consumption of greenfields (urban spawl), clear classification and deffinition, management and financing issues. [15] [18] [19]

Very naturally people think, that property owners and their attitude towards use of their land may change brownfield problem. Hovewer, property owners may not have skills and knowledge to follow land use trends and prevent degradation, while neglected brownfield sites stress the whole society and reduce property values. There is often lack of competence, knowledge, coordination and motivation related problems in minimizing brownfields impact at all administrative levels. [15]

Brownfields regeneration is highly holitic activity - can address political decission making process due economic, environmental and human health risks, land use planning (zoning, place making, value capture mechanism); high redevelopment costs (the combined cost of restoring all mega-size European brownfield sites likely exceeds 100 billion euro); involvement of stakeholders in all phases of the regeneration process; management (innovative technical and financial support) and have promoted public participation. [] Communities, cities and local authorities should play an active role in identification of the brownfields, mitigate (reduce) the effects of brownfields, assist in consultancy and support owners to revitalize brownfields, public promotion of projects related to brownfields; land use planning, take measures against the emergence of the new brownfields. [2] [3] [13] [15]

Comprehensive studies providing an overview of stakeholders perceptions, concerns, attitudes and information needs when dealing with brownfield regeneration are still missing.[15] [18]

There are several activities (or scenarious) possible for solving of brownfields problem (see Table 1 Life cycle of brownfields).[9] [10] [15]

Local governments very often see their efforts being shattered for the following reasons: legislators must formulate and approve the legislation, cooperation is difficult due to the different intersts of the involved parties (funds are in the hands of private financial institutions, but programs - of state agencies; real property belongs to private owners), only some regions see the use of ESF as a priority.

No.	Activity/scenario	Actions	Possible Impacts
1	Preparatory phase	Information collection, evaluation of site and risk analysis. Selection of scenario for brownfield. Preparation of the program (work scedule and cost). Securing funding and necessary permits. Selection of developer and approval of documents.	Ensure measures to prevent problems. Adjust rules on the environment. Reviwed/approvaled by the competent authorities. Ensure competitive tender to determine contractor.
2	Demolition or redevelopment	Demolition and removal of buildings and structures. The removal (only if necessary), underground constructions. Disposal of hazardous waste.	An expensive activity for preporatory site for greenfield or new construction. Must meet the requirements of environment protection.
3	Decontamination	Cleanup (or removal and disposal) of contaminated soil. Cleanup of contaminated ground water. Removal or cleanup of waste from the previoususe use.	The most expensive activity for significantly contaminated sites. Duration of this phase may be long (several years). It is recomended to study and use the best available technology and practices.
4	Restoration and landscaping	Stabilization of terrain (if necessary). Landscaping of site (planting of grass, trees, etc.).	Key activity for ensurance of attractiveness and marketability of the site. Amount of contribution depends from both: the condition of the site and planned new use.
5	New construction	Completing the transformation of the unused brownfield site on which can be fully exploited.	Can be carried out by public/private sector or using public private partnership (PPP) approach (the most reccomended). Some public investment (e.g. infrastructure) can be used even for private sector projects.
6	Infrastructure and services	Development of access roads, parking places, street lights, enfineering nets on site (water supply, sewerage, electricity, gas, telecommunications) and other services.	Some items may be provided in phases 2-4. Some costs may be covered by municipalities or public services.
7	Construction of buildings	Conventional construction projects and link to thecity's development.	Applicable when the public sector has an interest in using of new construction/buildings for sale/lease, or if not found a suitable investor.
8	Operation and maintenance	Especially necessary when the building will beleased.	Decisive local representative bodies. May also be needed public support, if rental incomes are low as a result of market failure.

Table 1 Life cycle of brownfields [9] [10] [15]

A serious obstacle for brownfield regeneration is the fact that they are less prepared for new use than greenfields. Brownfields are thus constantly loosing investments that otherwise they could receive. Easier availability of infrastructure (routes, sewerage, electricity) and ignoring externalities makes investors and institutions prefer development of greenfields, especially close to radial highways. There is also a need for investors to see a long term spatial vision and integrity with local development, coordinated action, less bureaucracy, a ,leading role played by local government in territorial development, local public acceptance. Also the content of public data bases does not comply with current requirements in regard to information and its operability. The experiance of the UK has shown that use of the National Land Use Database of Previously Developed Land to monitor reuse of brownfield sites has promoted a reduction in land degradation. In the UK policies to limit urban expansion are succeeding: e.g. the number of new houses built on brownfields land increased from 57% in 1996 to 77% in 2008. [11][13] [15]

5 POTENTIAL RISKS AND IMPACT

The most important risks for brownfields redevelopment are connected with the current political and decission making system (the lack of clearly defined sustainable policies and strategies, slow and non-transparent decision-making and legistlation process), data quality and integrity of national spatial data infrastructure (SDI), (e.g. low integration between cadaster and other national registers, low availability of mapping layers, poor content buildings related information), insufficient financial instruments (e.g. financial funds, programs), fiscal power (e.g. tax reliefs for brownfields redevelopers) and lack of tools for cooperation among institutional and non-institutional stakeholders (e.g. PPP). [5] [15]

At the local administration level, the most important risks are: the lack of transparency in legistlation application, planning, public procurement and use/sale/lease of brownfields; poor management of environmental impact (e.g. pollution); inadequate knowledge (tools) in the land market; inflexible parceling tools; insufficient financial and fiscal instruments; too uniform and inadequate ways of defining rules for decontamination; lack of information for decision making and planning (e.g. access to inventory of brownfields, their critical parameters); the lack of analytical tools and principles. [18] [20]

The reuse of brownfields brings: a national, regional and in local competitive advantage; enforcement of the implementation of the paradigm of sustainability (efficient land use; increase of environmental, land use and cultural standards in society; a reduction of the negative impact on human and environmental health; socio-economic benefits; public participation; new opportunities for the national economy (may bring more investors and employment) and an improvement of the national SDI.

For local communities the redevelopment of brownfields can provide an increased tax base (a well-functioning urban area represents significant tax proceeds), new businesses and jobs (each hectare has the possibility of creating 50 jobs), an increase in housing stock (e.g. each hectare allows placement of 30-45 residential units), value capture (an increase in the market value of neighboring properties due to public investments in infrastructure), aesthetic and landscape qualities (e.g. the wooded area improves the appearance of the landscape and directly affects the environment), efficient land use tools (e.g. a new division of the territory into parcels opens up new possibilities for land use permits and improves their infrastructure, a decrease of development on greenfields). [15] [21]

6 NOVELITY, PURPOSE AND GOALS

The novelty of the proposed solution is an automated brownfield related information integration (brownfields data integrator or brownfields broker) from various sources and its further distribution for other purposes (reuse of collected information) in a machine readable format that meets European requirements regarding the integration of spatial information (INSPIRE directive and its related activities).

The main purpose for the development of the brownfields information brocker is to support sustainable development (e.g. efficient land use) by propagating brownfields revitalization based on the experience of the project Brownfields4life and EU and cases from Czech Republic, Latvia and Slovakia.

The precise (specific) goals are:

- promote brownfields revitalization (as defined in the Brownfields4LIFE platform);
- develop a unique, open access data base, that is based on earlier successfully developed state-of-the-art technical solutions from several INSPIRE related EU projects (Plan4business, Plan4all, SDI4Apps, Open Transport Net) for automated brownfield spatial data integration, harvesting, storage, processing, analysis and visualization;
- offer unique, “in-operational”, “rich-content” spatial data base allowing one to compare different territorial units (regions, cities) and buildings (now only in Czech Republic);
- combine and then distribute data from OpenStreetMap to Europen local governments and citizens;
- help to improve the ratio between brownfields and greenfields developments, which is currently imbalanced and not precisely known. [15] [20] [21]

7 METHODOLOGY

The methodology is based on an analysis of the brownfields phenomen and its related data integration in Europe, particulary concentrating on the project Brownfields4life and cases fromCzech Republic, Latvia and Slovakia. The following steps are included:

- analysis of information sources (literature, researches, best practice, completed and ongoing projects and data portals - Plan4business, Plan4all, SDI4Apps, Open Transport Net, REVIT, CABERNET) related to brownfields;

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Editors: Manfred SCHRENK, Vasily V. POPOVICH, Peter ZEILE, Pietro ELISEI, Clemens BEYER

- identification of the needs/expectation of owners (private and public) of brownfields;
- consultancy with the public sector (persons and organizations dealing with spatial planning);
- interviews and dicsussions with spatial planers, realtors and potential investors;
- analysis of EU requirements and documents regard spatial data integration and its connnection to brownfields related information;
- analysis of national and regional information systems (e.g. focused on brownfields related spatial and descriptive data in order to make good use of brownfield sites; a way is required to effectively visualize, understand and communicate the potential opportunities to the stakeholders, who will ultimately undertake redevelopment);
- analysis of the experiance of Whatstheplan.eu portal and how this experience and data could be used as a source of additional information about brownfields;
- definition of data models for brownfield description;
- definition of mapping methodologies for brownfield mapping;
- offer solution supporting communication among different interested persons regarding quite complex brownfield redevelopment;
- additional analysis of FI-WARE generic enablers, on their maturity and also potential usability for the needs of the already developed proposal of Brownfields4LIFE.

The activities that need to be also undertaken are the ensuring of citizen participation in brownfields related data collection and revitalisation promotion. [15] [21]

8 STAKEHOLDERS AND THEIR INTERESTS

The six most important groups of stakeholders with their different interests have been identified: owner, investor, neighbourhood, local and state authotities and institutions, enterprises and financial institutions.

The main “actor” inthe whole problem is the owner. The owner owns degradated land and has a motivation to improve the situation (sell/rent to potential investor or redevelop the brownfield). The ownership status may impact the success of redevelopment (e.g. mixed ownership: property belonging to several private or institutional owners, the land and buildings having different owners). Access to ownership information may be crucial for those investors that have an interest in greenfilds development.

Investors are (or may not be) interested in particular land due to their own specific reasons: good location, availability of infrastructure, good price (brownfield can be less expensive than vacant land), less time to buy/rent (with all of the necessary documents and permissions), possibility of using ESF, etc. Esentially people are interested in living in a community with a clean environment, as well as well-developed economic activities and infrastructure. Municipalities are interested in value capture of properties: provision of efficient land use, well-developed infrastructure, successful local entrepreneurship and a wealthy society that will pay more taxes. Good monitoring of efficient land use usually will result in higher local incomes, higher budgets, more local investment, less socio-economic problems, etc. Because of these interests, state and municipalities are intrested in assisting owners and entrepreneurs in revitalizing brownfields. Additional “actors” are also “third” companies that potentially can assist with construction/reconstruction/demolition works and also with other tasks depending on the profile of the new enterprise. Access to financial funds also is a crucial factor for brownfields redevelopers. Revitalizing of brownfields for most enterprises (especially SME) is not possible without the assistance (loan) of bank. [15] [20] [21]

9 STAKEHOLDERS PLATFORM

The development of the stakeholders platform is a key element of the proposed solution. It will be a complex, open access tool that will contain several modules for potential investors, “third” companies, financial institutions and managenemt of potential brownfields (under risk properties/enterprises). User registration/authorization is required to access, input and update official data in the brownfield register (e.g. relevant details about a brownfield/loss-making enterprise, desired transaction information - for sale/rent, desired sales/rental price). Entered data will complemented by some analytical attributes (e.g. location in 5/25/100 years flooding area, distance from the highway, location in protected area; etc.) that are computed by the functions triggered when the user inputs a new row into the database. The database will be filled with a large variety of geospatial and statistical data (Eurostat, national statistics departments, cadastral and geodesic national departments, national ministry of culture, EEA, etc.), which will be appropriately presented and used for analysis (e.g., finding a brownfield‘s location, local statistics, economic potential, a variety of local busineses). Access will also be provided for all corresponding legal documents (building code, easement information, strategic land plan, potential land use, available funding, etc.). The tools for the development of a business plan, communication, contracting (sale/rent proposition) and payment also will be provided. Descriptions of offered services for specific groups of stakeholders are depicted in Fig. 1 Offered services for specific groups of stakeholders. [15] [21]

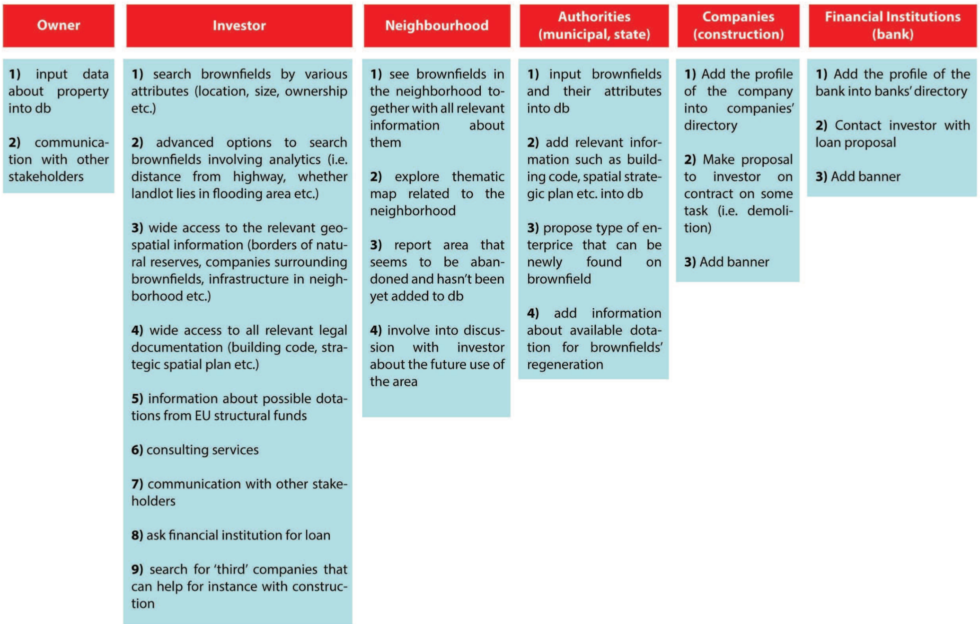

Fig. 1 Offered services for specific groups of stakeholders

10 INFORMATION REQUIRED FOR DATA INTEGRATION AND ANALYSIS

Primarily access is required to the available registers and maps from various data public/private portals. These sources may not be available in all countries. Public data bases are often updated and collected nationally and may not contain local data. The collected data are not always in a well [???] nationally [???] agreed format. In Central and Eastern Europe, the most commonly used separate registers of land and property in cadastral offices and land use planning documents [nesaprotu šo tiekumu!]. The Czech Republic, Slovakia, Poland, Latvia and UK do not use cadastral registers for recording information on brownfields.

The mapping of available evidences and the use of subsequent analysis of the development potential of brownfields must be taken into account the following information or aspects:

- the size of the territory (parcel data);
- internal characteristics of the territory (cadastral information);
- detailed functional characterization (current and past land - planning documents and other data);
- characteristics of the territory (vicinity, community, region);
- characteristics of the social and socio-cultural environment (including cultural benefits);
- characteristics of the natural environment (including air and soil pollution);
- characteristics of the regulatory environment (including land-use planning regulations)
- characteristics of the economy of the territory;
- owner’s conditions (Land Registry data);
- the location of the functional and physical structure of the city (spatial plan);
- the role of the organisation in the city;

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- existing development strategies, plans and programs for brownfield regeneration and relevant stakeholder external conditions for development.

The most important criteria and required activities for performance of economic analysis in case of regeneration of brownfields are depicted in Table 2 Criteria for economic analysis. [11] [12] [15] [21]

Phases/criteria	**Activities/information.**
Setting benchmarks and values (retrospective method)	Analysis of existing sites. Diagnosis - identification of problems and potential (analysis of key issues of environmental, economic and social nature). Identification ofownership. Adding critical attributes for decision making.
Prospective methods, visual analysis available source materials, evaluation of potential sources	Collection, standardization, transformation of data sources for further sharing (LOD), which will allow for further analysis. Descriptionof data sources. The selection of appropriate objects.
Analysis of case stydies, design of the program	Prepare infrastructure design, data model, application extensions, map portal, reports.
Implementation - methods of project management, design applications	Implementation of proposed procedures to program steps, implementation of program activities, coordination of activities, testing selected areas in real time.
Criteria of economic analysis	Objects for local business. Endogenous economic dynamics of the area. Areas dependent on external investment. Potential investment activity, strategic plans (public/private sector). Fluctuations enterprises (migration in/out). The demand/supply for retail goods and services. Property value/rental price. Structure, educational attainment. Conditions for starting a business. Availability of space for industrial, commercial and administrative purposes. The range of opportunities for local employment/the level of unemployment. Spatial mismatch between people and jobs.
Criteria of ecological analysis	Emissions from local industry/household/transportation. Polution (air/waater/soil/noise). Contamination of hazardous waste/possible loss of biodiversity. Suffitient/unsufitint open/green spaces. Risk of natural disasters (eg. floods).
Criteria of social analysis	Demography (population structure/death/birth rates/density) Migration/ethnic data Income level/ ratio of expenditure on housing in relation to income. The level of poverty/segragation/social transfers. Housing stock (availability). Social services – medicine/education The level of civic involvement/civic/sporting activities. The level of crime.
Criteria of urban structure	Barriers in th eperception of the city (image/perceptionfrom the outside and Image/perceptionfrom the inside). The image of city/urban structure/quality of housing. Vacancies for housing and facilities fo radministration. Condition of buildings (e.g. size, ownership characteristics for land and buildings, state of depretiation/renovation; state of internal wiring, quantity and quality of the socio-cultural infrastructure, the quantity and quality of technical infrastructure).
The general feeling and information available maps and other documentation	Tour of the property/situation assessment/description, Condition vegetation, animals, colors and odors. Photos/aerial photographic reconnaissance. Interview former employees, employers, neighbors, witnesses.
General Information	Details on the construction/building/project. Layout, size, span – spacing. Technical building systems, materials used, distribution networks. Resistance foundation soil.
General maps	City plan/local maps/general urban plan/zoning/flood maps. Diagram of restrictions on land use. Background GIS/cadastral map/orthophoto maps. Traffic information/maps.Plan of distribution/ transmission networks. Schemes cross links. Other documentation.
Specific maps	File of Environmental maps/layers (e.g. geologyical, hydrogeology, natural resources, geoch reactivity bedrock, foundation soil/soil, geochemical composition of surface water, geophysical indications and interpretations, geofactors - competition interests/landscape sights, protected areas and habitats, e.tc.).
Records of use	Method of use/ process, method of manufacture, applied technology. Substance use/changes in use/end use (data). Cultural/historical/landscape heritage. Ground water quality. Accidents/ dange/ sudden deaths/ fires/spills. Volume/frequency.
The information in archives and historical documents	Old city plans/previous use of the site. Rating of any related projects (reconstruction, conversion).
Comparison of legislation	Changes in the permitted concentrations/protection area/land use.

Table 2 Criteria for economic analysis [11] [12] [15] [21]

11 OPEN LAND USE DATA

The lack of land use data on a local level led to an idea of combining data from various sources and of different levels of detail into a seamless map. This idea has been picked up by the SDI4Apps project and turned into a pilot application Open Land Use Map through Volunteered Geographic Information, where an important aspect is that data is available as open data. The innovative aspect of the pilot is in the methodology of combining data into a seamless database and usingcrowdsourcing for data collection and update:

- all available open data from a certain territory is collected and stored in a database;
- data is harmonized into a common data model based on the INSPIRE data specifications on land use and using the same HILUCS classification;
- data of the highest level of detail (usually not covering the entire territory) is combined with data with second highest level of detail and so on;
- Data is published for download and as a WMS service;
- Data is updated through crowdsourcing, either online based on remote sensing images or directly in the field through a mobile application (not yet implemented).

The goal is to cover the entirety of Europe and then extend it to be a global dataset. The first country that has met this goal nationwide is the Czech Republic, where the following open data sources were used: digital cadastre data (RUIAN, highest level of detail), Land Parcel Identification System (LPIS), Urban Atlas, CORINE Land Cover for data download. The map can be also inserted into any HTML websites as an embedded object (iframe) – see Fig. 2 The steps undertaken for combining the data. [15] [17] [19] [21]

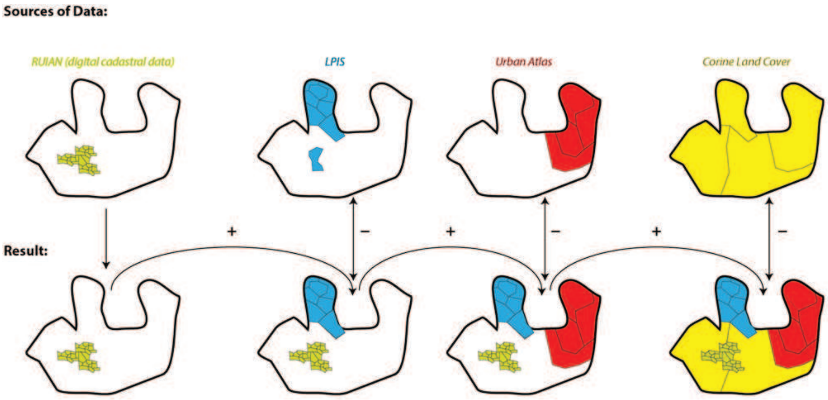

Fig. 2 The steps undertaken for combining the data[15] [17] [19] [21]

The Latvian Open Land Use map already currently includes first information about brownfileds and it is the basis for a future solution for brownfiled monitoring and assesmnt (see Fig.3. Open Land use map for Riga city, Latvia. [22]

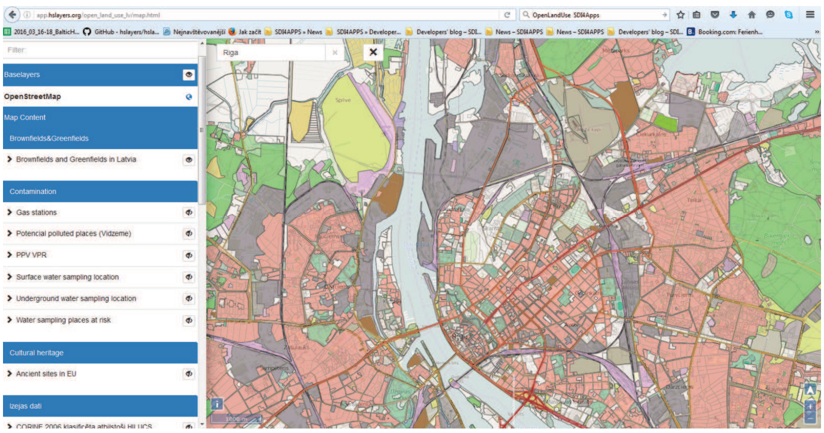

Fig. 3 Open Land use map for Riga city, Latvia [22]

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12 SOLUTION FOR SERVICES

The broker will provide services for automated data harvesting from various sources, data collection using mobile phones and mechanisms for data analysis and access through APIs and other machine to machine interfaces (See.Fig. 4 Basic scheme of Brownfields4LIFE). [15]

Fig. 4 Basic scheme of Brownfields4LIFE [15]

Different types of services will be available to different groups of stakeholders. The platform will deal with two types of information collection in regard to brownfields:

- Voluntary collected information (maps, photos integrated with OpenStreetMap) will be used only for information purposes and will be supported by Apps (mobile and web based).
- Validated data - the ideal sequence of steps thus will be as follows: the validated information will be available for registered users (e.g. for investors, banks, public authorities, spatial planners, architects). All of these groups will have the right to access information and to cooperate on revitalization.

Apart from this, the database will be filled with a large variety of supplementary geospatial and statistical data from various reliable sources on the web (Eurostat, national statistics departments, cadastral and geodesic national departments, national ministry of culture, EEA, etc.) for analytical purposes.

Part of this information is publicly available on the portal whatstheplan.eu, developed in project Plan4business through a specific API, Map Viewer and Location evaluator. Thematic viewer support visualization of different thematic maps related to spatial planning, geography, environment and economy of regions. These maps are available also for mobile clients (see Fig. 5 Thematic Map Viewer) [15] [17]

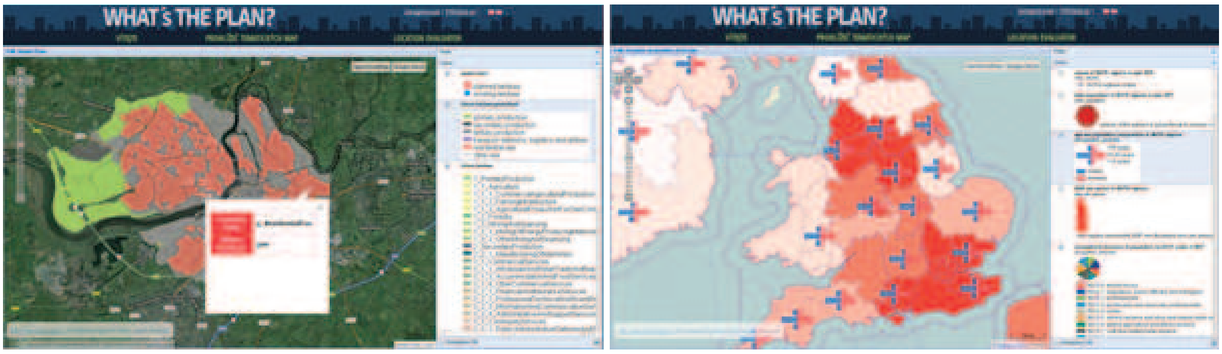

Fig. 5 Thematic Map Viewer [15] [17]

The Location Evaluator allows generation of reports from collected urban and regional data and also data about buildings in the Czech Republic. This allows the provision of assessment of specific objects on the base of existing data. (Fig. 6 Location Evaluator). [15] [17] [19]

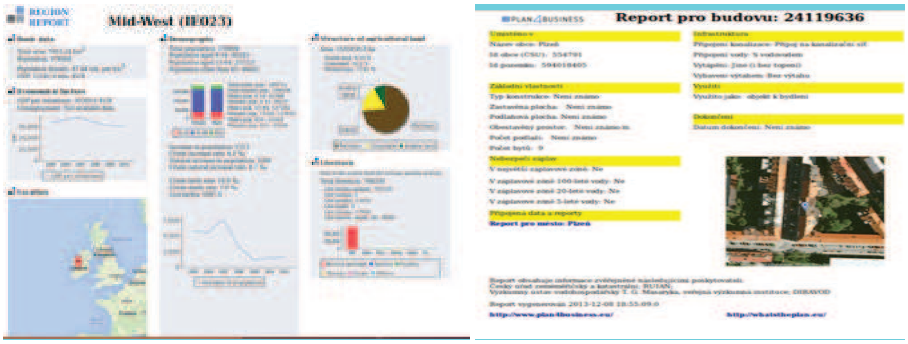

Fig. 6 Location Evaluator [15] [17] [19]

Both of the above mentioned tools will be used through the existing API by the brownfields brocker to allow for the analysis of existing brownfields in a broader context (e.g. scenario building for the process of revitalization of a specific brownfield), contact (communication) among interested parties (e.g. permitted and potential land use, building code, easements and restrictions, strategic planning documents, etc.) and to provide additional supplementary information (e.g., what local authorities would like to see on the place of the brownfield in the future, availability of funding) and to negotiate and seal contracts and provide payments. [15] [17]

13 CONCLUSION

Brownfield sites in the EU are less explored phenomenon regard to terminology, classification, economic analysis and impact, potential use and the use of ICT in brownfield related information integration and intelligent management. Brownfields regeneration is connected with issues of sustainable development: land is finite resource - needs care and effitient use. The six most important groups of stakeholders with their different interests have been identified: owner, investor, neighbourhood, local and state authotities and institutions, enterprises and financial institutions. Comprehensive studies providing an overview of stakeholders perceptions, concerns, attitudes and information needs when dealing with brownfield regeneration are still missing.

The main “actor” in the whole problem is the owner. However, owner may not skills and potential to deal with land degradation and need support. Municipalities are primaly interested in value capture of properties and are motivated to assist land owners and potential investors in brownfields redevelopment. Access to financial funds also is a crucial factor for brownfields redevelopers. Revitalizing of brownfields for most enterprises (especially SME) is not possible without the assistance (loan) of bank. International experiance (e.g. U.S. and UK) has shown that public policies and public registers can promote brownfields redevelopment and encrease quality of building stock. Stakeholders also demand more integrated information and less bureaucracy regard to search of approriate locations for enterpreneurship. The most important risks for brownfields redevelopment are connected with the current political and decission making system, data quality and integrity of national SDI, low capacity and financial power of local governments and lack of tools use PPP. Brownfields are less prepared for new development in comparission with greenfields regard to procedures, access to market and finances.

Therefore, proposed brownfields data integrator is novel: comply with demands of stakeholders, ensure solution (services) for automated brownfield related information integration from various sources, its further distribution for other purposes (reuse of collected information), also compliance with European requirements regarding the integration of spatial information (INSPIRE directive and its related activities) and use of best practices regard to ICT progress in spatial data integration.

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Can the Integration of Environmental Dimension Make Smart a Metropolitan Context? An Argument about Planning in the Recently Established Metropolitan City of Cagliari and Natura 2000 Network

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1 ABSTRACT

In accordance with Article 3 of the Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (Habitats Directive), Natura 2000 is a coherent Ecological Network (EN), distributed throughout the European Union, that includes Sites of Community Importance (SCIs) and Special Areas of Conservation[1] (SACs), mentioned in the Habitats Directive, and Special Protection Areas (SPAs), mentioned in the Directive 79/409/EEC of 2 April 1979 (Birds Directive, modified by the Directive 2009/147/EC on the conservation of wild birds).

In the context of scenarios based on ecosystem relationships, the strategic concept of EN can mitigate biological issues on natural components related to the high pressure of human activities. These activities generate impacts and fragmentations in the matrix of ecosystems.

Environmental fragmentation and connectivity of ecosystems are crucial points for implementing sustainability concepts in territorial government processes. For a good governance and to make the necessary correction in environmental management, the achievement of urban and regional quality, compared with this issues, is essential. Planning in ecological connectivity needs an appropriate conceptual EN model about the Natura 2000 Network, in order to reason about elements defined in Article 10 of the Habitats Directive.

In the last years, in Europe, the phenomenon of metropolitan growth is rising and the issue of government in metropolitan contexts assumes considerable importance. Indeed, most of the EU inhabitants live currently in metropolitan areas, where they generate more than two thirds of the Gross Domestic Product (GDP) of Europe. The European Commission, in order to the Cohesion Policy 2014-2020, urges Member States to adopt an urban agenda regarding several features (e.g. limitation of land use, urban regeneration, transport infrastructure and sustainable mobility). These aspects can help to making cities smarter integrating environmental dimension. Indeed, this work is based on the recent debate concerning Italian metropolitan cities, focusing on the environmental context of the Natura 2000 Network related to one of the most populated areas of Sardinia: the Metropolitan City of Cagliari, recently established. Many sites of the Natura 2000 Network are included in this metropolitan area and they are ruled by management plans.

In the current debate on approaches to metropolitan planning, we discuss the implementation of the Natura 2000 Network into public policy and governance, in order to achieve smart practices in planning. These approaches are decisive to set up an evaluative knowledge taking into account the eco-environmental sphere represented by the EN.

For this purpose, we propose a qualitative approach based on habitat suitability of a specific species in order to interpret its possible movements through the metropolitan area. Habitat suitability models allow to put in evidence relationships between species and environment; this constitutes an important initial basis to assess potential distribution of each species in the metropolitan area. This issue can relate to the Natura 2000 Network management, both as nodal and as connective elements, in planning in metropolitan contexts.

In our opinion, the Strategic Environmental Assessment (SEA) is a fundamental process for integrating environmental considerations into plans and programs and it allows to formulate objectives and to support monitoring of plans. We believe "environmental smart" could be meaning the implementing of this ecological concepts into public policy and governance, based on the sustainability theory. Our position is that to becoming smarter, the Metropolitan City of Cagliari should become more environmentally sustainable and aware of its environmental heritage.

Keywords: Cagliari, Management Plans of Natura 2000 sites, Metropolitan Planning, Natura 2000 Network, Strategic Environmental Assessment

[1] SACs are sites established by Member States through a statutory, administrative and/or contractual act.

2 INTRODUCTION

In accordance with McHarg (2007, p. 202), making plans into metropolitan areas has to understand natural processes, hence, we have to learn to "design with nature".

From a smart environmental perspective, we cannot avoid the environmental context on which planning should be based, because the increasing fragmentation of habitats is a consequence of human activities. One of the most critical point on the habitat fragmentation is the land connectivity reduction for species (Pereira et al., 2011; Ferretti et al., 2013). Therefore, subjects concerning EN should be annexed in planning processes, but, at present, they are lacking. To address existing lack at all levels of spatial planning, several studies (e.g. Cullotta et al., 2011) emphasize the importance of integrating multi-disciplinary aspects in planning in the field of EN.

The SEA is a fundamental process that allows the integration of these aspects. Indeed, according to the European Directive 2001/42/EC, if plans and programmes have an impact on the environment, the strategic environment assessment is required. This assessment involves the systematic identification and subsequent evaluation of environmental impacts of strategic actions and it considers social, environmental and economic effects of plans or programmes.

This work aims to propose an analytical approach to integrate the Plan of the Metropolitan City of Cagliari and habitat suitability models, during the drafting of the SEA, taking into account an environmental relationship between land spatial elements and the perception of a species (or groups of species). We discuss, in particular, both about the current situation of the Natura 2000 Network, and about how general ecological aspects can be integrated into spatial planning.

The paper structure is organised as follows.

In section 3, we discuss some general concepts about EN, to introduce the Natura 2000 Network and describe some aspects of sites management. In section 4, we describe the Natura 2000 Network in the Metropolitan City of Cagliari. Initially, we draw attention to some aspects about the metropolitan governance; then, we provide an analysis of the metropolitan context with reference to the Natura 2000 Sites. In section 5, we propose a qualitative approach based on habitat suitability, using data available in literature which concerns only the inner part of the sites of the Regione Autonoma della Sardegna (RAS) [Autonomous Region of Sardinia]. The purpose of our approach is to extend existing data throughout the Metropolitan City of Cagliari. Hence, we select a species that, in addition to the availability of data, is also representative of a critical situation for its preservation. Finally, after discussing data and results obtained, we draw attention to the connectivity for species dissemination and conservation with a potential ecological corridor in the metropolitan area, emphasizing problems associated with wide-area planning in reference to the Natura 2000 Network. In sections 6 and 7, we discuss some issues to integrate this environmental dimension in metropolitan planning into the SEA. Our proposal concerns integrating an analytical approach, based on habitat suitability, inside the SEA process, in order to planning and formulating strategic objectives for a sustainable development, enabling the materialization of an EN within the metropolitan context.

In our opinion, the integration of this environmental dimension about ecological aspects make the metropolitan context smart.

3 ECOLOGICAL NETWORKS

3.1 General concepts about ecological networks

In scenarios based on ecosystem relationships, the strategic concept of EN allows to minimize ecological problems related to high pressure due to human activities on natural components. These activities, like use of unsuitable agricultural and forestry practices, pollution, spread of exotic species, infrastructure construction and urbanization, have significant impact on the environment and cause changes and fragmentation of the ecosystems matrix. EN should be a role model for conservation, protection and management of biodiversity within processes of land use government, through a systemic approach in planning decision making processes (D'Ambrogi et al., 2013).

In landscape ecology, the movement of the species in the EN is ensured through important elements for wild fauna and flora, and mentioned as ecological corridors, but, about this matter, we need to distinguish the concept of "connectedness", from the more complex concept of "connectivity" (Baudry et al., 1988).

The first concept regards the physical contiguity between kinds of ecosystems and/or populations. The second concept takes two components into account: the first is a structural element and it depends on the spatial position of ecosystems, on their physical continuity, on the presence, type and size of natural or anthropic elements; the second is a functional element and it regards the species perception scale, and their ecological and behavioural requirements, including their degree of specialization. Therefore, there is a substantial difference between physical and territorial aspects, and ecological and functional aspects about the concept of spatial “restitching” relatively of wild species mobility (Battisti, 2004; D’Ambrogi et al., 2015).

3.2 The Natura 2000 Network

Natura 2000 is a coherent EN, established in accordance with Article 3 of the Habitats Directive in order to protect biodiversity, to conserve wild flora and fauna species, and natural habitats existing within the Member States, taking economic, social, and cultural requirements into account, as well as regional and local characteristics. This EN includes SCIs and SACs, designated under the Habitats Directive, and SPAs, designated under the Birds Directive.

In relation to habitats and species, the ecological coherence should be a function not closely bound up with individual sites, but also with their overall interrelation with the entire network. In this context, the concept of ecological corridors plays an essential role.

In the Decree of the President of Italian Republic (DPR) no. 357 of 8 September 1997, Article 2, paragraph 1, letter p, there is a first definition of connective elements, about ecological corridors, as “aree di collegamento ecologico funzionale [functional ecological linking areas]”, in relation to Article 10 of the Habitats Directive. Consequently, in order to improve the ecological coherence of the Natura 2000 Network, a smarter spatial planning should integrate elements that are of major importance for wild fauna and flora, which may be construed as connective elements essential for migration, geographical distribution, and genetic exchange of wild species. Therefore, planning in the context of EN assumes a crucial importance with particular regard to priority natural habitat types and priority species.

3.2.1 The sites and their management

In accordance with the principle of environment integration into other Community policies, to contribute to the coherence of the Natura 2000 Network, the Habitats Directive, in Article 6, paragraph 1, introduces the management plans as “specifically designed for the sites or integrated into other development plans”. In Italy, this issues are transposed by the DPR 357/1997, and subsequent amendments, where conservation measures may involve, when necessary, appropriate management plans, in order to regulate activities and to maintain sites in a good state of conservation, and to establish protection rules. The Ministerial Decree of 3 September 2002 introduces national guidelines for the management of the Natura 2000 Sites; these management plans are not always necessary, but, when they are drafted, they should take the peculiarities of sites and all planned activities into account. However, drawing up a management plan is important, inasmuch conventional spatial planning seldom ensures the integration of environmental objectives in planning practices.

In Sardinia, management plans for all sites of the Natura 2000 Network are compulsory, according to regional guidelines for drawing up management plans of SCIs and SPAs. Moreover, regional guidelines describe when the process of management plan has to be accompanied by SEA, and instead when the process of management plan has to be submitted to screening.

4 THE NATURA 2000 NETWORK WITHIN THE METROPOLITAN CITY OF CAGLIARI

In Sardinia, the Natura 2000 Network consists of 31 SPAs, 87 SCIs and 6 SCIs/SPAs; no SCI has become SAC yet.

In this work, the proposed reflection lays the foundation in the recent regulatory fervour regarding metropolitan cities, reasoning about one of the most populated areas in Sardinia: Cagliari and its extended hinterland.

The Metropolitan City of Cagliari, recently established, consists of 17 municipalities where 16 sites of the Natura 2000 Network are included (12 SCIs and 4 SPAs, see Fig. 1 and Table 1). As such, this new authority should adopt a new spatial plan able to address on smart management the metropolitan area and, in this context, the role of the SEA will be essential.

4.1 Some aspects about the metropolitan governance

Metropolitan cities are local authorities acknowledged by the Italian Constitution. The Italian Law no. 56 of 7 April 2014 attributes to metropolitan cities the same functions of provincial administrations. In addition, other functions are the adoption and the annual update of a three-year metropolitan strategic plan, and general spatial planning.

In Sardinia, the Regional Law no. 2 of 4 February 2016 establishes the Metropolitan City of Cagliari as local authority. According to the Regional Law no. 9 of 8 September 2006, functions of provincial administrations (consequently now also of the Metropolitan City of Cagliari) are the protection and the enhancement of natural environment, and the protection of flora and fauna.

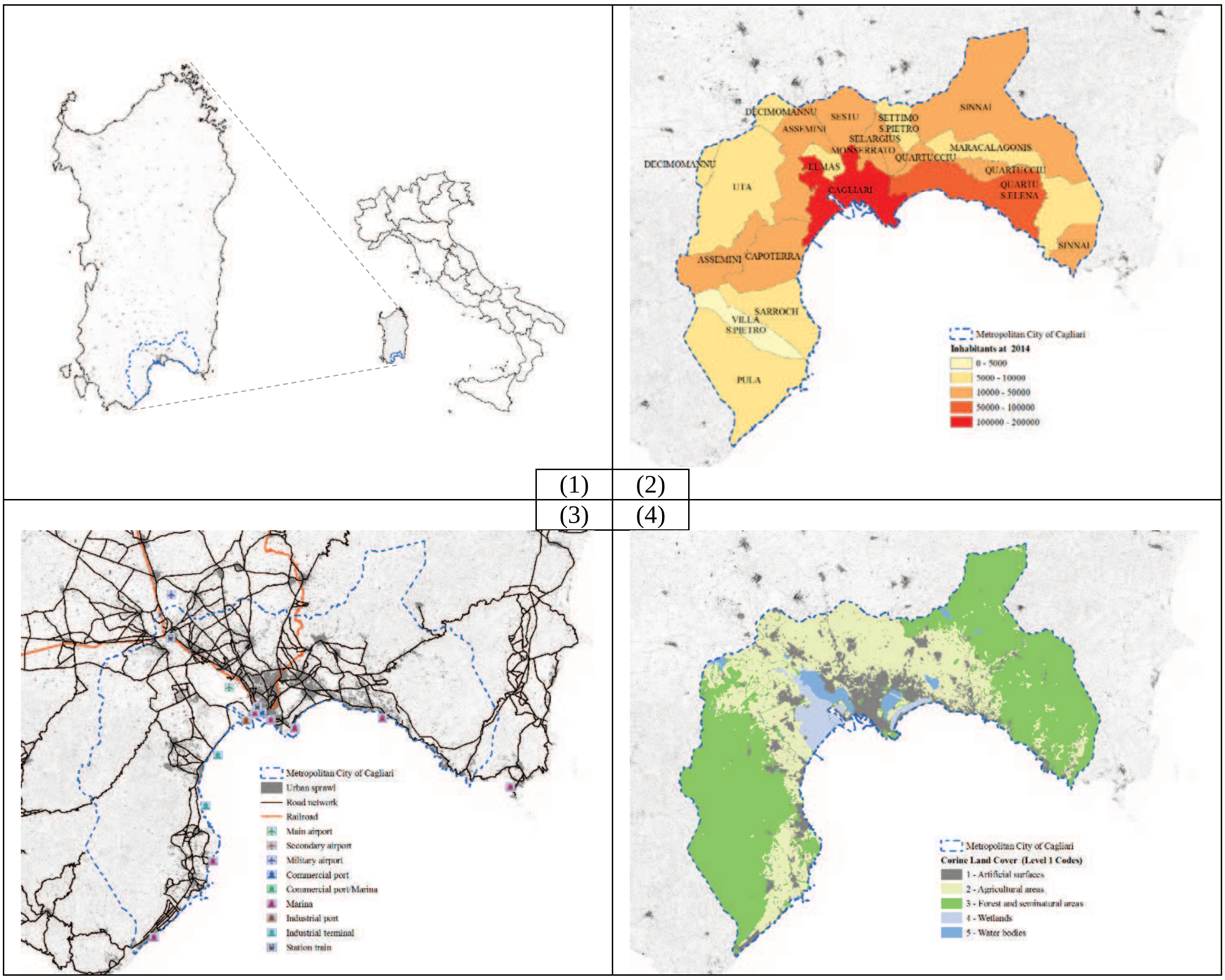

Fig. 1: the metropolitan context of Cagliari. In (1), the geographical information; in (2), the 17 municipalities classified by population; in (3), the main transport network; in (4), the land use based on level 1 Corine Land Cover. Source: authors' elaborations.

4.2 Context analysis of the study area

The Metropolitan City of Cagliari is located on the southern coast of Sardinia and includes: Assemini, Cagliari, Capoterra, Elmas, Monserrato, Quartu Sant'Elena, Quartucciu, Selargius, Sestu, Decimomannu, Maracalagonis, Pula, Sarroch, Settimo San Pietro, Sinnai, Villa San Pietro, Uta. The population is approximately 430,000 inhabitants, and Cagliari and Quartu Sant'Elena are the municipalities with the highest number of inhabitants. The total area amounts to 1,247 km2, about the 5% of the surface area of Sardinia. In the metropolitan context there are some of the most important strategic transport poles for Sardinia's Island, such as ports (Marina, commercial and industrial port) and airports (the main, the secondary and the military airport), as shown in Fig. 1, panel 3.

The land use, based on level 1 Corine Land Cover[2] (CLC), is classified in: the 10.2% of the area is artificial; the 31.9% is agricultural; the 52.3% is forest and seminatural; the 3.3% is wetlands; and the 2.3% is water bodies. Artificial areas, with wetlands and water bodies, are concentrated in the central part of the metropolitan area, surrounded by agricultural areas; forest and seminatural surfaces are mainly placed in two large opposed bands, one in West and one in East.

This configuration shows a clear mirror structure of the metropolitan area compared to the Municipality of Cagliari, which is located in a central position and constitutes the centre piece attraction that over time has resulted to the urbanization process of the context.

4.3 The Natura 2000 sites in the study area

In the metropolitan area, 16 Natura 2000 Sites (12 SCIs and 4 SPAs) are included (Fig. 2). Some sites are partially outside the metropolitan boundaries. The area of sites included in the metropolitan context amounts to 366 km2, about 29% of the metropolitan city area.

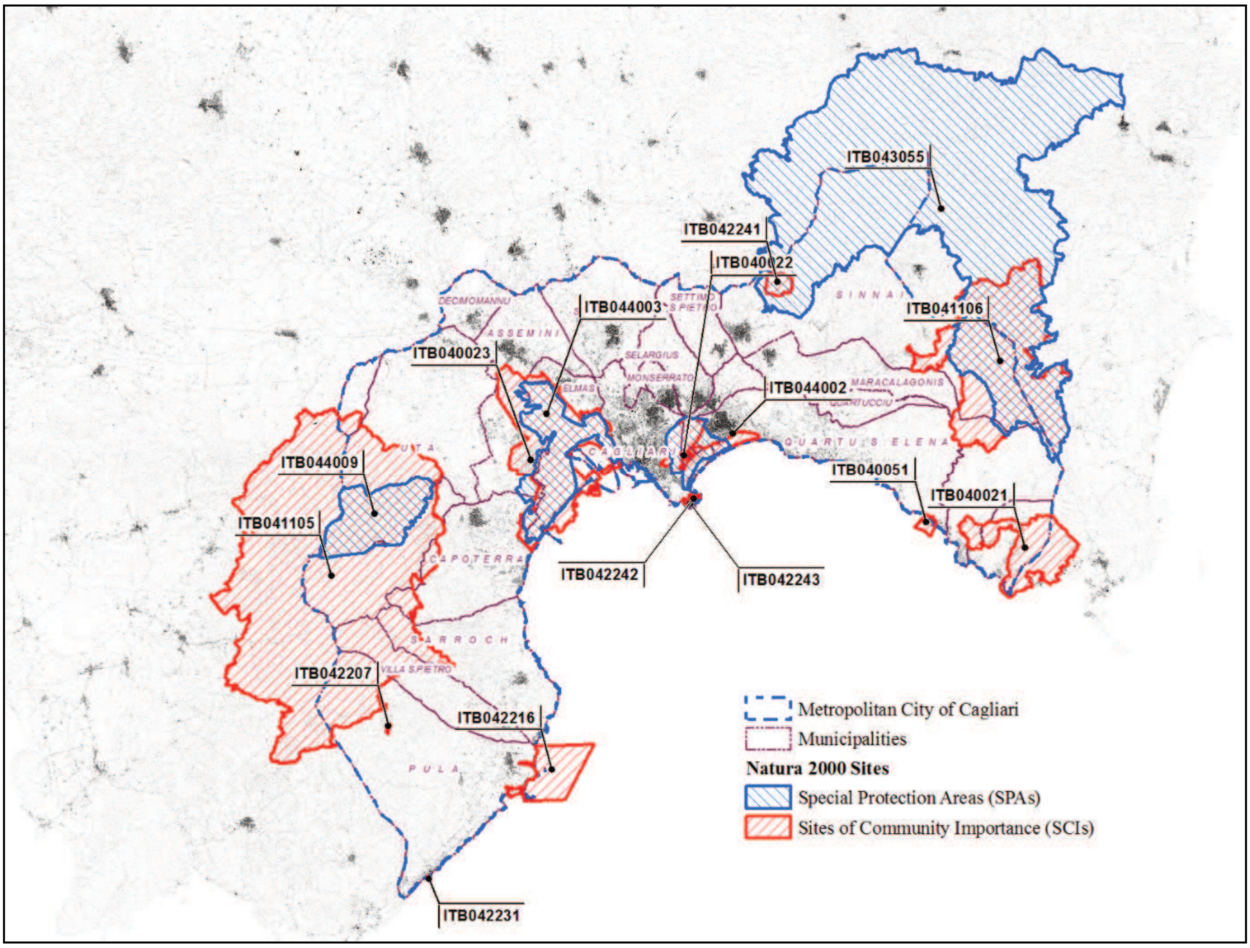

Fig. 2: The Natura 2000 Sites in the Metropolitan City of Cagliari. Source: authors' elaborations.

Type	N.	Natura 2000 Sites		Management plan
SCI	1	ITB040021	Costa di Cagliari	Approved
	2	ITB040022	Stagno di Molentargius e territori limitrofi	Approved
	3	ITB040023	Stagno di Cagliari, Saline di Macchiareddu, Laguna di Santa Gilla	Approved
	4	ITB040051	Bruncu de Su Monte Moru, Geremeas (Mari Pintau)	Approved
	5	ITB041105	Foresta di Monte Arcosu	Approved
	6	ITB041106	Monte dei Sette Fratelli e Sarrabus	Approved

[2] The European programme Corine Land Cover aims to constitute a homogeneous database on cover and land use and its changes over time. Other information is available at: http://www.eea.europa.eu/publications/COR0-landcover.

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	7	ITB042207	Canale su Longuvresu	Approved
	8	ITB042216	Capo di Pula	
	9	ITB042231	Tra Forte Village e Perla Marina	
	10	ITB042241	Riu S. Barzolu	Approved
	11	ITB042242	Torre del Poetto	Approved
	12	ITB042243	Monte Sant'Elia, Cala Mosca e Cala Fighera	
SPA	13	ITB043055	Monte dei Sette Fratelli	In approving (with SEA)
	14	ITB044002	Saline di Molentargius	-
	15	ITB044003	Stagno di Cagliari	-
	16	ITB044009	Foresta di Monte Arcosu	In approving (with SEA)

Table 1: The sites of the Natura 2000 Network in the Metropolitan City of Cagliari.

Only two of the four SPAs are not endowed with a management plan (ITB044002, ITB044003), while the other two SPAs are endowed with a management plan and with SEA process (ITB043055, ITB044009). Each SCIs is endowed with a management plan, but in two cases a single management plan is established for multiple sites: one is the case of ITB042242 and ITB042243 sites, which are completely contained in the Municipality of Cagliari; and the other one is the case of ITB042207, ITB042216, and ITB042231 sites, which are completely contained in the Municipality of Pula. No SCI management plan possesses a SEA process.

In the Natura 2000 Sites, into the metropolitan context, there are 90 species of Community interest: 3 amphibians, 63 birds, 3 fishes, 2 invertebrates, 9 mammals (one of which is a priority species: Cervus elaphus corsicanus), 6 reptiles (one of which is a priority species: Caretta caretta) and 4 plants (one of which is a priority species: Carex panormitana).

5 A QUALITATIVE APPROACH FOR HABITAT SUITABILITY ASSESSMENT FOR A SPECIFIC SPECIES

The followed methodology to analyse the metropolitan context of Cagliari is based on a dual approach linked to territorial and ecological aspects. Maintaining a physical and territorial, and an ecological and functional continuity within natural environment is an eligible strategy to be considered during the planning processes, which would mitigate fragmentation effects in favour of a better ecological connectivity (Battisti, 2004).

The particularity of this dual approach is developing a habitat suitability map, based on suitability species-specific values and on land uses, with literature data. In this way, it is possible to investigate both suitable elements for species displacements, and elements that simultaneously constitute resistance to the movement. This resistance could be described as effect of physical characteristics preventing rate of flow of species, energy, and material (Forman, 1995, p. 279; EEA, 2014). For a specific species, resistance values could be simply selected by similarity of elements to suitable habitats; consequently, a study area could be subdivided into more-suitable and less-suitable like habitats, so less-suitable elements could be represented as major resistance (Forman, 1995, p. 279). These maps, processed for the whole metropolitan area, allow to locate potential movements of a species: from one side, a physical sense given by land use meanings; from the other side, a perceptive scale of species examined in the context.

A similar approach is suggested in several studies (Massa, 2001; Boitani et al., 2002; Marull et al., 2005), and in our work it is qualitatively applied to the context of the Metropolitan City of Cagliari.

5.1 Description of materials and input data

Used data in the applied methodology to this study are based on two conceptual types:

- spatial data that describe environmental variables, such as land use classes of level 3 and infrastructure networks data;
- spatial perception data on species compared to a particular land use, such as suitability of fauna species-specific values.

5.1.1 The land use maps

A land use map[3] was built by the RAS in 2008, in 1:25,000 scale, on the Roma40-GaussBoaga West-zone reference system. The map is a geographical database of the land cover of Sardinia; the legend, adapted to the local situation, respects the standard coding and the classification methodology of CLC entities. Database contains both areal and linear elements. Areal elements are related to land use classes and their classification is until level 5. Linear elements represent: potential hydrographic network with canals and waterways, and rivers, streams and ditches; transport infrastructures with railway network and allowed space, and road networks and ancillary spaces.

In our study, as baseline reference for physical analysis of the land suitability, we assume the level 3 CLC.

5.1.2 The monitoring system

Since 2010, a monitoring system of conservation status of habitats and species of Community interest has been implemented by the RAS (RAS, 2010). Among the attachments of this report, there are several elaborations about fauna suitability maps and values, in 1:10,000 scale. These maps are built only for the space included into the Natura 2000 Sites boundaries. For each land use class (specifically for level 3 CLC) species-specific values of habitat suitability have been associated. These values have been derived directly from the “Rete Ecologica Nazionale [National Ecological Network]” (REN, see Boitani et al., 2002).

The REN is a similar approach taken at Italian level for the protection of several fauna species. Despite this, the list of fauna species, analysed in the REN, does not include all species listed in the Habitats Directive and contained in standard data forms. Consequently, in Sardinia habitat suitability values are identified, over land use, but not for all species.

The suitability values available in these cartographic products are organised as follows:

- 0 (not suitable): spatial elements that do not meet the ecological requirements of species;
- 1 (low suitability): spatial elements that can support presence of species, but not stably over time;
- 2 (average suitability): spatial elements that can support stable presence of species, but that are not optimal places;
- 3 (high suitability): spatial elements that are optimal places for permanent presence of species.

As baseline for our analysis, we assume these fauna suitability maps in order to effectively identify potentially suitable areas to host fauna species of Community interest, not just within the Natura 2000 sites, but also within the entire metropolitan area. In our view, these assumptions are useful for a smarter management and planning of the metropolitan area in a perspective of eco-environmental dimension.

5.2 The selection of the species for analysis

5.2.1 The species chosen: Euleptes Europaea

The Euleptes Europaea (previous scientific name was Phyllodactylus Europaeus and in Italian is known as Tarantolino) is a reptile and is an endemic species of the west-central Mediterranean. The species prefers coastal areas and lives especially in large Mediterranean islands, as Corsica (France) and Sardinia (Italy). Its habitat and ecology preferred are arid and rocky areas, such as cliffs, boulders and stone walls in agricultural land and it can be relatively abundant within suitable habitat. This species may be encountered in abandoned houses, but it largely avoids areas of maquis vegetation, woodland and urban areas. Euleptes Europaea is a nocturnal species and its diet is constituted by insects, spiders and vegetables. Particularly, in Sardinia this species[4] is locally threatened by habitat loss resulting from fires, picking recreational purposes and urbanization (Corti et al., 2009).

The Euleptes Europaea is mentioned in the standard data forms of seven Natura 2000 Sites within the Metropolitan City of Cagliari: ITB040021, ITB041106, ITB042216, ITB042241, ITB042242, ITB042243, ITB043055.

[3] The last updated land use map, referring to 2008, can be downloaded from the RAS website by interoperability services on GIS: WFS services for vector data of SITR-IDT available at:
http://webgis.regione.sardegna.it/geoserver/ows?service=WFS&request=GetCapabilities, version: 1.1.0.

[4] Other information is available at: http://www.sardegnaambiente.it/j/v/159?c=1582&s=9024&t=1&v=2.

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5.2.2 The grounds for selecting the species

In this study, the species selection is conditioned by the availability of data and information. Indeed, as mentioned earlier, suitability values, derived from the REN, do not concern all species of the Habitats Directive and, therefore, not all species existing in Sardinia can be studied with an approach based on habitat suitability values compared to land use. In particular, the choice is based on the assessments contained in the "Quadro di Azioni Prioritarie per la Rete Natura 2000 della Regione Sardegna – Periodo di programmazione 2014-2020 [Prioritised Action Framework for the Natura 2000 Network of the Sardinia region, programming 2014-2020]" (RAS, 2014, p. 41), where the conservation state of some species is evaluated, in accordance with Article 17 of the Habitats Directive, for the whole region.

This assessment sets species according to the following definitions, agreed at the Community level:

- Conservation status "FV – Favorevole [Favourable]": species able to thrive without any change of management and strategies currently in place.
- Conservation status "U1 – Sfavorevole/inadeguato [Unfavourable/inadequate]": species that require a change of management policies, but not endangered.
- Conservation status "U2 – Sfavorevole/cattivo [Unfavourable/bad]": species in serious danger of extinction (at least locally).
- Conservation status "XX – Sconosciuto [Unknown]": inadequate information to make a judgment.

Table 2 shows the evaluation of the conservation status of the Euleptes Europaea species. The choice of this species depends on whether it is in a state not overly critic, which allows to mitigate situation by taking appropriate measures.

Species	Range	Population	Habitat	Future Prospects	Overall Assessment
Euleptes Europaea	FV	U1	U2	U2	U2

Table 2: The assessment of the conservation status of the Euleptes Europaea. Source: RAS (2014).

5.3 The Habitat suitability approach

Habitat suitability models allow to integrate relationships between species and environment and, therefore, they represent a powerful tool for supporting hearings and projects relating to conservation and regional planning. A habitat suitability assessment constitutes an important initial basis to plot potential distribution of every single species in the area (Boitani, 2002, p. 34).

Using data and materials, as described above, we process the habitat suitability map, as shown in Fig. 3, for the Euleptes Europaea species in the context of the Metropolitan City of Cagliari.

Regarding Fig. 3, panel (1) represents the habitat suitability map, specifying: in red areas with zero value; in yellow areas with low suitability; and in green areas with average suitability; while there are no level 3 areas with high suitability, because level 2 is the highest suitability for this species in this study. Panel (2) highlights sites where the Euleptes Europaea presence is detected (according to data extracted from the standard data forms transmitted to the European Community on 2015). Panel (3) highlights all 16 sites that interest the metropolitan area. Panel (4) indicates, in green dashed line, a potential species-specific "ecological corridor", which is an ideal path that the test species could take during a hypothetical movement from East (areas where it is listed) to West (areas where there are a lot of values equal to 2).

However, it is important to highlight that the species behaviour depending on the scale of its perception, its mobility and ecological profile. Consequently, functional connectivity is species-specific and there are no "universal corridors" to support all movement through fragmented habitats or an exclusive valid scale to study ecological connectivity (Gurrutxaga et al., 2010).

5.4 Issues associated with the spatial planning and the Natura 2000 Network

Reduction and fragmentation of natural habitats are considered one of the main reasons of critical issues involving biodiversity, as a result of intensive farming practices, excessive urbanisation and infrastructure networks. Into the ecological field, the spatial planning plays an important role in conservation policies and strategies, recognising the need to integrate issues related to the eco-environmental dimension (Ferretti et al., 2013).

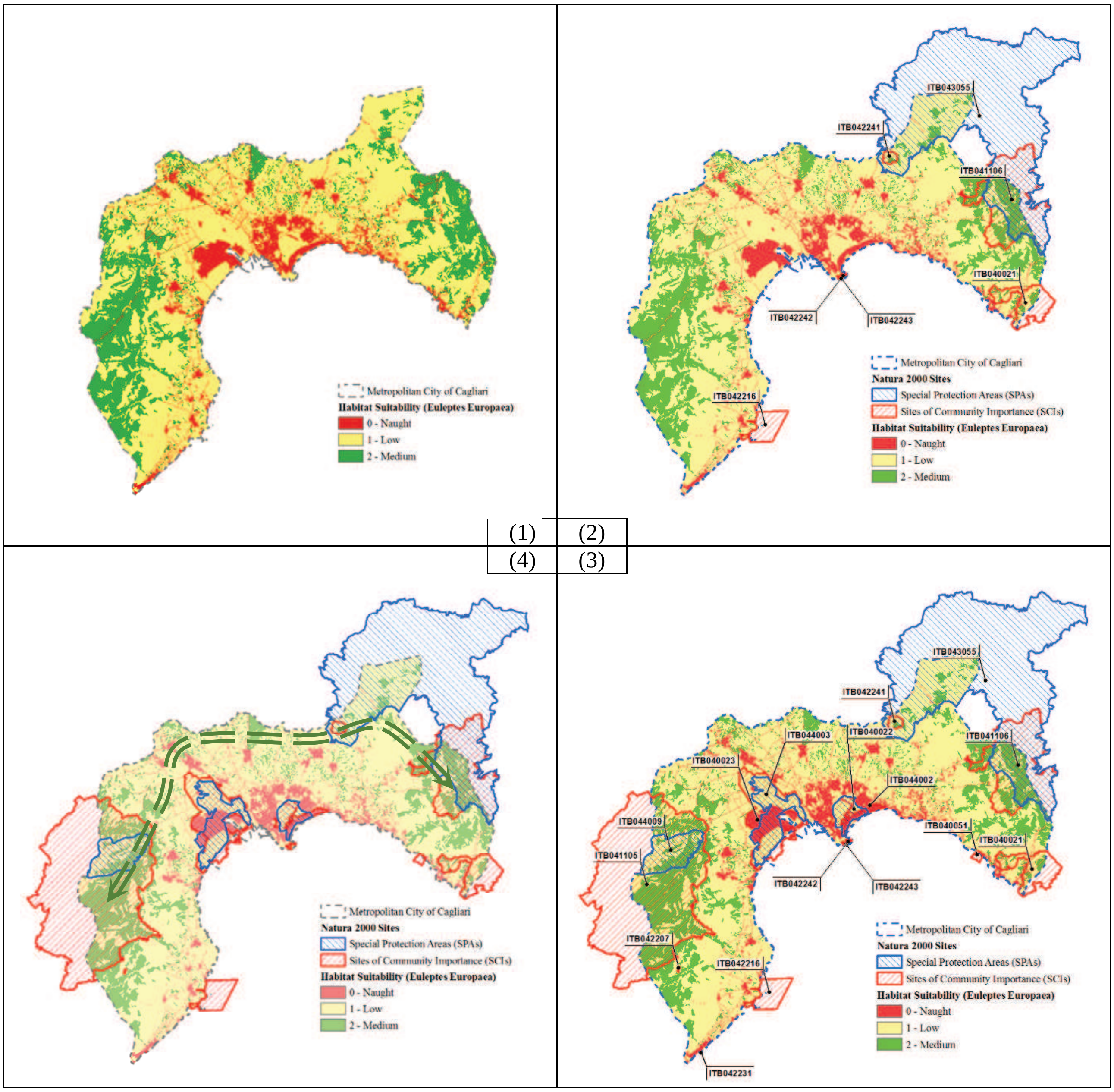

Fig. 3: Habitat suitability maps of the Euleptes Europaea in the metropolitan context of Cagliari. Source: authors' elaborations.

The Metropolitan City of Cagliari shows the highest population density in the central area and along the coast. From an ecological and functional point of view, physical elements, in particular such as main road infrastructures in central sector, seem to be an almost insurmountable obstacle between East and West (Fig. 4). In the "Rapporto ambientale del Piano Urbanistico Provinciale/Piano Territoriale di Coordinamento della Provincia di Cagliari [Environmental Report of the Master Plan of the Province of Cagliari]", a critical issue, already reported, is that a provincial emergency is attributable to the wetland system (located in middle position, as shown in Fig. 1, panel 4) in the area of Cagliari (Provincia di Cagliari, 2011); in fact, from an environmental point of view, this area is threatened by urban and industrial pressure. These factors influence quality and ecological functions due to the settlement growth, compromising opportunities of relationship with inland environmental systems.

The implementation of ENs, through identification of connective elements, into environmental policy-making should mitigate the critical aspect shown in Fig. 4. Western sites, where the Euleptes Europaea species is not listed among the species present in standard data form, have a potential suitability according to the highest value. Therefore, at planning level it is necessary to take possible movements of the species into account within the metropolitan area, anticipating critical issues that the plans could generate.

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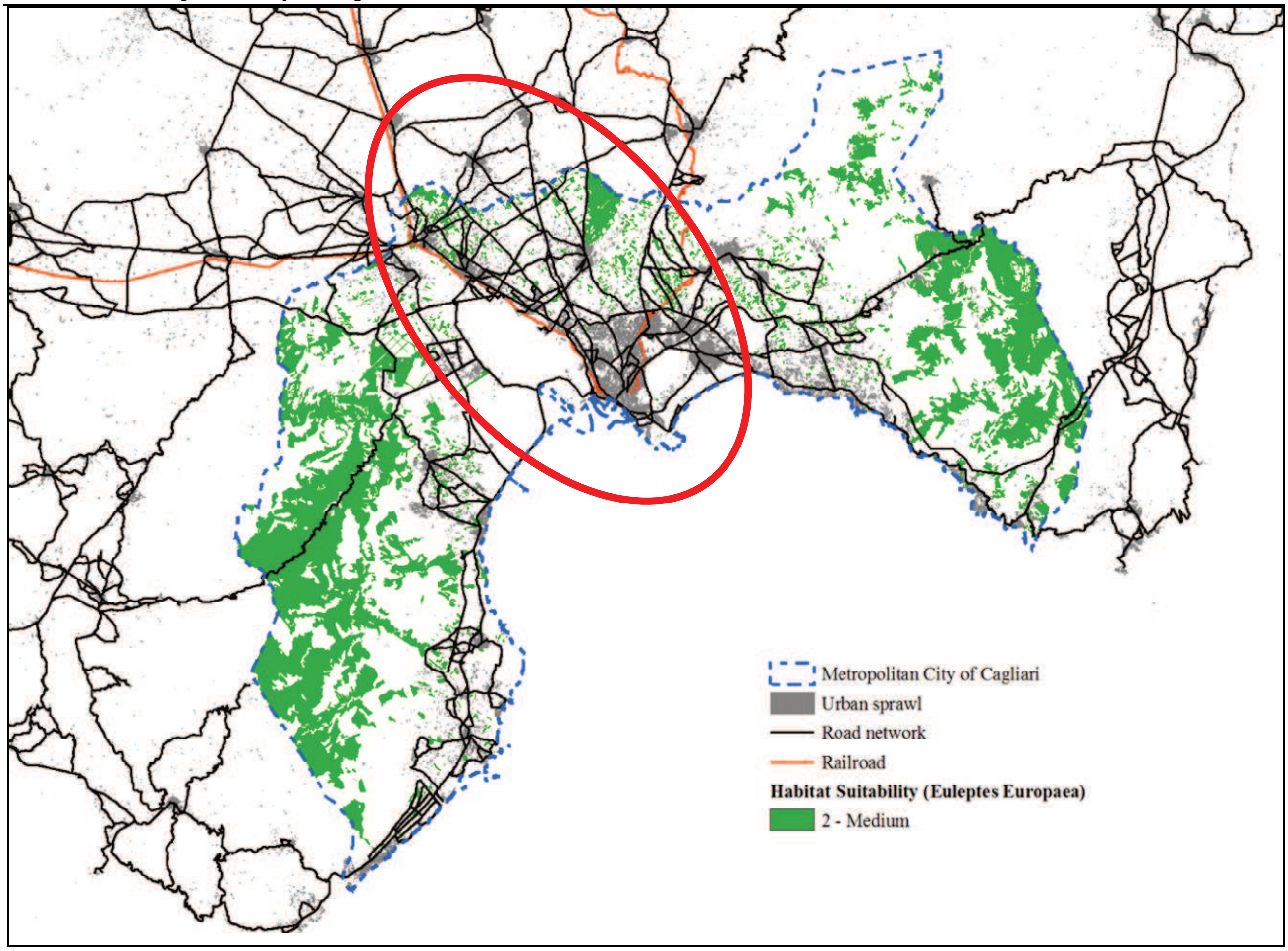

Fig. 4: Bordered in red, the main critical area for the Euleptes Europaea in the metropolitan context of Cagliari. Source: authors' elaborations.

Furthermore, the management plans of the Natura 2000 Sites, included in the metropolitan area, are specific for each sites and they do not relate with the other management plans of sites nearby. Moreover, they do not assess external elements that can mitigate this critical situation, and they do not address the concept that species can migrate from one to another site. Not even in the only two cases of the SEA process of SPAs Management Plan, these critical issues are addressed or mitigated.

In fact, an EN implemented into a large area may not be the only integration of all species-specific networks, but it should be a comprehensive assessment of the whole context, based on the knowledge of ecological functionality. In this way, it is possible to build a network model, regarding functions of species in relation to dynamic, structural, and ecological characteristics (MATTM, 2009, p. 8).

In our study, the analysis related to examined species has identified obvious weaknesses. These weaknesses need to be addressed in completing the configuration of network and, at metropolitan level, spatial planning has to provide elements of environmental reinforcement and improvement.

6 INTEGRATING ENVIRONMENTAL DIMENSION INTO METROPOLITAN PLANNING BY STRATEGIC ENVIRONMENTAL ASSESSMENT AND MANAGEMENT PLANS

The need to read the territory from an environmental point of view has become a priority, and planning sciences have to transpose their theoretical basis (Battisti, 2001, p. 40).

Metropolitan planning should define overall strategy to be pursued at municipal level, where an EN may be materialised. In this sense, metropolitan planning assumes the role of coordinator for the EN, providing support guidelines for training local plan.

According to the "Manuale per la gestione dei siti Natura 2000 [Manual for Management of the Natura 2000 Sites]", metropolitan area is one of the spatial government levels to integrate environmental concepts into planning processes (MATT, 2002).

Our opinion is that the EN could be integrated into planning as dialogue on environmental, economic, social, political issues aimed at the sustainable urban development. Conventional urban and regional plans do not always guarantee the integration of environmental objectives.

Boitani (2000), Battisti (2003) and Boitani et al. (2007) (as cited in MATTM, 2009, p. 9) explain that the EN should fit both between environmental spatial planning strategies and among those of conservation. Therefore, from this perspective it is not possible to develop strategies that may be defined without specifying conservation objectives over time and space. Indeed, relatively to EN, a weakness of plans is represented by the lack of specific objectives and indicators that can be monitored over time, so as to allow the assessment of these measures.

About ENs, the role of the SEA process, related to the metropolitan plan and management plans of the Natura 2000 Sites, becomes crucial to formulate objectives and to support the monitoring phase.

As illustrated in the previous section, a habitat suitability approach provides a picture of the potential suitability of species to environmental and land use variables considered. In addition, it is useful to represent the relationships between habitat and species in a simple and easily understandable form. The integration of this approach in planning process, placed in the SEA process of management plans and metropolitan plan, should allow for a better management of the metropolitan environment, identifying policies or practices that might cause destruction or reduction of important habitat for species. This enables to evaluate different scenarios corresponding to different changes due to planning decisions, thus closely related to land use changes (e.g. the prediction of new areas for housing, infrastructure networks, ...).

Indeed, a habitat suitability model is useful, as well as to design networks, also to address spatial planning, monitoring of network and environmental system, and to verify land use transformations (MATTM, 2009, p. 19). Numerical indicators, which take an initial state of species suitability (also in percentage terms) into account, could be implemented, and they can be monitored over time.

Analysis and modelling of ecological connectivity have been one of the objectives of several methodological studies based on ecological principles, which combine them with planning in pragmatic approaches (Marull, 2005). However, there are some restrictions, such as the difficulty to validate field data, thus their accuracy is often not high.

In our study, the model means a qualitative rather than quantitative sense, in order to provide, in a wide-area scale, decision support elements in planning process, even during the phase of environmental assessment. Moreover, specific conservation actions should be supported, in a detailed multidisciplinary context, by specific quantitative analyses. A similar approach requires: a good understanding of ecological requirements of the species within the area; uniform spatial data of the study area; and the results should be translated into estimates.

In our opinion, if the metropolitan plan is developed under the perspective of the EN integration, then its smart environmental value is highlighted by strategic policies for development and transformations. Indeed, the metropolitan plan takes the meaning of the ENs integration factor, as structural pillar of future spatial planning, and it will direct municipalities to the task of developing an EN design more detailed.

7 CONCLUSION

In this work we describe an example of an ecological analysis approach applied in the Metropolitan City of Cagliari. We use species-specific habitats suitability models to analyse the ecological connectivity, which is interpreted as the vocation of the metropolitan context to be crossed by species. In our view, this approach could be a good starting point for sustainable land management and evaluation of environmental conditions. We think that this analysis, integrated in the SEA process, allows to define objectives on protection of the ecological and natural heritage, and to improve the coherence of the Natura 2000 Network. A similar method starts from a deep knowledge of physical and functional elements with reference to the conservation of species. In addition, it can be a crucial moment in spatial planning, because taking species relationships with land uses into account, the critical points may be rapidly identified. Thus, this analysis becomes an essential element in the planning decision-making process.

In our work, this approach describes only an empirical purpose and should be accompanied by more extensive global data, in order to implement a sensitivity analysis and verify the robustness of results.

Therefore, fauna and flora specific findings would be useful to verify the correlation between the interest species presence and structural elements. In this way, this approach could be adjusted, from a simple qualitative approach, to a quantitative approach based on validated data from professionals, such as naturalists and zoologists, since this is an open field widely suitable for a multidisciplinary confrontation.

Our study shows the critical issue related to a specific species that try to cross the metropolitan area of Cagliari from East to West. The metropolitan plan, based on the concept of sustainability, might address land use choices, even considering aspects of EN, which should be even more detailed in planning in local municipalities. In our opinion, this issue is important to implement sustainability concepts into the metropolitan planning.

If the ambition of the Metropolitan City of Cagliari is to become a smart metropolitan city, at least from the environmental point of view, the Metropolitan City of Cagliari should recognise the EN existing in its context and should become aware of its environmental heritage.

8 ACKNOWLEDGEMENTS

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10 ACRONYMS

CLC: Corine Land Cover
DICAAR: Dipartimento di Ingegneria Civile, Ambientale e ARchitettura [Department of Civil and Environmental Engineering and Architecture]
DPR: Decreto del Presidente della Repubblica [Decree of the President of Italian Republic]
EC: European Commission
EEA: European Environment Agency
EEC: European Economic Community
EN: Ecological Network
EU: European Union
GDP: Gross Domestic Product
MATT: Ministero dell'ambiente, della Tutela del Territorio [Ministry of the Environment, and Protection of Land]
MATTM: Ministero dell'ambiente, della Tutela del Territorio e del Mare [Ministry of the Environment, and Protection of Land and Sea]
SAC: Special Area of Conservation
SCI: Sites of Community Importance
SEA: Strategic Environment Assessment
SPA: Special Protection Area
RAS: Regione Autonoma della Sardegna [Autonomous Region of Sardinia]
REN: Rete Ecologica Nazionale [National Ecological Network]

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reviewed paper

City Lab Lisbon – Development of a Smart Roadmap for the City of the Future

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1 ABSTRACT

Lisbon is a city with more than half a million inhabitants and one of the most touristic capitals in Western Europe, constantly trying to find ways to deal with challenges in a smart and sustainable manner. How to turn Lisbon into a more inclusive, connected, and resilient city going into the future, is the question that researchers in the Fraunhofer project, Morgenstadt, are trying to solve. Lisbon has developed a city development strategy for the next decades, defining goals that aim to create more employment, attract more people and to become a more liveable city. This last goal does not only include the improvements in living standards of citizens, but addresses topics such as new mobility concepts, renewal of old buildings, increased energy efficiency, among others. All this can be fostered by using more participative approaches and an extensive exploration of the local resources to stimulate the economy and incentivize local innovation.

The question that arises is how to get there? How to make Lisbon a more liveable and attractive city not only for tourists but especially for its citizens and workers? This paper is based on an interdisciplinary project in the form of a so-called "City lab" that began in September 2015 in the context of the ongoing long-term research project called "Morgenstadt: City Insights" initiated by the Fraunhofer Society.

This paper therefore first provides a general introduction into the smart city concept (chapter 2) and an overview over the initial position of Lisbon in this regard (chapter 3). In a next step, the research methodology applied in the City Lab will be outlined, dividing the analysis process (chapter 4) and the project development process (chapter 5). In the following the results of the city lab Lisbon will be presented. While the first part of results concentrates on key outcomes such as the sensitivity analysis and exemplary sector specific results (chapter 6), the second part will provide an overview over the developed projects to foster a smart and sustainable development of Lisbon (chapter 7). According to the identified challenges and opportunities in chapter 6 that reveal a good level of smartness among the different sectors, the projects presented in chapter 7 will specifically address the strengthening of interdisciplinary and cross-department as well as cross -stakeholder cooperation, which has been identified as Lisbons key challenge.

Keywords: City Lab, City of the Future, Morgenstadt, Roadmap, Smart City Development

2 INTRODUCTION. CONCEPT OF SMART CITIES

A smart city refers to a concept of integrated urban planning that emphasizes achieving efficiency and sustainability in all aspects of its development from economic and social to technological development. In collaboration with key stakeholders, the intelligent integration of data and ICT, the smart city aims to create a framework for its citizens that enables and promotes intelligent innovation and creativity. Among the principal goals of a smart city is the reduction of the city's ecological footprint, high resource efficiency and increased economic competitiveness, all with the underlying objective of maximizing the welfare of urban dwellers. A smart city follows the principle of good governance, referring to the institutional capacity to design, manage and implement strategic long-term goals, openly share information, provide data and create an innovative network with business, scientific and institutional actors. Therefore, the smart city allows for interdisciplinary collaboration, provides access to financing models, and offers a stable environment that stimulates the initiation of innovative processes and a dynamic economy. In this sense, the creation of innovative partnerships and functional linkages is a precondition for the successful implementation of the smart city principles but more important it opens the door for national as well as international cooperation and sharing of experiences and good practices.

3 LISBON ON THE WAY TO BECOME A SMART CITY

Lisbon is currently facing a range of issues that will be significant challenges going into the future. The city is still feeling the effects of the financial crisis, with high unemployment, especially among youth, as well as austerity measures that limit public spending beyond core competencies. Furthermore, demographic changes mean the city's aging population is going to prove burdensome in terms of effective support through social

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security in the future. This is not just an issue that is playing out in economic terms but also in terms of the spatial and functional design of the city's urban systems. These represent challenges that have no simple short-term solution but can only be solved through long-term strategic development.

At the same time, the city is doing its best to try to maintain its youth, who have tended to leave the city in search of greener pastures, leading to a brain-drain effect where many of the city's best and brightest leave the city contribute to the development of other cities rather than Lisbon's. The city administration has acknowledged these challenges and is trying to position itself as agile and future-proof, able to absorb the coming challenges while developing a liveable, creative and innovative city with many opportunities for its citizens.

In this context Lisbon already participated in various European innovative initiatives, trying to tackle these core problems. For example, the city was elected as one of the three lighthouse cites together with London and Milan for the EU H2020 lighthouse program. One of the main goals of the project is urban regeneration through better energy performance and the development of innovative business models. This shows that the city of Lisbon is working towards establishing itself as one of Europe's most liveable cities while addressing a range of challenges heading into the future.

Nevertheless, not all problems can be solved within such innovation networks or European projects; without a deep understanding of system interdependencies, specific and local challenges cannot be tackled. Therefore, the city decided to apply for the Morgenstadt City Challenge in 2015. The city was selected as a winner city due to its clearly stated sustainability goals, its effective preparation of strategies in the past in a range of sectors, and because of a clear recognition of a need for strategic planning and demonstrated an interest in a holistic approach for its development. The main reward consists of an interdisciplinary city lab investigation performed by the Fraunhofer IAO, assessing the current sustainability status of Lisbon and developing a roadmap to make Lisbon more sustainable and smart.

This paper will outline the key outcomes of this city-lab investigation, starting with a general description of the performed procedure, followed by the analysis results.

4 CITY-LAB LISBON. DESIGN AND PROCESS

Fraunhofer, together with numerous industry and city partners of the Innovation Network "Morgenstadt: City Insights" has developed an action-oriented model for accelerating and strengthening the sustainable development of cities. It is based on six deep-dive analyses and hundreds of case studies to enable other cities to improve their sustainability credentials. Based on an integrated indicator framework and the assessment of over 80 action fields, Morgenstadt experts derive individual city profiles that serve to design and implement individual strategies for city transformation (Fraunhofer 2016). Between March 2015 and May 2016 Prague (CZE), Chemnitz (DEU), Lisbon (PRT) and Tbilisi (GEO), will be supported with this approach by the Morgenstadt Innovation Network. The city lab is structured into five larger phases:

(1) Formal negotiations, team setup, signatory process, communication;

(2) Analysis of existing strategic documents & data assessment by city partners;

(3) 2-weeks assessment and analysis of the city by an interdisciplinary team;

(4) Development / creation of sustainability profile of city;

(5) Development of strategic roadmap for sustainable development.

The in-depth analysis of Lisbon was carried out based on the Morgenstadt assessment framework for sustainable urban development. This framework is structured into three levels of analysis: indicators, action fields and impact factors. They were designed to understand the current sustainability performance of cities and to support development of coherent strategies and an integrated roadmap for development. A mixture of quantitative benchmarks and qualitative data analyses ensures that an objective performance profile of Lisbon can be generated respecting the individual factors of the city (Kalisch et al. 2013).

The City Lab Lisbon began with the Kick-off event in March 2015 and is planned to conclude in May 2016. During the process, a team of 4 Fraunhofer researchers supported by Morgenstadt experts from industry and cities and a local counterpart team from the local administration in Lisbon have assessed a broad range of information and data of the city. This analysis has been the basis for developing integrated measures and projects that are meant to contribute to the sustainable development of Lisbon.

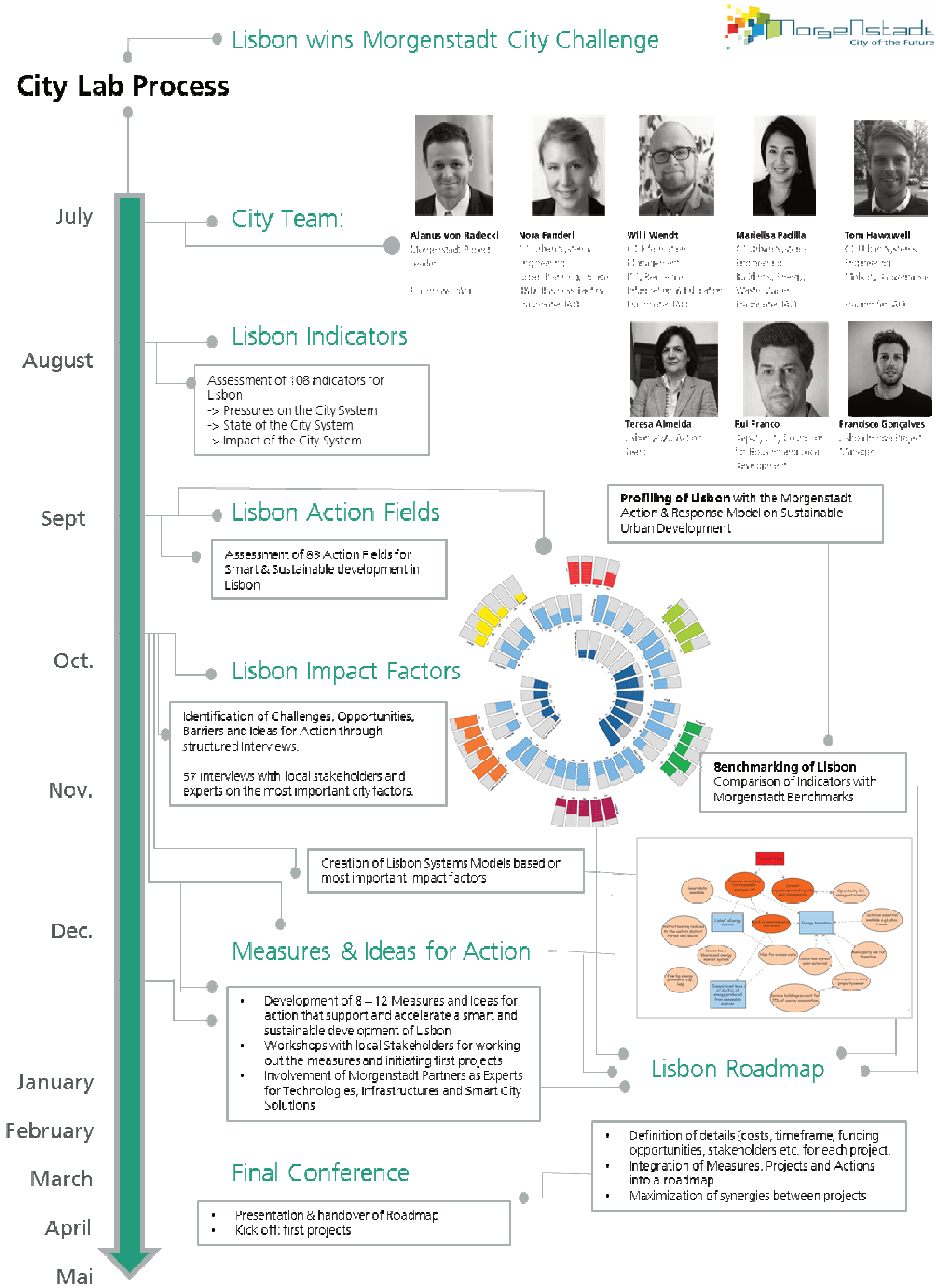

Figure 1: City Lab process Lisbon

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Throughout the analysis the City Team assessed the current status of more than 80 action fields and over 100 indicators that helped to identify the pressures that have an impact on Lisbon (social, economic and environmental pressures), the current state of a range of sectors in the city (mobility system, energy system, socio-economic parameters, security system, water-infrastructure etc.) and the impact that the city has on its society, economy and environment.

The in-depth analysis occurred in the context of an onsite assessment that took place from the 19th until the 27th of October. Together with the on-site mirror team, the University of Lisbon and the local energy and environmental agency, Lisboa E-Nova, the Fraunhofer Morgenstadt team carried out the evaluation in situ, where relevant data was collected and strategic documents were analysed. 57 interviews with local stakeholders from the municipality, local industry, civil society and other institutions that are closely related to the city were conducted, focussing on the identification of current strengths, challenges and opportunities for the development of innovative projects and partnerships within the city. The collected data helped to create a global understanding and to recognize systemic impact factors that allow to identify external pressures, underlying forces, dynamics, socio-cultural and historic implications that are present (often unnoticed) and have an effect on decisions, structures, strategies and measures taken at the city level.

The integration of members of the city hall and Lisboa E-Nova throughout the entire assessment and project development course was part of the capacity development process for the local counterpart team. Knowledge and expertise regarding the methodology, the technologies and the process was gained for enabling a strong sense of local ownership.

5 CITY LAB LISBON. DEVELOPING PROJECT IDEAS

After the analysis of the strategic documents of the city during the preparation phase and the data collected during the evaluation in situ, the Fraunhofer team put together the primary city lab results into a list of more than 15 project ideas, which were then validated by the Lisbon mirror team. From the list a total of 9 projects were prioritized and selected for a more detailed research and further discussion during a project development workshop that took place on the 16th of December 2015. More than 40 participants from the city hall, the private sector as well as Morgenstadt network partners participated and discussed the proposed innovative solutions, such as the creation of a business model for energy transition or the creation of an urban sensor network. The aim of the workshop was to validate the project ideas proposed and to concretize them regarding the needs and demand of all relevant actors, the value that the project creates for the city, the necessary components and the activities that have to be carried out for its implementation. For the discussion, reference projects were taken as examples and inspiration in order to further develop the suggested solutions. The workshop results were the basis for the elaboration of the strategic Roadmap, which shows a series of potential measures for a future sustainable development of the city.

The following Figure 1 visualizes the entire city-lab process, including all process steps from Lisbon's initial application up to the final conference held in May 2016. The next sections of this paper will concentrate on the results of the city lab investigation.

6 CITY LAB LISBON. RESULTS OF THE ANALYSIS

As a result of the city lab, very detailed reports can be derived for each city sector including urban planning, governance, mobility, buildings, energy, resilience, or ICT. In order to gain a better understanding of the interdependencies and interrelations between these sectors, a sensitivity analysis was performed, trying to identify and define systemic key-impact factors that can be identified as:

- DRIVERS - have the potential to drive change and to stay stable over a long time
- LEVERS - are the crucial factors that one needs to get right in order to transform the system in the desired direction.
- INDICATORS - serve to display the change in the system.
- BUFFERS - do not influence many other factors and they are not influenced by many other factors.

The following Figure 2 visualizes the resulting matrix of the sensitivity analysis.

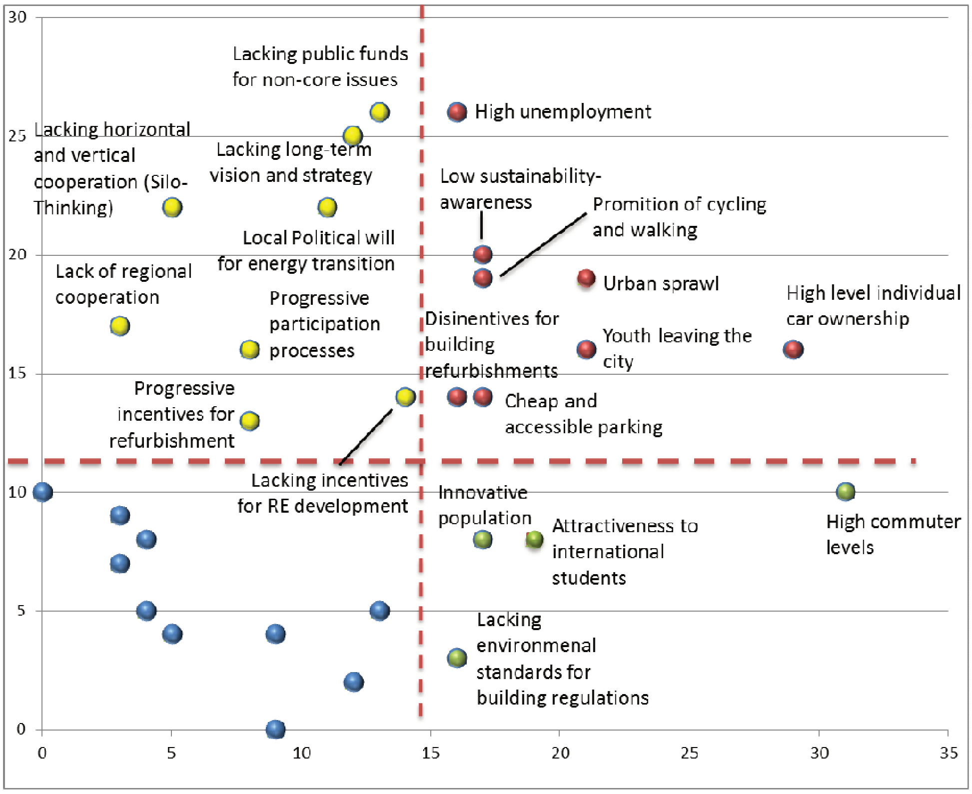

Figure 2: Sensitivity Matrix Lisbon

This result represents a central key outcome of the Lisbon city lab. The main DRIVERS and LEVERS are not limited to specific topics or action fields, rather they address overarching challenges and opportunities such as horizontal/vertical cooperation or long term visions. The sector specific analysis also proves this hypothesis, since almost all sectors carry out innovative and sustainable projects and concepts individually. Exemplary, three best practices from the sectors Water, Mobility and Innovation will be outlined below.

6.1 Intelligent water management for usage optimization

The losses caused by leaks, thefts, metering inaccuracies of Portugal are 7%, which makes Lisbon one of the world leaders in water sector. This optimization has been achieved by various measures and awareness programs, in particular smart initiatives like the online water management system called Aquamatrix (EPAL 2016 a), an commercial management system designed and used by the water provider company EPAL. Besides the Waterbeep (EPAL 2016 b), which is an innovative service offered as a smart app in Lisbon providing customers information about their water consumption. The app sends alerts and warns about abnormal water consumption and even possible bursts, therefore allowing the customer to minimise losses and unnecessary use of water.

These programs also provide information over water consumption breakups from various sources, e.g. municipal water, treated water, rain water etc. They are available as smartphone apps and can be used by individual households and industries. All these initiatives are part of EPALs long term vision to reduce the water consumption and make the overall water sector of the city more efficient.

6.2 Innovation and Creativity Hubs

Lisbon has the vision to become one of Europe’s most competitive, innovative and creative cities, utilizing the outlined opportunity of a lively innovation landscape. In order to achieve this vision, the following goals were set, addressing a creative and innovative target group:

- Creating, attracting and retaining talents, companies, investment and strategic clusters;
- Stimulating the innovation, creativity and entrepreneurship spirit in the city;

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- Making Lisbon a space open to the exploitation of new motivations, experiences, concepts and innovations.

Following these goals, a multitude of hubs have been installed, supporting the creative and innovative citizens of Lisbon in the development of their ideas. Innovators get support on all stages of the development process, be that the early product experimentation stage (e.g. at fab lab lisboa or Mouraria Innovation Hub), the stage of making products marketable (Startup Lisboa) or the final stage of finding business investors for market entrance (Invest Lisboa). Under financing of the city council all those hubs provide expertise for local entrepreneurs, making Lisbon on of the most innovative and creative city of the world with more than 100 companies established by to Start-Up Lisboa and over 800 supported businesses so far by InvestLisboa (Fraunhofer IAO 2016).

6.3 Integrated Mobility Strategy

As a major source of local air pollution, noise pollution, GHG emissions, injury and death, as well as valuable time lost spent in traffic, Lisbon has identified urban mobility as a key challenge going into the future. Smart development doesn't always require the addition of new infrastructure or the integration of new technologies, but can simply mean taking stock of what is already available to gain a more comprehensive understanding of the state of urban systems. This allows planners to highlight weaknesses as well as opportunities for more effective intervention. Lisbon has demonstrated this through the development of its integrated mobility strategy. The city has identified ten "layers", each demonstrating an important perspective on the city's mobility system. In addition, the city has identified five key intervention mechanisms that can be utilised to steer mobility behaviour on the respective layers. Finally, the strategy includes a set of goals that help guide interventions, communicate objectives to the public and justify any impositions on the public that might result from induced change in mobility behaviour.

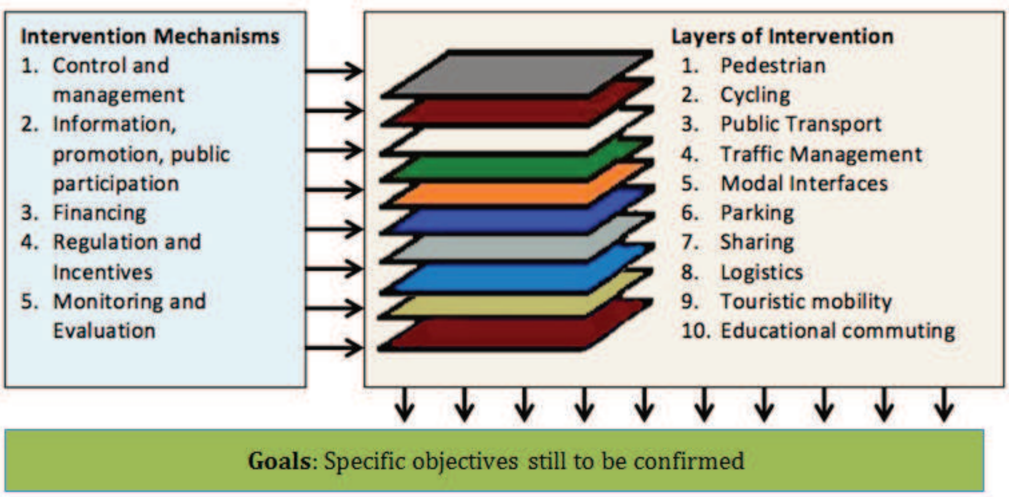

Figure 3: Lisbon's Integrated Mobility Strategy (Fraunhofer 2016)

Taking stock of all of these dimensions of the city's mobility system forced the strategic developers to gather information about influencing factors that previously remained hidden in the periphery. Furthermore, the process encouraged contact with stakeholders whose perspectives too would not have been considered, encouraging a more participative planning approach. By attempting to get a holistic understanding of the system and making the data gathered usable, the city is better able to target planning in an integrated way to maximise positive outcomes. This approach demonstrates that the first step towards smart development is to better understand the state of urban systems in a holistic way to allow for more effective intervention.

These three examples demonstrate the capacity for sustainable innovation among the different sectors in Lisbon. Falling back on the sensitivity analysis it can therefore be stated, that Lisbon´s core need is located in between the innovative sectors and all the implemented best practices, requiring strong support in solutions that strengthen the cooperation among departments and stakeholders. This would allow Lisbon to make better use of the multitude of the already explored opportunities, stepping toward a more holistic integrated system.

7 CITY LAB LISBON. PROPOSED PROJECT IDEAS

Based on the outlined results, the city-lab team proposed a set of project ideas in order to make Lisbon more sustainable and smart. Even though a few of the projects are oriented towards specific topics (compare table 1), the proposed solutions had a very strong interdisciplinary focus, concentrating on a better cooperation among all stakeholders, departments and administrative areas. The following three key-projects were proposed:

(1) A strong Sustainability Action Team with clear authority - the limited capacity of the existing Lisbon 2020 Action Team illustrated the need for clear competences and cross-department authorities for such a team. To allow the body to effectively coordinate activities, it further requires more resources to conduct activities.

(2) The Lisbon Forum - A second key finding was a lack of on-going coordination going into the future. The city itself is constantly changing and is faced with constantly modifying conditions and new challenges. In this context, a more formalised body to facilitate integrated urban development could help to address this. The difficulty with formalising such bodies is that they can often become bogged down in bureaucratic processes, losing their dynamism and agility. Thus, the developed proposal resembled a "Sustainability Forum", rather than a new municipal department or working group. The general idea is that the Forum would comprise of sustainability representatives from the municipal departments and coordinated by the Lisbon 2020 Action Team. Depending on the topic in discussion, different actors from within the municipality, universities and research institutes, NGOs, civil society, private sector, innovation hubs, or any other actors deemed relevant for the topic, would be called upon to build topic-specific think tanks. The integration of other representatives from other municipalities or regional organizations could potentially assist with improving regional coordination, another major issue in the Lisbon Metropolitan region.

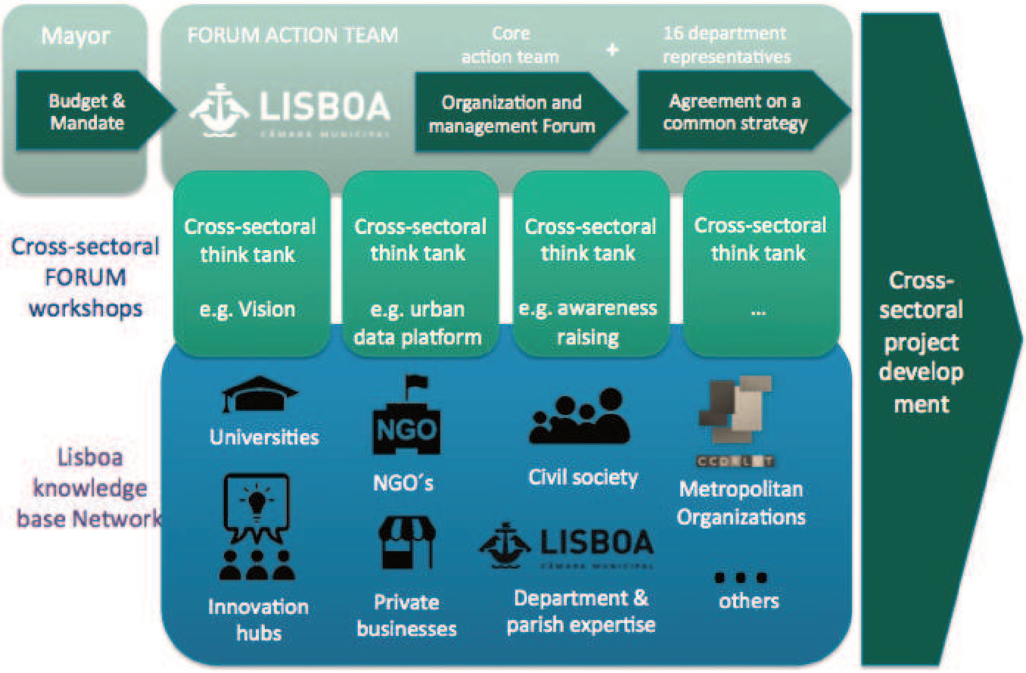

Figure 4: Concept of the Lisbon sustainability Forum (Fraunhofer IAO 2016)

(3) A measurable vision for Lisbon - A third important finding is related to the lack of a vision to help unify actors and guide towards more sustainable development processes across all departments. This too is a process that the city must develop independently, but it is suggested that the proposed Sustainability Forum would be a logical vehicle to create such a vision. Such a vision must be developed in an inclusive and integrated way and be linked to SMART (specific, measurable, achievable, results-focused and time bound) principles, which act as a means of measuring success. Measurable goals allow for transparent communication processes towards the society, reasoning for specific activities and projects and achieving a higher acceptance for these projects.

Further there is a great need for a smart data platform that combines and disseminates all knowledge among all city departments as well as local stakeholders. By developing the Integrated Operational Centre (COI) the

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city already targets this issue. Therefore this core need seems to be taken care of and the city should concentrate on other open issues.

Additionally a set of specific key- measures was developed in cooperation of all city-lab partners, targeting the analysed sectors and identified gaps.

Sector	Project	Short- Description
Energy & Buildings	Extended Solar Potential Map & development of a business model for energy transition	Connecting the existing solar potential map to the energy demand to make it a useful tool for decision making. Implementing a lighthouse project with 8 municipal buildings as a demonstrator to trigger and scale-up the energy transition in Lisbon.
Water & Buildings	Closing the urban water cycle	Designing projects for the use of treated waste water & using prototypes to expand the current regulation for the use of rain water and grey water in new building projects.
Education, Waste & Energy	Sustainability contests	Sustainability awareness campaigns using new technologies and participatory methods to increase energy efficiency and waste reduction and public environmental awareness
Education, Waste & Energy	Smart Waste management solutions: GPS sensors & waste bins sensors together with a waste/recycling app	. The information provided is used to: - Adapt the routes to avoid unnecessary trips (half full bins) and traffic jams in the city. - Provide real-time information to the users about the actual collection time at their street and houses - Apply the polluter pays principle in the taxation
Mobility & Logistics	Upgrade of public lighting network with potentials for inclusion of sensor network	City-wide process of upgrading street lighting by integrating the development a sensor network into this process, this could leverage a range of benefits for all other sectors
Business Tactics	Lisbon Social Innovation Hub	Development of a social innovation hub that offers advanced facilities for social innovation, co-working and micro production.
ICT	ICT Cooperation Strategy	Establishment of a constant cooperation strategy between the city administration, local IT-research institutes, the society and local ICT-companies in order to cooperatively develop bottom-up innovations for the city.
Resilience	Tool-catalogue for civil protection solutions and applications	Development and implementation of a tool-catalogue, including a usage- guideline that allows crisis management professionals to identify relevant tools and solutions.

Table 1: Proposed topic-specific key measures (Fraunhofer IAO 2016)

8 CONCLUSION & OUTLOOK

Lisbon presents the necessary conditions to promote smarter urban development. There was a clear demonstration of political will, reflected in the initiation of integrated planning processes and the encouragement of dialogue between key actors in a range of sectors. However, the city lab process highlighted a range of overarching issues that could not be addressed alone through interventions in specific sectors. Many of these areas are characterized by high complexity and cannot be addressed in the short term through projects that simply integrate new technologies, which is an approach often associated with "smart" development. Therefore, the key proposed solutions for Lisbon relate to overarching interventions that create a dialogue, encourage cooperation between key actors in different sectors, and set meta level objectives. Part of this process is the reinforcement of the capacities of the action team to promote intersectoral cooperation, the establishment of a forum to create a dialogue between key actors in the city, and the integrated development of a set of clear goals to act as a “guiding star” for future city activities. These overarching interventions need to be complemented by specific projects “on the ground” in the different sectors. Consequently a part of the road map developed together with the city, a range of projects are already on track, including the a lighthouse project for energetic refurbishment in public buildings, including the extension of the solar potential map as a tool for the development of business model for energy transition, and the smartification of the waste management services though the installation of GPS sensors in the collection trucks and filling level sensors in the waste bins. Furthermore the Lisbon 2020 action team is currently under a restructuring process, where its duties and competencies are being redefined.

The City Labs process has demonstrated that „smart“ urbanism isn’t just about high-tech solutions, but also relates to striving for a more holistic understanding, as well as appreciating the complexity of urban systems. A key first step to achieving this is to create the channels of dialogue between key actors in the city, and create overarching objectives to promote intersectoral communication and cooperation.

Even if a smart city is described as one that operates with intelligent systems and modern technologies, particularly in the form of digital information and communication technologies, it needs to be supported by strong institutional bodies and partnerships able to create the right framework that allows for changes and adaptations, addressing the new challenges and opportunities. These forms of intelligent collaboration together with a clear vision and strategy constitute the basis and at the same time the precondition for becoming a smart city.

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Communal Companies Merging as Smart Approach: Kikinda Town in Serbia Case Study

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1 ABSTRACT

The objective of this paper is to show that one of the possible approaches to get smart town is communal companies merging, because such venture improves municipal budget. This paper presents a case study of a new public communal company of Kikinda Town in Serbia. Following Kikinda Municipality description, previous five communal companies and the new one are briefly presented. Five public communal companies duties are merged into the duty of one compound public company named Public Company "Kikinda" (PC Kikinda).

PC Kikinda services are more efficient, less costly and provide better quality. Also, the entire business and public funds spending are more transparent. Kikinda Municipality public expenses in recent years are displayed by tables and diagrams. The expenses analysis approves that communal restructuring has improved the Municipality budget.

The restructuring of public utilities services carried out has improved Kikinda Municipality economic capacity and has allowed different allocation of budgetary resources. This is an essential prerequisite for the Municipality of Kikinda future economic and social development towards a smart town.

Keywords: communal, company, Kikinda (Serbia), merging, town

2 SMART TOWN CONCEPT

2.1 Urbanism challenges

Contemporary *urbanism* should investigate general issues and functions, while ignoring particulars and singularities. Link of scholastic and real facts induces synthesis. If synergy is a creation of a whole which is greater than the simple sum of its parts, than simultaneous combination of theoretical research and practical experiments produces synergy. Renowned urban planner *Kevin Lynch*, in his "*A Theory of Good City Form*" (1981), distinguishes five characteristics of a city: vitality, sense, fitness, access, control.

Modern urban planning has to include and apply knowledge of other academic and pragmatic *disciplines*, such as systems theory, project management, economics and investment, real estate appraisal, ICT (Information Communication Technology). Urban design essential task is creation of functional, aesthetic, economic, social and environmental elements.

2.2 Smart city concept

History of urban development is long and complex. Famous historian *Lewis Mumford*, in the last chapter "Retrospect and Prospect" of his unsurpassed masterpiece *"The City in History"* (1961), could not have foreseen "smart city". Visionary Mumford urges for an "organic city" where not only nature has a balance with technology, but also culture prospers by technical innovations.

Sintagma *"smart city"*, and its alternative *"intelligent city"* or *"digital city"*, appears in the 1990s when ICT infrastructures raised within cities (Townsend, 2014). Planning and design of cities relates to information and communication technology, such as telegraph and tabulator were a century ago, and cellular networks and cloud computing are today. New technology impact on cities infrastructure spreads to economy, society and public institutions. Avant-garde architects, devoted to urbanism, ambitiously create cities for a smart, mobile, internet future.

There are many definitions of the term "smart city" (Albino et al., 2015). Harrison et al. (2010) declare that smart city is "a city connecting the physical infrastructure, the IT infrastructure, the social infrastructure, and the business infrastructure to leverage the collective intelligence of the city." In the same manner, Bakici et al. (2012) argue: "Smart city as a high-tech intensive and advanced city that connects people, information and city elements using new technologies in order to create a sustainable, greener city, competitive and innovative commerce, and an increased life quality".

The smart city has smart components and related urban features (Lombardi et al., 2012). These 6 components are: economy, people, governance, mobility, environment, living. Related 6 urban features, respectively, are: industry, education, democracy, infrastructure, sustainability, quality.

2.3 Smart town circumstance

There is no standard, internationally accepted – criterion for difference between town and city. Traditionally, the settlement size is the criterion for distinction. A town is a smaller dwelling place than a city. But the criterion may also be of administrative significance, or economic importance of a settlement.

Eminent architect and town planner *Constantinos Doxiadis*, in his "*Ekistics*" (1968), proposes a classification of human settlements by size. Such a classification enables discussions of various anthropological phenomenona, like life quality and others. According to Doxiadis' (1976) settlement hierarchy, town and city are distinguished by citizens. Town (over 20 000 population) is not as large as a city (over 75 000 population).

The authors of this paper think that, analogous to smart city (Harrison et al., 2010; Bakici et al., 2012), *town* can be determined as *smart* when financing of a society and infrastructure provides economic growth, life quality and sustainable development. Modern municipal stakeholders and public utilities managers recognize the importance of a smart town momentum.

In many countries of Europe, an important question is: *How to become a smart town?* There are diverse approaches to achieve smartness. The hypothesis of this paper is that *merging of communal companies* is one of the possible approaches to becoming a smart town, if that merger improves the municipal budget. In the following, a communal merging effect is studied of the case of a new compound public company of Kikinda town in Serbia.

3 SERBIA IN TRANSITION

The process of *transition* in Eastern Europe (EE) starts after the fall of the Berlin Wall (1989), when fundamental political and economic changes occurred at the same time. Multiparty political systems, with democratic institutions, replaced the communist system. The market becomes the principal mechanism for the distribution of resources, products and properties. The majority of EE states accesses gradually to the European Union (EU).

The transition of *Serbia* represents an unusual, complex, slow and delayed process. Causes of delay are internal (Yougoslavia decomposition, military conflicts) and external (international sanctions, NATO bombing) (Uvalic, 2010). A satisfactory outcome of Serbia's transition requires legal harmonisation, innovative strategies (institutions, administration, agriculture, industry, research and development) and EU financial assistance.

Experiences of EU member states that previously passed through the accession process to the EU are very important (Young, 2013). *Local government* duties are public procurements, communal services, rural development, employment reduction, social policy, energy efficiency, and environment protection. *Communal services* improvement encompasses actions transparency, greater competition, services regulation, and state subvention minimization.

The public sector reform is a key determinant of transition in Serbia (Veselinović, 2014). At the present time, in spite of all the years spent on the transition process, there remain many *state companies* (**Table 1**).

COMPANY TYPE	Companies	Employees
Companies controlled by the Privatization Agency	600	100 000
Large public and state companies	50	110 000
Local public companies	650	70 000
TOTAL	1300	280 000

Table 1: State and public companies in Serbia (2012). (Compiled by the authors, source: Arsić, 2012)

Local public companies (LPC), which are 50% companies (and 25% employees) of total (Table 1), differ not only in size, but also in market conditions which are natural monopolies (water supply and sewerage), non commercial services (parks, street cleaning), or commercial services (market maintenance, parking).

Among LPC, the most important are local public *communal* companies, which employ circa 80% of the total number of employees in LPC (Arsić, 2012). The usual problems of LPC companies are weak management, low efficiency, nonprofit prices (heating, public transport), and local budget substantial subsidies.

4 KIKINDA – TOWN AND MUNICIPALITY IN SERBIA

4.1 Kikinda location and data

Kikinda is a town (**Figure 1**) and a municipality (**Figure 2**) located in the Banat district, in Vojvodina - autonomous province of Serbia. *Kikinda Town* and *9 villages* in its surrounding constitute *Kikinda Municipality* (**Table 2**). The town of Kikinda, with circa 38000 population, is the economic and social centre of North Banat.

Figure 1: Kikinda Town in Serbia (Redrawn, source: Jovanović, 2015)

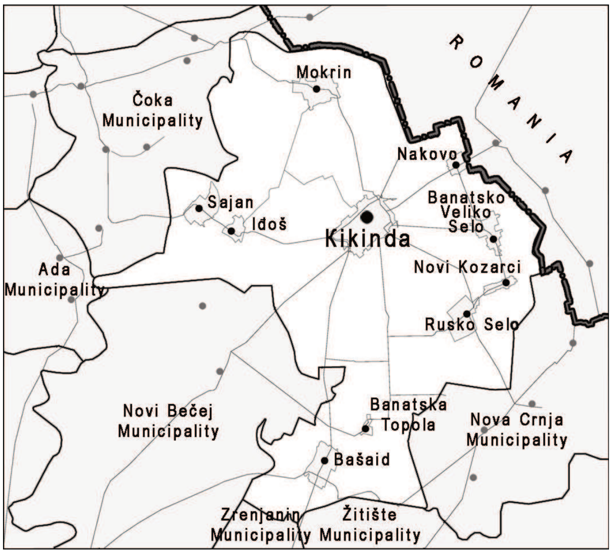

Figure 2: Kikinda Municipality map (Redrawn, source: JPKZS, 2015)

Total area	783 km^2
Agricultural area (2013)	70 538 ha
Population (2011)	59 453
Number of population per 1 km^2 (2011)	76
Population average age (2011)	42.4
Natural increase per 1.000 inhabitants (2014)	– 6.8
Number of employees (2014)	13 679

Table 2: Kikinda Municipality essential data (Compiled by the authors, source: SORS, 2014)

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4.2 Infrastructure and economy

Kikinda, established as a modern settlement in the 18th century, is a well *planned* town (Ilijašev, 2002) with wide streets orthogonally laid, a central square, city hall, churches, public edifices, market, et cetera. Town urban *infrastructure* is basically founded for the flow of people, goods, water, energy, and information.

Regional *roads* connect Kikinda with adjacent towns and villages in Vojvodina. Kikinda is 10 km from the Romanian border, 65 km from Hungarian border, and 130 km from Belgrade, the capital. The town is connected by *rail* with the Romanian border, with Subotica, and with Belgrade via Zrenjanin. There is a dock for *waterway* industrial transport by Danube – Tisa – Danube Canal passing through Kikinda Municipality.

Banat's fertile farmland ensured successful *agriculture* (wheat, sunflower seeds, soybean, fruit and vegetables) and existence of natural raw materials (oil, gas, quality clay) provided the development of *industry* (oil derivates, metal tools, chemical products, tiles and bricks) in the 1980s, before Yugoslavia broke down. Both agriculture and industry were devastated almost completely during the transition process which was long lasting and not finished in Serbia yet.

The present economy crisis, however, does not change Kikinda *investment* opportunities. Fertile land, natural raw materials, location near borders, road and rail connections, an urbanised town, existing infrastructure and agricultural and industrial traditions offer a favorable combination for investors. Nowadays Kikinda offers *brownfield* and *greenfield* investment locations (CKIK, 2016), which are private propriety and others owned by the Municipality of Kikinda.

4.3 Communal problems

Communal services are related to urban infrastructure and have direct influence on the living standard of the inhabitants. The contemporary economy *crisis* deteriorates the already inefficient transition process in Serbia. The crisis amplifies communal problems common to many of Serbia's towns, especially in recent time. Poor running of utility services has an unfavorable impact on economic progress in general.

There were many public communal companies in Kikinda Municipality. These companies had similar obstacles. Typical *problems* of the utility company were: excessive company size, weak management, employees inadequate qualifications, technological obsolescence, political parties interference, irrational consumption, accumulated loss, considerable dependence on municipal budget, lack of own funds for large investments.

Kikinda communal problems are increased over the last years and effective solution finding becomes more complicated. Bearing in mind existing problems, Kikinda public communal companies ask for comprehensive *reform* as soon as possible. The reform aim is utility services amelioration and development. Also, the reform of communal companies is very important for towns people and local businesses.

5 COMMUNAL MERGING IN KIKINDA

5.1 Historical background

The modern history of Kikinda starts with the *Habsburg Monarchy* in the second half of the 18th century (Ilijašev, 2002). Communal infrastructure development in Kikinda is influenced by a variety of natural, historical, economic and social circumstances (Gedl, 2013).

After the First World War (WW I), a new geopolitical division of Europe took place. The *Yugoslavia Kingdom* establishment was soon succeeded by an economic crisis. As a result of that crisis, Kikinda communal infrastructure advancement was lagging. Regular supply of healthy drinking water, storm water drainage and wastewater treatment appear as the main communal obstacles. Street and road construction and urban infrastructure develop more slowly than expected.

After the Second World War (WW II), the *Yugoslavia Republic* constitution founds a socialist state ruled by the communist party. The transition of the political system from capitalism to socialism involved the complete nationalisation of many goods (land, resources, industries, etc.) and state planning and control of the national economy. As a result of private property abolition, the entire communal infrastructure in Kikinda town and municipality became the property of the state and the local government.

In the last quarter of the century (1990-2015), when disintegration of Yugoslavia occurred and the *Serbia Republic* is established, Kikinda communal infrastructure was chiefly split into component elements.

5.2 Communal companies history

Kikinda public communal companies' *history* (**Figure 3**) shows changes over time. Name of each company, (in Fig. 3 intentionally translated from Serbian into English), ilustrates clearly communal activity.

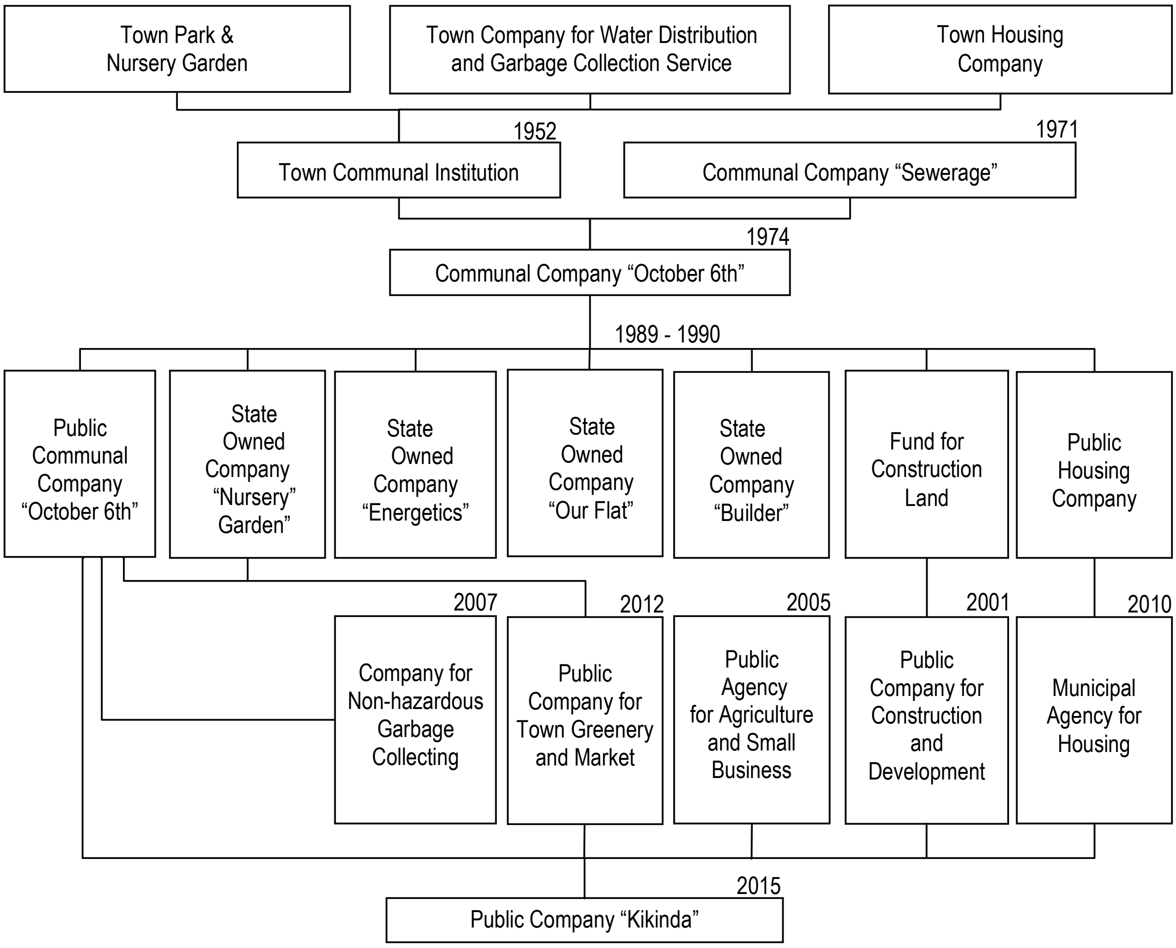

Figure 3: Kikinda communal companies' history (1952-2015). (Compiled by the authors)

Three communal companies (*Town Park & Nursery Garden*, *Town Company for Water Distribution and Garbage Collection*, *Town Housing Company*), established after WW II, are merged (1952) into one company (*Town Communal Institution*). This single company (*Town Communal Institution*) later (1974) is not only enlarged with another company (*Communal Company "Sewerage"*) established earlier (1971), but it is also renamed (*Communal Company "October 6th"*).

One company (*Town Communal Institution*), it should be remarked, worked for *22 years* (1952-1974). If enlargement (*Communal Company "Sewerage"*) and renaming (*Communal Company "October 6th"*) are ignored, it can be noticed that *one basic company* (*Town Communal Institution – Communal Company "October 6th"*) worked for *37 years* (1952-1989). Previous facts indicate that later *splitting* (Figure 3) of communal companies (1990-2012) is not business necessity, but it is a result of other circumstances, mainly political, happening during transition in Kikinda.

In two years (1989-1990), the existing company (*Communal Company "October 6th"*) split into *7 companies* (*Public Communal Company "October 6th"*, *State Owned Company "Nursery Garden"*, *State Owned Company "Energetics"*, *State Owned Company "Our Flat"*, *State Owned Company "Builder"*, *Fund for Construction Land*, *Public Housing Company*). Except company "*October 6th"*, which keeps the predecessor activity explained by origin (Figure 3), the other 6 companies' names in English describe their main communal tasks. These 7 companies are changing name or/and activity in the next years (2001, 2005, 2007, 2010, 2012).

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5.3 Five companies replaced

On the base of long time (1989-2014) experience, Kikinda residents' common opinion is that communal companies splitting (Figure 3) did not bring any improvement. Available communal resources use is not reasonable, utility services are not efficient, works quality is not sufficient, services prices are too high. Companies are not sustainably organised. Therefore, they are considerably dependent on municipal subsides. Local government cannot provide investment capital for large infrastructure projects important for the community.

Unfavorable communal circumstances, explained above, inspire and encourage *radical reform* of utilities services in Kikinda. As communal companies *splitting* produces worse results in the case of Kikinda, it is obvious that communal reform should be: *merging* of companies.

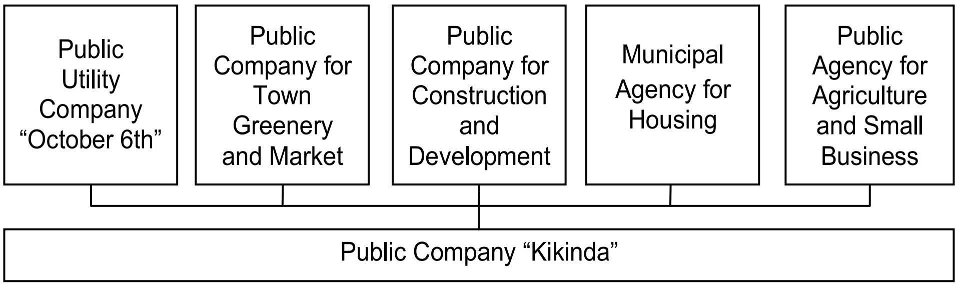

Figure 4: Kikinda communal services merging (2015). (Compiled by the authors)

After utilities services substantial analyses, managed by the first author of this paper and lasting few months, it has been decided to *reform* public communal services in Kikinda and to apply an organising structure adopted after several iterations and required calculations. Activities of five communal companies (*Public Utility Company "October 6th"*, *Public Company for Town Greenery and Market*, *Pubic Company for Construction and Development*, *Municipal Agency for Housing*, *Public Agency for Agriculture and Small Businesses*) are merged into the activity of one compound company (*Public Company "Kikinda"*) (**Figure 4**).

Communal services, being split into 5 companies, *merging* into 1 compound company join together real estates, resources, equipment, staff, knowledge, management. For example, 5 administrative divisions, one in each of 5 companies, are substituted with 1 division, in 1 company. It is obvious that such merging provides transparent business, reduces expenses and contributes to a municipal budget improvement.

Merging of communal companies reduces the number of necessary *employees* and some of them lose their job. During the transition process, needless administrative working places were opened in the public sector in order to solve the *unemployment* problem. Unproductive administration was considerably developed using the municipal budget. That reduced investing into agriculture, or industry. Frequently incompetent personnel was employed under the influence of political parties. From that stand point, communal merging only uncovers artificial employment hidden inside the public sector and supported by the whole society.

5.4 New company established (PC Kikinda)

Communal activities are activities of *service* or *production* character (ZKD, 2011), which serve to satisfy basic needs of the population in the town and surrounding area. Local government defines scope, quality and continuity of communal activities, and control of prices. A *public company* (ZJP, 2014) can perform communal activities, which are financed from sales of services income, or from the municipal budget.

The Public Company for Communal Infrastructure and Services "Kikinda", with its shorter name: *PC Kinkinda* (**Figure 5**), is established at the end of 2014 (OAJPK, 2014) and the statute is enacted (SJPK, 2014). PC Kikinda is not the legal successor of any of the previous 5 companies (Figure 4), which started liquidation.

PC Kikinda is created by applying a *systems approach* (Kerzner, 2009) and *project management* (PMBOK, 2013). The mission of PC Kikinda is to perform *compound* communal services, sustainable technologically and economically. The company is divided into sectors, services, and departments (Figure 5). A lower number of employees is carrying out the job of the five merged companies.

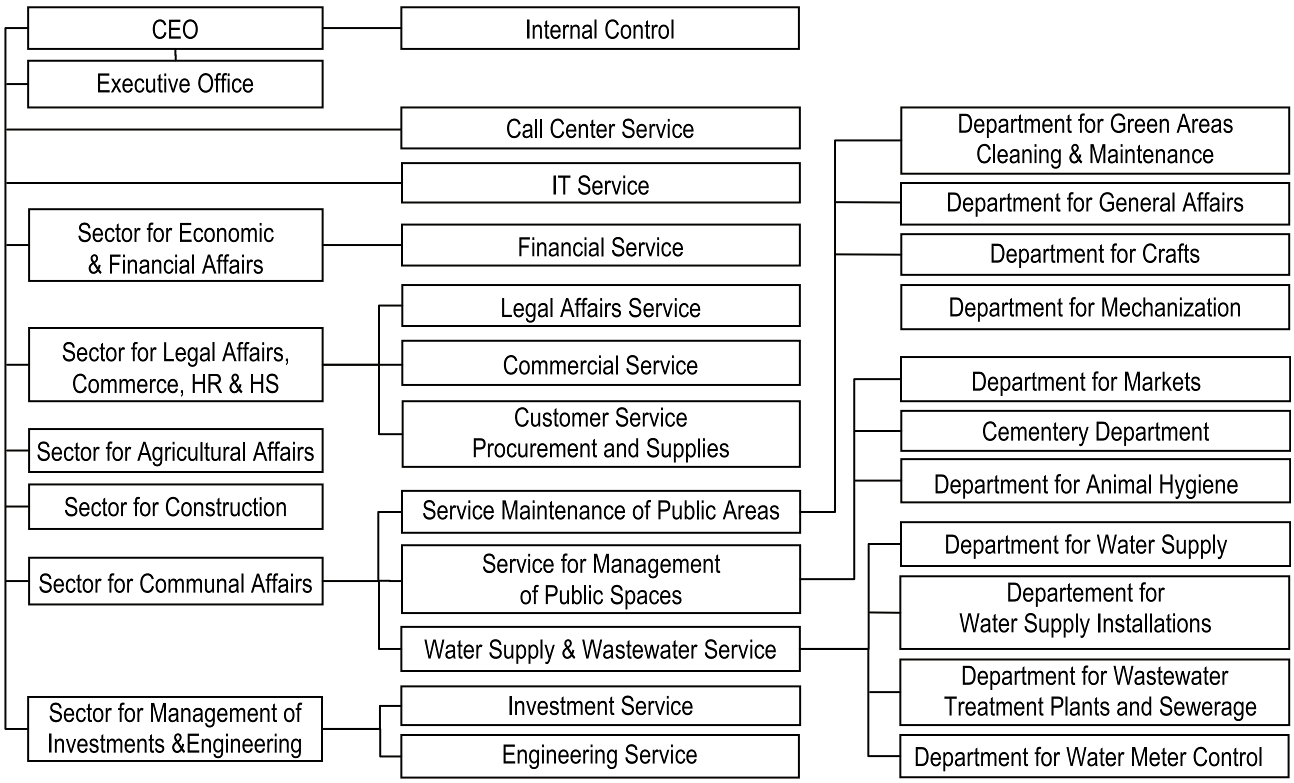

Figure 5: PC Kikinda organigram (Compiled by the authors)

6 MERGING ECONOMIC ECHO

6.1 Companies list and notation

With the aim to simplify and to brief analysis of economic echo caused by communal merging in Kikinda, overview list of companies and its units is presented in **Table 3**, where *key words* and *symbols* associated are also given. Sign of *asterisk* (*) denotes company entirely financed by the municipal budget. Average official exchange rate (NBS, 2016) is used for conversion of dinar [RSD] into euro [€].

#	COMPANY NAME	Key word	SYMBOL
1	Public Communal Company "October 6th"	October	PC1
2	Public Company for Town Greenery and Marketplace	Greenery	PC2
3	Public Company for Construction and Development*	Construction*	PC3
4	Municipal Agency for Housing*	Housing*	PC4
5	Public Agency for Agriculture and Small Business*	Agriculture*	PC5
3-5	Three companies* (PC3, PC4, PC5)	Three*PC	3PC
1-5	Five companies (PC1, PC2, …, PC5)	Five PC	5PC
∑	Public Company "Kikinda" – PC Kikinda	Kikinda	PCK

Table 3: Kikinda communal companies list (name, key word, symbol). (Asterisk * denotes budget dependence entirely)

6.2 Costs non comparability

Five communal public companies merging feasibility can be estimated by comparison costs of these five companies (5PC) and PC Kikinda (PCK). As a matter of fact, *cost* is one of the key economical factors for each company. The cost has a crucial impact on business success and company development.

Unfortunately, cost comparison of relevant companies (5PC and PCK) is not possible in reliable and trustful manner. This *costs non comparability* is because relevant companies financial statements are not done in a single way and meaningful comparison of costs is impossible.

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6.3 Cash outflow

Cash is the basis of every business. Without information on *cash flow*, a company cannot adequately make business decisions. In view of the fact that costs comparison of merged companies (5PC) and compound company (PCK) is not possible, *cash outflows* are analyzed in this paper. In order to evaluate feasibility of communal companies merging, available cash outflows *before and after merging* are compared.

OUTFLOW	BEFORE MERGING: Five companies (5PC) 2014 (state)		AFTER MERGING: PC Kikinda (PCK) 2016 (plan)		DIFFERENCE: (5PC–PCK)
	Cash [million €]	Share [%]	Cash [million €]	Share [%]	Cash [million €]
Operating activities	5.410	73	2.119	86	3.291
Investing activities	1.838	25	0.358	14	1.480
Financial activities	0.162	2	0	0	0.162
TOTAL	7.410	100	2.477	100	4.933

Table 4: Cash outflow of Five companies (5PC) & PC Kikinda (PCK). (Compiled by the authors, sources: BSP, 2014; PPJPK, 2015)

In **Table 4**, the cash outflow of the five companies (5PC) – in the time *before* merging and with available data for 2014 (BSP, 2014), is compared with the cash outflow of the compound company (PCK) – in the time *after* merging and with available planned data for 2016 (PPJPK, 2015).

As it can be seen (Table 4), Five companies (5PC) realized total outflow (€7.410×10^6) is *lower*, for respectable difference (€4.433×10^6), than PC Kikinda (PCK) planned total outflow (€2.477×10^6). In other words, outflow difference (5PC–PCK) presents remarkable 67% of outflow (5PC) before merging. Operating activities outflow reduction produces that difference. After merging, lower operating activities outflow provides fund for investing activities.

OUTFLOW	BEFORE MERGING: Five companies (5PC) 2014 (state)	AFTER MERGING: PC Kikinda (PCK) 2016 (plan)	DIFFERENCE: (5PC–PCK)
	Cash [million €]	Cash [million €]	Cash [million €]
Employees' expenses	2.249	1.392	0.857
Supplies & services	2.854	0.581	2.273

Table 5: Part of cash outflow comparison of Five companies & PC Kikinda. (Compiled by the authors, sources: BSP, 2014; PPJPK, 2015)

In **Table 5**, five companies (5PC) cash outflow part in time *before* merging (BSP, 2014), is compared with compound company (PCK) cash outflow part in time *after* merging (PPJPK, 2015). Presented outflow part includes employees' expenses and supplies & services expenses (Table 5).

Number of employees after merging is decreased by circa 30%. Because of that, and in accordance with Table 5, employees' expenses (€2.249×10^6) before merging are decreased (€1.392×10^6) after merging, what makes a significant difference (€0.857×10^6). Supplies and services expenses before merging (€2.854×10^6) are also decreased (€0.581×10^6) after merging, what makes very significant difference (€2.273×10^6).

Both Table 1 and Table 2 indicate indisputably that five communal public companies (5PC) *merging* into one compound communal public company (PCK) is *ecomically approved* in Kikinda case. Financial savings realized already create space for improving Kikinda's municipal budget.

In addition to finances, the new PC Kikinda establishment through the merging process, managed with a systems approach (Kerzner, 2009), enables the layout of a modern company with a matrix structural organization (PMBOK, 2013) and corporative management of utility services and other business.

6.4 Municipal budget relaxation

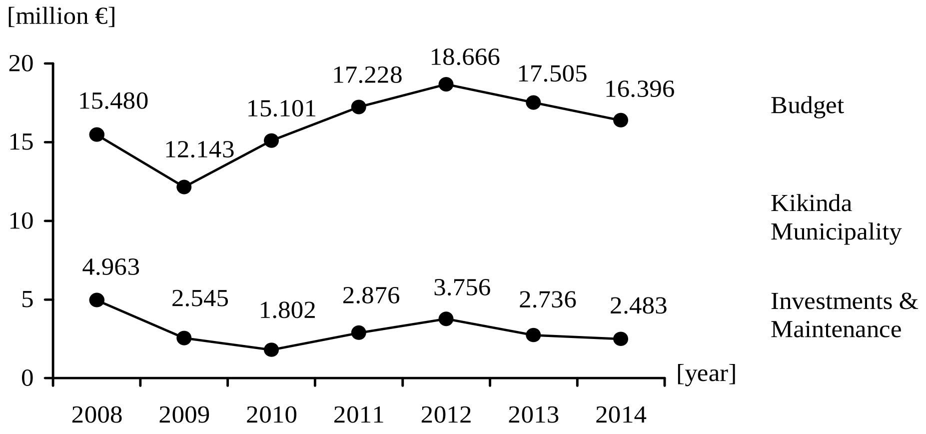

Figure 6: Kikinda municipal budget (2008-2014). (Compiled by the authors, source: ZRBOK, 2014)

		BEFORE MERGING						
	Year:	2008	2009	2010	2011	2012	2013	2014
BUDGET	[million €]	15.480	12.143	15.101	17.228	18.666	17.505	16.396
Investments & maintenance	[million €]	4.963	2.545	1.802	2.876	3.756	2.736	2.483
Share	[%]	32	21	12	17	20	16	15

Table 6: Kikinda municipal budget and investments with maintenance (2008-2014). (Compiled by the authors, source: BSP, 2014)

Kikinda municipal *budget* and *investments* & *maintenance* recent history (2008–2014) (**Figure 6**, **Table 6**) reveals that budget increase is not accompanied with adequate investments increase. In the observed period (2008–2014), for which it can be easely calculated (Table 6), annual average share of investments and maintenance is only 19% of the budget. It is obvious that during the observed years, the budget surplus is not used for investments (developing purpose), but rather for current expenses (consuming purpose).

			BEFORE MERGING							AFTER	
#	BUDGET	Year:	2008	2009	2010	2011	2012	2013	2014	2015	2016
1	Municipal	[million €]	15.480	12.143	15.101	17.228	18.666	17.505	16.396	20.645	18.996
2	Three*PC	[million €]	5.939	3.533	3.153	4.313	5.110	4.374	4.218	2.049	1.191
3	Share	[%]	38	29	21	25	27	25	26	10	6

Table 7: Kikinda municipal budget and three* companies (before and after merging). (1 – Municipal budget costs; 2 – Three*PC total costs in budget; 3 – Participation in budget). (Compiled by the authors, source: ZRBOK, 2014; PPJPK, 2015)

Municipal budget and three* companies (3PC, Table 3) expenses are jointly presented (**Table 7**). Before merging, 3PC are completely financed from the Municipal budget. After merging, however, 3PC activities are fully melted into PCK and are not any more financed from the Municipal budget.

7 CONCLUSIONS

Public Company "Kikinda", established through merging five communal company activities, has reduced immediately utilities expenses and contributed to municipal budget.

Kikinda communal companies merging presented is, as the authors believe, *pioneer venture* in Serbia these days. Results achieved promote Kikinda merging case as a template useful for towns of similar size.

Nowadays economy is a chief key of a successful urban planning. Communal services merging can be considered as one possible path towards smart town creation.

8 ACKNOWLEDGEMENT

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Comparing Automated Methods for Identifying Areas of Critical Heat Demand in Urban Space

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1 ABSTRACT

In recent years, urban heat supply has shifted to the center of attention of German energy policy. It is believed that heating grids are an important instrument for climate protection. For one, they open up a heat sink (i.e. a circle of heat customers) large enough to be able to take up heat from cogeneration, which needs a certain minimum scale of operation to be economically viable. Secondly, they allow the relatively easy tying-in of renewable energy sources.

However, heating grids are not the one-fits-all solution. As heat transport is associated with losses, a minimum heat density in urban space (that is: MWh per hectar urban space) is needed to make a district heating grid lucrative (and, possibly, ecologically worthwhile – depending on the source of the heat). At the same time, given the nature of the heat generator, a larger area served may offer economies of scale.

Opportunities to construct small and medium-sized grids often are overlooked, as information about critical parameters like heat density in a neighborhood are not obvious to potential initiators of such grids.

This paper offers a comparison of methods to systematically search an urban heat demand map for areas of critical heat density. Urban heat demand maps are now developed by many municipalities; they are usually constructed using electronic cadastre data, combined with an energetic building typology into which the buildings in the cadastre are mapped. Some potentially interesting opportunities for developing district heating grids may be visible to the experienced eye; algorithms that automatically search over the entire heat map may offer yet more insights. As algorithms I apply (1) a tessellation of the city into tiles of comparable size, and (2) a clustering method used to identify hot spots with two different approaches. I use selected neighborhoods in Hamburg to compare the results of both methods.

Keywords: District Heating, Urban Heat Demand, Energy GIS, Energy Planning

2 INTRODUCTION

This paper's goal is to examine the effectiveness of different algorithms designed for the purpose of finding heat densities in urban areas. It reflects on the work done for the GEWISS project (GEographisches WärmeInformations- und SimulationsSystem Hamburg, verbatim: Geographical Heat Information and Simulation System Hamburg). GEWISS is a research project within the EnEff:Stadt (EnEff:City) programme funded by the German Federal ministry for Economy and Energy (BMWi). It strives to provide an interactive information tool on the spatial distribution of heat demand and supply in Hamburg, as it is today and could develop over time (Peters 2015).

The final energy demand for private households compares to the demand of industry and traffic (BMWI 2016, page 5), whereas space heating makes up the highest portion in households (BMWI 2016, page 16). New and energy-efficient constructions make up only a small percentage of the German building stock (around 1 % each year). A high-leverage option to reduce CO2 emissions is therefore the retrofitting of the existing building stock. For an effective retrofitting strategy we need to acquire knowledge about the patterns of urban heat flows. CO2 emission reduction measures should focus on urban areas with high heat density and promote (1) a reduction in primary energy demand and (2) an increase in the share of renewables in heat supply – this without additional environmental burden. The algorithms tested for this paper are primarily designed to identify urban areas where combined heat power plants seem particularly lucrative.

Automated algorithms become handy as nowadays we tend to have more data available than we can assess without the use of electronical devices. Although they do not make the urban planner superfluous, their application helps them to spend their time more efficiently. The algorithms presented in this paper are all meant to be visual and statistical aids to find areas of interest faster. They do not provide a result that could stand without human interpretation. The algorithms discussed in this paper are specifically programmed to work with a lminimum input of data to ensure that planners can apply them to their specific urban context. The required attributes–geographic coordinates, floor numbers and footprint sizes–surely exist in the electronical cadastre (ALKIS) of each city. The mapping of construction years is-at least in Hamburg– not

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mandatory and therefore incomplete, I therefore need to reduce the building stock to buildings with known construction years.

To test the algorithms applicibility I chose two urban neighborhoods in Hamburg. After describing the neighborhood selection criteria I will explain the algorithms' working and assess their overall usefullness to determine urban heat densities.

3 NEIGHBORHOOD SELECTION

For the paper I selected two urban areas for which information about building stock–primarily the construction periods–is sufficient to estimate an annual heat demand using a building typology. The geographical data for this paper was provided by the Transparenzportal Hamburg, which is maintained by the city of Hamburg and can be accessed by everyone. As building typology I used the commonly used IWU-de (Institut für Wohnen und Umwelt, verbatim: Institute for Housing and Environment) to estimate the heat demand for individual buildings. Further data sources are not required.

Hamburg's building stock, as represented in the ALKIS, consists of roughly 372,000 buildings. I used the attribute Gebäudefunktion (GFK, building use), coded as four digits, to identify 220,000 residential buildings. This includings all buildings that have a GFK with the pattern "1XXX", excluding garden houses (1313) as they only have saisonal use and usually do not have a heat demand. Only for half of the building stock (108,000 buildings) construction years are known, which are paramount to determine building types and thus heat demands. The documentation for modelling the geodatabase reveals that the mapping of construction years is not mandatory for a complete data set (AdV 2015, p.245). I will therefore exclude all residential buildings without known construction years from the analysis. This of course implies that results will not capture urban heat flows accurately. For the purpose of testing and comparing algorithms, however, the reduced data set suffices.

The IWU typology primarily takes two attributes into consideration to determine a building's heat demand: (1) its size class and (2) its construction age class (Größenklasse and Baualtersklasse, IWU 2015, p.9). The age classes reflect historical and architectural epoches, like the Wilhelminian epoche (1860-1918) or the reconstruction phase after World War II (1949-1957). The size class depends on architectural characteristics, primarily the number of floors and floor area. For the purpose of this paper–its automated applicability to a set of geographical building stock data–I chose a simplistic approach that only takes the buildings' number of floors into consideration (see Table 1). Inarguably, one family houses with more than one floor exist, but since the average floor number in Hamburg is already rather small[1] in comparison to other cities, I strive for more diversity in size classes to test the algorithms.

Größenklasse (Size class)	Number of floors
Einfamilienhaus (EFH, one-family house)	1
Reihenhaus (RH, row house)	2 or 3
Mehrfamilienhaus (MFH, multi-family house)	4 or 5
Großes Mehrfamilienhaus (GMH, big multi-family house)	6 and more

Table 1: IWU size classes determined by number of building floors (own representation)

Conversations with the Landesbetrieb Geoinformation und Vermessung (LGV) revealed that the mapping of building characterics are–to a certain degree–subjective and may vary from surveyor to surveyor. I therefore find this single objective criterion sufficient to determine the Größenklasse for the purpose of this study.

An R script matched the abbreviations of size and age classes for each individual building which then can be linked to a certain specific heat demand, denoted as kWh/(m²a), typical to the respective building type. I calculate the demand with the assumption that around 60% of each floor is heated. The formula, applied to each building, is:

(1) heat demand [kWh/a] = specific heat demand [kWh/(m²a)] * floor area [m²] * floor number * 0.6

However, some manual adjustments had to be made since not all automated matches actually exist within the IWU typology. Adjustments were usually in favor of multi-family houses (see table A.1). For the sake of

[1] Calculating the 1 % quantiles of the ALKIS floor numbers, I determined that 68% of Hamburg's building stock have less than two floors, while 99 % have less than six.

simplicity I regarded each building as not retofitted (Ist-Zustand) and put buildings from the age class 2010-2015 (K) into the class of 2002-2009 (J), as the new constructions have slightly different characteristics and would demand more specifications (IWU 2015, Appendix C.3). The share of these buildings, however, is rather small. As all buildings are regarded as not retrofitted, the heat demand of my selection will be higher than the actual heat demand of the current building stock.

For the scale of the selected area I examined the 941 Statistische Gebiete (SG, Statistical Units) and the roughly 10,600 Baublöcke (BB, City Blocks). The geographical boundaries of both levels are manually chosen by the Statistikamt Nord, the Statistical Office for Hamburg and Schleswig-Holstein. However while the SG aim for statistical comparability across the city of Hamburg, BB are primarily cut by traffic infrastructure. The scale of BB was impractical for further analysis; 90 % of all BB had only 29 or less residential buildings left after the automated type matching (with a maximum of 232). For the SG the remaining building stock was approximately tenfold. I determined the absolute building count, the total energy demand of the heated building area (kWh/a) and the heat density (MWh/(ha*a)[2]) for each SG to find a neighborhood with a sufficiently large building stock and tangible density. Since the SG vary in size and construction type this was but a visual aid to select a fitting area. I eventually chose the following two SG:

- 76010: The neighbood Neuallermöhe in the East of the district Bergedorf which mostly consists of one-family houses (total: 511 residential buildings) from different age classes; in the following denoted as Neuallermöhe; (Figure 1)
- 93001: A settlement, Langenbek, of one- and multi-family houses (total: 709 residential buildings) in the south of the district Harburg; in the following denoted as Langenbek. (Figure 2)

While Neuallermöhe has many small structures with homogenenous distances, Langenbek has both denser and sparser areas of rowed houses mixed with larger scale buildings. The difference between both areas is paramount to test the algorithms applicability to diverse urban contexts.

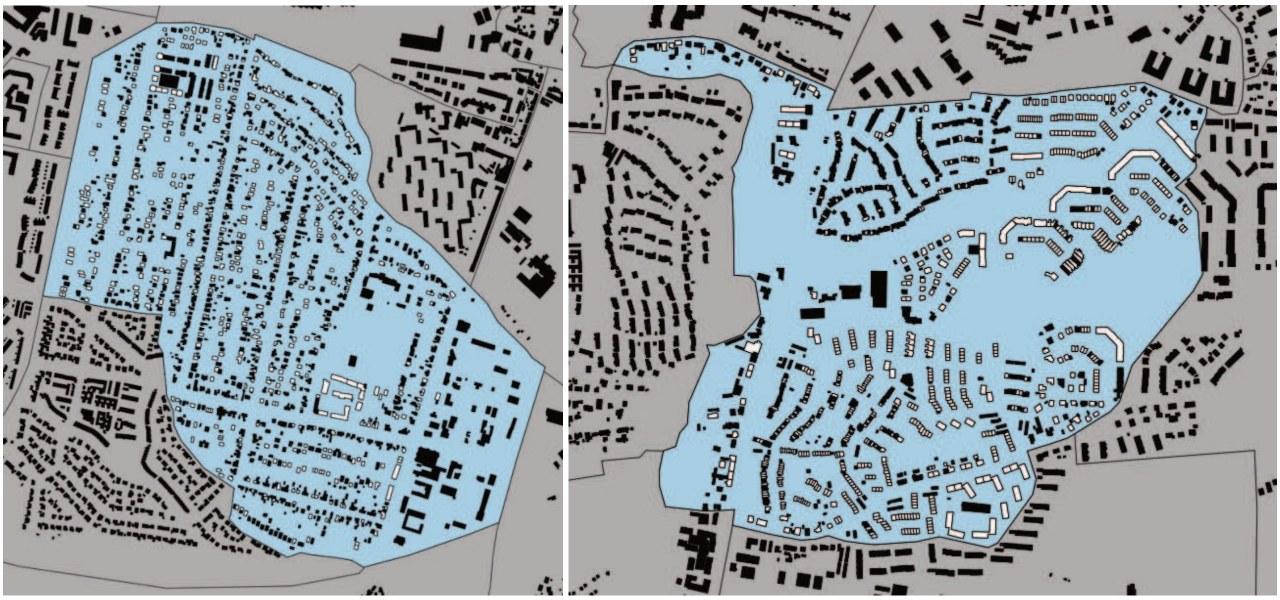

Figure 1 (left): Neuallermöhe, 511 buildings, 128 ha (own representation).
Figure 2 (right): Langenbek, 709 buildings, 79 ha (own representation)

4 COMPARISON OF AUTOMATED ALGORITHMS

I developed three algorithms to determine heat densities. In this chapter I shortly describe their unique approaches and compare their usefulness to find urban areas that fulfill certain criteria that would help to decide whether the installation of cogeneration plants seem feasible.

All three algorithms are defined as functions–programmed with R–and can be found in the following github repository: https://github.com/hannes-seller/CORP2016

[2] hectar of each SG's area urban space

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4.1 Tessellation of urban space into raster tiles

The first algorithm uses a simple spatial approach that partions the area under investigation into equally sized raster tiles. Besides a data frame with spatial data of the desired area, the function requires five numeric inputs:

- both eastern and western boundaries of the area as X coordinates
- both northern and southern boundaries of the area as Y coordinates
- the edge length of the square raster tile in meters

The function uses the coordinates to determine the area's spread as well as its geographical location and creates a grid of square tiles whose edges are equal to the length of the user's input. All tiles are consecutively numbered from north-west to south-east. In a second step, the function loops through all buildings of the data set and determines in which tile it is situated. Grouping the buildings by their tile numbers, it determines for each square:

- Total annual heat demand (MWh/a)
- Total heated floor area (m²)
- Heat density (MWh/(ha*a))

I applied this algorithm to neighbourhoods with the raster lengths 100 m, 150 m and 200 m (1 ha, 2.25 ha, 4 ha), leading to six results which I display with histograms (see Figure A1). The outcomes for Langenbek and Neuallermöhe are quite different (see Table 2). The latter has a generally low density throughout all raster sizes. The area's density does not change much, probably due to its homogenous building structure. In Langenbek, however, the densities are less consistent. The 150 m raster has a much lower density which might be caused by the area's rather amorphous shape (see Figure 2).

	Neuallermöhe		**Langenbek**	
Raster	Tiles	Med. density [MWh/(ha*a)]	Tiles	Med. density [MWh/(ha*a)]
100 m	106	53,574	78	111,454
150 m	55	45,781	43	78,88
200 m	36	47,846	23	103,038

Table 2: Results from tessellation, using 100, 150 and 200 m raster

This method's advantage is the comparability among tiles of urban space that have the same area. Thus it provides a good overview about heat densities in the area with the aim to identify those locations with tangible heat sinks. The algorithm's application only takes little time and processing power since it is basically a table join mechanism. Nonetheless, the algorithm has several disadvantages. Mostly, to ensure comparability among the raster tiles, the built-up urban structure requires a certain degree of homogeneity. As seen in Langenbek (Figure 2), non-built up areas in the center and the amorphous shape (especially in the east) lead to tiles that only contain a few buildings and therefore small densities. Also, tiles closer to the edge will include urban space that is outside the area of interest which lowers the heat density as well. Since bigger buildings are assigned to the tile where their X and Y coordinates are located, they can increase the density of a certain tile while surrounding tiles can have significantly lower densities. This algorithm works better for Neuallermöhe–or in general–for areas with homogeneous structure, both in built-up density and construction sizes, and a more rectangular shape. Regarding raster size, lengths of roughly 100 m appear to be optimal, as bigger areas include too much space outside the area, leading to lower densities, and smaller sizes (< 1 ha) lead to higher calculated densities. The Figures A2 and A3 show the rasters with 100 m and 150 m for both Langenbek and Neuallermöhe. Bigger raster tile have noticeably lower heat densities. Therefore, to assess the outcome, both the density and the total heat demand have to be considered and put into perspective of technical necessities of desired cogeneration power plants.

4.2 Clustering urban space by desired area size

The two clustering algorithms work similarly, but group buildings into clusters by assessing different criteria to determine heat densities. Since heat density is defined as MWh/a divided by hectares urban area (i.e.

energy demand over area), the highest densities depends on (1) a high numerator and/or (2) a low denominator. The first algorithm aims to reach a predetermined cluster area (e.g. 1 ha) and calculates the heat density of each cluster found: The smallest area with the highest demand. The second one strives to reach a certain total heat demand with as few buildings as possible: The highest heat demand with the smallest area.

Both functions operate with two while-loops, leading to longer computation times in comparison to the raster algorithm. However, in the examples, the computation time was not longer than a few seconds with any of the algorithms. I describe the first algorithm with the following pseudo-code:

- Input: A data set with buildings that have X and Y coordinates and calculated heat demands
- while 1: repeat as long as the data set contains at least one building:
  - arrange data set, sort buildings by their demands in descending order
  - cut out the first entry (highest demand) and paste it to a temporary data set (temp)
  - while 2: add closest neighbours to temp until desired area is reached
    - calculate the distance of remaining buildings to the cut out one
    - cut out closest neighbour and add to temp
    - calculate the area described by buildings from temp (distance between smallest and biggest X coordinates times distances between smallest and highest Y coordinates)
    - repeat while 2 until temp reaches desired area (e.g. 1 ha)
  - assign a cluster number, its density and total heat demand to temp buildings
  - save temporary buildings into output data set
  - repeat while 1 until all buildings are clustered and brought to the output data set

The longer computation time comes from the necessity to re-calculate the building distances to each other every time the while 2 loop ends. The first clusters found come very close to the desired area and enable comparable densities. The later cases reach larger areas since the algorithm might need to add neighbours that are more distant, as the number of buildings in the original data set decreases after each loop.

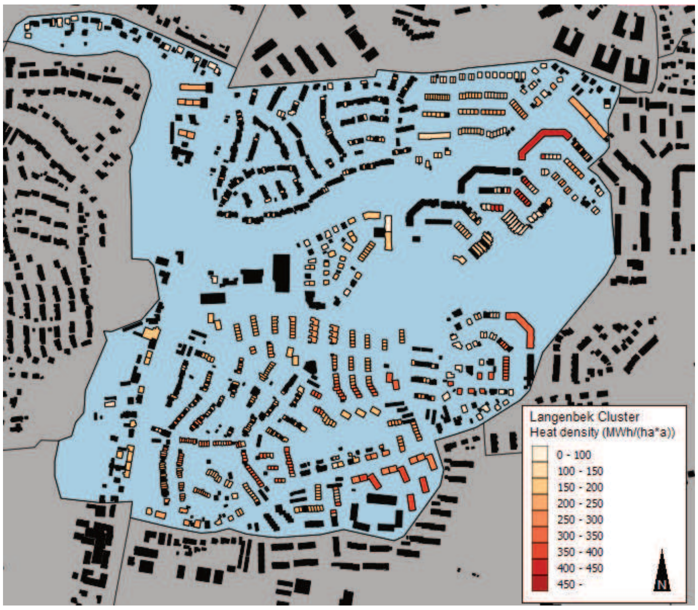

Figure 3 (left): Neuallermöhe, Cluster by Area (own representation).
Figure 4 (right): Langenbek, Cluster by Area (own representation).

This algorithm is better in finding the densest areas in regard of heat demand in comparison to the raster algorithm. While the boundaries of the latter ones are rather arbitrary, the first one aims directly for areas that promise a high density since it starts with the building with the highest total demand in the whole area (see Figure 3 and 4). The raster approach provides a better overview about the whole area; however, the

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cluster algorithm can spot islands of high densities within the area under investigation. A disadvantage is that it cannot aim for a desired heat density since the first loop iteration (highest demand building plus closest neighbour) usually creates very high densities (e.g. 5,000 MWh/(ha*a)) as the denominator–the area of urban space between both buildings–can be very small. Therefore I recommend reaching a certain area (1 ha or more) of urban space before assessing the density.

4.3 Clustering urban space by desired heat demand

The second cluster algorithm only differs in one aspect: The second while loop is repeated until a certain heat demand is reached, as opposed to a certain area of urban space. This method can be used to find building clusters that provide a desired total demand within the smallest possible area. However, the sizes of each cluster can vary strongly since the function cuts out buildings with highest demand first, forcing later loops to reach further to reach a certain total demand. For the investigated areas, the results look very similar to the results from the first clustering algorithm; I therefore do not include a visual representation here.

Both cluster algorithms can be used in addition to each other. While the first one finds spots with the highest density over an equal area of urban space, the second one can determine whether one of the found clusters has the highest demand of the whole area under investigation. This method helps as a visual and statistical aid to find a good location for a cogeneration power plant. However, I want to make clear that these algorithms are only meant to bring arguments to decision makings in regard of district heating planning; they do not deliver a result that makes further investigations obsolete. If a possible spot for a power plant is found, the buildings which actually should be connected to the plant need to be selected with more thorough investigation since the automatically formed clusters are based on simple algorithms that do not reflect on all relevant factors.

5 CONCLUSION AND OUTLOOK

This paper's aim was to determine the usefulness of three algorithms with the purpose of finding urban areas with properties that might justify the installation of cogeneration power plants. Automated processes are helpful when data sets are large and not all attributes are known for each observation (i.e. each building). Especially in urban planning, knowledge of a place is needed to make decisions. If areas under investigation are too big to ensure a decent knowledge about all local characteristics, automated approaches can help planners to set their focus to areas that are worth a deeper and more time consuming investigation.

The algorithms I presented are all meant as tools to subset larger urban areas to spots of interest. The raster tessellation provides a comparability of urban heat densities as it creates tiles with equal area sizes. Since the cities usually develop naturally and in dependence of topographical necessitates, the overlay of square shapes does not do justice to all urban contexts. Especially raster tiles close to borders, natural barriers like rivers or open spaces loose comparibility. The algorithm is most useful for areas with homogeneous building structures and built-up densities. Both cluster algorithms have similar strengths and weaknesses. They are apt to find spots within the urban area that fulfil certain conditions: a desired area size and density or a desired minimum total heat demand. However, they do not provide a complete overview about the whole area under investigation like the raster algorithm does. Applying the cluster mechanisms to larger areas will lead to spots of interest while areas among these spots may be underrepresented as they draw data from less desired buildings. The advantage of all algorithms is the low demand of known building characteristics: They can be applied to each set of buildings that provides geographical coordinates, number of floors and construction years.

However, I'd also like to admit that all algorithms are rather crude and could be improved by increasing the complexity of their match making processes. Furthermore, it would be beneficial to investigate more diverse urban areas as the results of all algorithms in both Langenbek and Neuallermöhe do not differ much from each other. For the raster algorithm it is worth investigating a possibility to shift raster tiles a few meters to all directions to reduce the arbitrariness of the raster's starting points. This would allow getting multiple density values for each construction which could be averaged to eliminate outliers caused by heterogeneous urban contexts. The cluster algorithms could be taught to choose a fitting neighbour by more than just the spatial vicinity. By applying weights to the data set's attributes, these mechanisms can favour neighbours with higher heat demands or buildings which are in need of retrofitting. These options would increase the effectiveness of strategies aiming for CO_2 emission reduction.

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reviewed paper

Computing Residential Heat Demand in Urban Space using QGIS. A Case Study for Shumen, Bulgaria

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1 ABSTRACT

Smart Cities need Smart Energy Planning. This requires knowledge about the spatial configuration of building heat demand, to facilitate circumspect decisions about where and how to renovate the building stock and what type of heating supply technology to implement. This paper presents a tool for static heat demand computation for residential buildings within the open-source Geographical Information System QGIS. It comes in the form of a Python script that analyses building geometries, accounting for walls shared with neighbouring buildings and computing heat demand according to the German norm DIN-4108-6. The novelty of the approach presented here, compared to standard procedures to compute urban heat demand which rely on building typologies, lies in the individualized computation for each building which allows for the inclusion of building specific characteristics not accounted for in standard building typologies.

Keywords: Building Renovation Levels, City-Wide Heat Demand, GIS Modelling, Analysis, urban space

2 INTRODUCTION

2.1 Smart Cities Need Smart Energy Planning

Smart cities make use of smart technology in service provision, governance and planning. Energy provision is no exception, in fact it is one of the drivers of the development of „smart" urban technology. Climate protection demands an increased effort towards energy efficiency and smart energy planning.

This requires the development of new tools, in particular, for modelling and simulation of heat demand in the building sector. The efficiency of heat provision has an important spatial component, since heat transport, much more so than electricity transport, gives rise to losses. Providing heat for the building sector (space heating, space cooling and hot water) accounts for a large share of urban primary energy consumption and associated CO2 emissions.

While thermal building simulation has been performed for decades at the individual building level, it is only in the last few years that it begins to be performed in an urban context with explicit spatial reference.

2.2 Accounting for the spatial context of heat demand

The spatial distribution of building heat demand within a city is relevant for several policy and planning questions: "Where to implement energy-efficiency measures?" and "what type of heating system is best suited to meet sustainability and climate protection needs?", possibly also "where to demolish old construction, and where place new one?". The answer to these questions (from an energy-efficiency and reducing CO2-emissions perspective) requires information at a spatial scale finer than the entire city.

Ideally, information on the heat energy needs of a building should be available at the building (or even dwelling unit) level. From there, the figures can be aggregated straightforwardly to different, coarser levels, appropriate for the purpose of the analysis. One approach to obtain a spatial reference is to use a digital building cadastre and based on building characteristics to assign a building heat demand type from a residential building heat demand typology (usually in the form of a KWh/m2*annum value). This yields a spatially referenced building stock with values for heat demand per square meter of floor area which can easily be transformed into total heat demand for a given building by multiplying with the floor area of the building according to the digital cadastre or into a heat demand density for hectare of urban space.

2.3 Organization of the paper

This paper begins with an overview of current approaches to estimating the heat demand of residential buildings at large scales, in particular, various building typologies. Then, the need for increased flexibility is explained and a different approach is proposed. This approach is implemented in the form of a software tool, which is then applied in a case study for the city of Shumen, Bulgaria. Residential heat demand for the entire

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city is computed and resulting spatial patterns are discussed. Finally, a measure of the usefulness of increased flexibility and the potential gain of heat demand estimation precision are presented.

3 ASSESSING URBAN HEAT DEMAND WITH BUILDING TYPOLOGIES: STATUS QUO

Until a few years ago, the spatial referencing of heat demand was achieved (in Germany) through the use of urban space typologies, offering urban space types ("Stadtraumtypen") with average heat (or heat and electricity) densities (i.e. in the form of a KWh/m2*annum value). These urban space typologies were derived from specific case studies of urban areas; city maps were then partitioned into different areas which were assigned an urban space type. (F.ex., see (Everding, 2007) – a recent example of this method is the Energieatlas Wilhelmsburg 2010 (IBA Hamburg Gmbh et al, 2010).

With the advent and availability of digital cadastres (in the mid-2000s), it became possible to carry out this classification into energy demand types at the building level. An electronic cadastre is more than a map of a city. It contains information on geo-referenced individual buildings.

This allowed combining "building typologies" with digital cadastres. Building typologies have been developed in Germany since the early 1990, for policy studies addressing the building stock – back then without the intent, or the possibility, to apply them in a spatial context (Institut Wohnen und Umwelt, 2005).

Numerous such typologies have been created since then – building typology for the State of Schleswig-Holstein (Arbeitsgemeinschaft für zeitgemäßes Bauen e.V, 2012); for Germany (Blesl, 2002); for the city of Hamburg; (Ecofys Germany Gmbh, 2011). The most prominent example is the TABULA project (Episcope/Intelligent Energy Europe, 2009-2012), as part of which national building typologies for 20 countries were developed. These include Germany (Institut Wohnen und Umwelt, 2011), Austria, Great Britain, Serbia, Bulgaria and many others.

Although they differ in some respects, all of these building typologies use the construction type of a building (e.g. single-family house, row house, prefabricated block of flats etc.) together with the construction epoch (e.g. built between 1960-1969) in order to evaluate its thermal properties and assign a value for the heat demand per square meter floor area per year (KWh/m2*annum). Some typologies also include calculations for heat demand for warm water, which however is not addressed in this paper.

Given a building typology and a digital cadastre, the task is then to assign these usually around 30-40 building types to the individual buildings contained in the cadastre and thus generating the heat demand value for each building. For a discussion of how to assign types from a typology to buildings in a cadastre see (Muñoz Hidalgo & Peters, 2015). For a practical example of the construction of a building heat demand typology and using it to develop a heat demand atlas see (Ecofys Germany Gmbh, 2011).

A project developed at the TU Darmstadt (Hegger, et al., 2014) resulted in a tool which differentiates between urban types (Stadtraumtypen - e.g. a territory with predominantly single-family houses, built between 1960 and 1969), that, however, uses the same underlying logic of creating a typology with heat demand values and assigning it to real objects using a cadastre of some sort.

An important point to mention is that three of the mentioned typologies (IWU Typology for Germany, Schleswig-Holstein Typology and the Stadtraumtypen) use a third criterion to differentiate buildings – the renovation level. For example, according to the IWU typology a single-family house in Germany built between 1958 and 1968 could have a heat demand of 211 KWh/m2*annum for a "baseline" condition, 97 KWh/m2*annum with "renovation package 1" or 52.1 KWh/m2*annum with "renovation package 2" (Institut Wohnen und Unwelt, 2011, p.77-79).

A somewhat different approach was undertaken for the SimStadt tool (Hochschule für Technik Stuttgart, M.O.S.S., GEF Ingenieur AG, 2015). This tool uses building typologies and 3D building data to assign materials and characteristics rather than heat demand values to buildings and then uses the DIN-18599 calculation procedure to compute heat demand. This method is more flexible than the assignment of heat demand values. The tool presented in this paper is in a similar spirit.

4 PURPOSE AND APPROACH OF PROPOSED TOOL

4.1 The need to make existing methods more flexible

The issue addressed in this paper is the lack of flexibility of the approaches described above (with the exception of the SimStadt approach). There is a need to account for building-specific parameters – beyond bulding types – in assessing heat demand. To illustrate why that is so, the standard procedure for calculating heat demand is briefly sketched in the following paragraph:

Computing heat demand of a building follows well-defined principles. Basically, heat demand is computed as the sum of heat transmission losses through the areas of the building shell. Heat transmission losses are greatly influenced by material and thickness of the building shell; this is reflected in the heat transmission coefficients (captured by so called "U values") associated with particular areas of the building shell. A number of parameters are also important for the calculation: Indoor air temperature, air exchange rate, and indoor heat gains, for example. For computing heat demand to suffice legal requirements or energy planning, normed values for these parameters are assumed.

Building typologies cointain (implicitly or explicitly) information on the heat transmittivity of the building shell. They are based on knowledge and experience of materials and construction typology for buildings of different construction types and epochs.

In recent years, it has become obvious that actual heat consumption of buildings greatly differs from heat demand calculations as described above (Arbeitsgemeinschaft für zeitgemäßes Bauen e.V, 2009, p.5). Reasons for these discrepancies could be numerous - from wrong assumptions of building characteristics and user behaviour to inaccurate assigning of building types to buildings. Whatever the reasons may be – the possibility to account for building specific information would offer an improvement over methods using standard building information. This is what the method and the tool proposed in this paper is about.

The following example serves as illustration. When using a predefined typology as described above, an analyst differentiates buildings according to the three criteria as mentioned: construction type, construction epoch and (in some cases) renovation level, in combination with normed values for indoor air temperature, ventilation rate and the like. Now imagine a situation where the heat demand of buildings in neighbourhood A (multifamily buildings, built between 1960 and 1969 and renovated in 2000) differs from the heat demand of the buildings of neighbourhood B (same characteristics) because in neighborhood A, half of the dwelling units are vacant, or the renovations which the buildings in A underwent in 2000 differed from the renovations B underwent, or inhabitants of neighbourhood A tend to keep an average internal temperature of 190C and the inhabitants of B an average temperature of 220C (because of demographic differences). Such variables are usually accounted for during the construction of the typologies by taking averaged values. This approach is rooted in the assumption that user behaviour and other characteristics average themselves out and thus dissappear at aggregated levels. Although this could be the case with respect to some characteristics, others, which are spatially autocorrelated and exhibit spatial clustering could still be present at an aggregated level and if averaged values are assumed, a variance in the spatial pattern of heat demand could be lost.

One other phenomenon which could invalidate standardized heat demand projections is the "patchwork renovation" typical for former East Block countries. This situation occurs when a building receives insulation and energy-efficient windows only on parts of the façade. This occurs frequently in these countries as building ownership is organized as condominiums, a consequence of privatizing former state property of buildings by selling flats to renters. Some apartment owners decide to renovate, while others do not, resulting in a façade which contains patches of insulated and non-insulated shell. Such situations cannot be covered by the normal typology approach unless numerous more types are predefined.

The tool presented in this paper can account for such specific building (and occupant) characteristics where they are known – something that the standard building typology approach does not allow.

4.2 Approach: Individualizing heat demand computations

The approach of the tool presented here is the following: Rather than assigning heat demand values which were calculated- or empirically sampled - for representative buildings in a typology, the analyst assignes all heat demand-related variables to the buildings using a typology and then calculates heat demand for each

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building in the building stock separately. In this way, the analyst has the opportunity to modify characteristics for individual buildings or groups of buildings and is not bound to the three criteria that the typologies are based on. Using the example of neighbourhoods A and B, which have buildings of the same construction type, construction epoch and renovation level – using a more flexible tool, the analyst first assigns an average internal temperature of 200C from a typology but then he is able to modify it for individual buildings or groups of buildings, if it is suspected that the user behaviour is different. With the example of the "patchwork renovation", this problem can be tackled by being able to assign different U values (thermal transmittance) to different parts of a building façade.

5 IMPLEMENTATION OF PROPOSED TOOL

5.1 Software

The software environment chosen for the tool, was that of the open-source QGIS. Using a GIS environment for large-scale heat demand calculations is benefitial, because it provides tools for spatial analysis and visualization. The tool designed is in the form of a script in the python programming language and is executed directly from the QGIS python console. It is still in a beta phase – it is complete, operatable, but still undergoing computing optimizations and upgrades. It can be viewed on Github at: https://github.com/ivandochev/QGIS-Heat-Demand.git

5.2 Building Specific Variables

The workflow begins with a building dataset (in the form of a shapefile, database or similar) which, based on an adopted (or designed) building typology, digital cadastre and assumptions/estimations, inherits building characteristics. These characteristics can then be modified for each individual building, or for groups of buildings in accordance with the needs of the analysis.

Table 1. summarizes these characteristics and presents the sources/assumptions behind the computations in the test case study presented in chapter 6. Many of the assumptions are taken from the TABULA project, in order to ensure comparable results.

Script Variable	**Example Schema for Input Shapefile**	**Explanation // Source in example case study**
City level Data		
Average Temperature per month	Not taken from Shapefile, added manually in script as a list of values	Climate data in such form is, in many cases in the EU, provided in energy-efficiency legislation. // Bulgarian Ordinance 16 (Bulgarian Ministry of Economics, Energy and Tourism, 2009)
Solar radiation		
Building level Data		
OBJECTID	OBJECTID	Unique identifier of building // Cadastral ID
Height	HEIGHT	Height in meters // Simplified = floors * 3
Floors	Floors	Number of floors // Cadastral Data
Area	BuildArea	Area of footprint // Cadastral Data
Perimeter	BuildPerim	Building perimeter // Cadastral Data
RoofType	RoofType	Used to differentiate the heating losses to unheated space. If value 'hip', then it is assumed that the last floor is under unheated space with average temperature of 10^{0}C // Satellite Imagery
WinWallRatio	WinWallPer	The ratio between openings (windows) and walls. // A uniform ratio for all walls is used in beta version of script, equalling 2:8 (20%), based on empirical data.
HeatStorCapacity	HeatSCap	Effective heat storage capacity of building – simplified - 50 Wh/(m^3K) – heavy building, 15 Wh/(m^3K) – light building. All buildings were categorized as heavy. // DIN 4108-6.
WallU	Walls	Transmission coefficient for Walls // Building Typology
WindowU	Windows	Transmission coefficient for Windows // Building Typology
RoofU	Roofs	Transmission coefficient for Windows // Building Typology

BaseU	Base	Transmission coefficient for Windows // Building Typology
EnEfWallsU	Walls_Reno	Transmission coefficient for renovated walls. If insulation is present for the entire building – modify 'WallU' variable and leave blank here. If "patchwork renovation" is observed, provide U value for the insulated part of the façade. // 0.5 (SOFENA, 2012. p.8)
EnEfWindowsU	Windows_Re	Same as EnEfWallsU // 1.7 (Bulgarian Ministry of Economics, Energy and Tourism, 2009, p.23)
PerIns	PerIns	Could be given as percent of façade area with insulation. Alternatively, the ratio of renovated to non-renovated dwelling units can be used. // Census Data
PerEnEfWin	PerEnEfWin	Same as above. // Census Data
Temperature	InsideTemp	Average Internal Temperature // A standard 20^0C was assumed (Episcope, n.d.)
AirChangeRate	AirChR	Air change rate // A standard 0.6 was assumed (Episcope, n.d.). This is a highly debatable value which is precisely why it is important to be able to account for it. For the purposes of the case study a uniform value was taken, acknowledging the possibility that these could vary a lot in reality.
HeatedVolumeCoef	HtVolCoef	Ratio between building volume and heated volume. // 0.8 was assumed roughly equals an average floor height of 3 meters and clear height of 2.5 meters (Episcope, n.d.)
InternalGainsPerSq Meter	IntGains	Given as W/m^2 residential space. This is a simplification that is deemed reasonable. If more detailed information is available it can be transformed into W/m^2 and thus accounted for. // In the case study 3 W/m^2 was taken in accordance with the TABULA project defaults. (Episcope, n.d.)
SolarGainsFactor	SolarGRec	This reduction factor accounts for shading, percent transparent surface on windows (substracting frame area, glazing effects and others) // 0.3024, (Episcope, n.d.)
TotalAnnualHeatDe mand	KwhAnnum	Output variable – heat demand (KWh) per annum
TotalAnnualHeatDe mandperSqMeter	KwhMetAnnu	Output variable – heat demand per annum per square meter gross floor area (KWh/m2*a)

Table 1: Input and Output variables for heat demand estimation tool.

The example shapefile schema provided can be altered in the beginning of the script.

5.3 Algorithm

The computation starts with a classification of the buildings into two categories – "attached" and "detached". This is done in order to account for party walls, which are assumed not to have heat losses in the beta version of the script.[1] Then, if a building is classified as "having party walls", a spatial check is made to find which segments of the outer walls border other buildings. For these segments no thermal loss is computed. If, however, the height of the current building is larger than the neighbouring, the area of the party wall which is above the neighbouring building is considered for thermal losses.

In the next step each segment of the footprint of each building is multiplied with the height of the building and a percentage of windows is applied. In addition, a percentage of renovated insulation and windows is also applied, so that each segment wall (each segment of the footprint multiplied by the height) is divided into four parts – window area, wall area, renovated window area and renovated wall area. This is a simplification of reality which is considered plausible. The geometry of the building shell of the building is also simplified in this way, but remains as complex as the building footprint. For each wall, heat losses are considered and then ventilation losses for the buildings are added. In the next step, solar gains and internal gains are computed and added to the equation. Finally, a utilization factor for the gains is calculated and applied. The script does not take into account cooling demand. For a step-by-step explanation of all

[1] The assumption in the beta version is that the temperature difference between two buildings will not be great enough for meaningful losses to occur through party walls. This issue will be further developed.

computation steps also in “pseudo code” see README file at: https://github.com/ivandochev/QGIS-Heat-Demand.git

6 APPLICATION TO CASE STUDY: THE CITY OF SHUMEN, BULGARIA

In order to test the algorithm a case study city was chosen – the city of Shumen, Bulgaria. The choice was based, on the one hand, on the relatively rich building data that was available – a digital cadastre and census data and, on the other, on the scale of the city - with 5500 residential buildings (circa 70 000 inhabitants) the performance of the algorithm for larger datasets could be tested.

6.1 Data available

The data was gathered from three sources – cadastral data from the municipal administration of the city, census data (2011) from the National Statistics Institute of Bulgaria and finally, in order to map the roof types of the buildings, satellite imagery from Google Earth (2014). An overview of the variables thus made available is given in Table 2.

OVERVIEW OF DATA AT THE BUILDING LEVEL	
Variable	**Possible values**
Cadastral Data	
Building Geometry	Coordinates (Float)
Building Type	Single-family, Multifamily
Number of Floors	Integer
Building Height	Approximated = Floors * 3
Statistical Data from Census 2011, provided by the National Statistical Institute of Bulgaria	
Building Material	Brick, Adobe brick, Steel-Concrete, Prefabricated Panels, Stone, Wood, Other
Construction Year	Integer
Number of dwelling units in the building	Integer
Energy Efficient Insulation	Number of dwelling units with EE Insulation (Integer)
Energy Efficient Windows	Number of dwelling units with EE Windows (Integer)
Dwelling units heated on Wood or Coal	Number of dwelling units (Integer)
Inhabitants	Integer
Data gathered by visual analysis of Satellite Imagery	
Roof Type	Flat Roof/Other Roof type – Google Satellite Imagery from 2014 used.

Table 2: Data available at the building level.

6.2 Modifying the Existing Building Typology for Bulgaria

Although the data available from the digital cadastre and the census was relatively rich, key variables needed for the heat demand calculation algorithm were missing. In order to estimate these, a typology had to be used. Such a typology actually exists – designed by the consulting company SOFENA as part of the TABULA project (SOFENA, 2012), however, some discrepancies[2] within the data available from the TABULA website (Episcope, n.d.) and in the documentation provided by SOFENA were found and therefore only three building types were taken from this typology. In order to estimate the thermal properties of the building envelope for other types of buildings the Bulgarian Ordinance 16 (Bulgarian Ministry of Economics, Energy and Tourism, 2009) was used. This is a legislative document that determines the lawfully binding minimal U value (thermal transmission coefficient) for parts of the outer shell of buildings for

[2] In the data provided online (Episcope, n.d.), some example buildings were found to have implausible window areas and U values for external walls (a maximum of 0.93 for all buildings built after 1960). These however, varied in the documentation provided by SOFENA (SOFENA, 2012, p.12-14), where much more plausible values were presented. Due to this, the U values and estimations for only the types in the documentation were taken and considered as plausible - single-family house (1960-1998), multifamily building (1918–1939) and a prefabricated block of flats (1960-1968).

different construction epochs. Based on these two sources a new typology was constructed (referred to as the "mixed typology" - Table. 3). It has to be noted, that the construction of a typology based on legislative norms, despite its logicalness, has to be viewed with caution – the level of quality of construction could result in deviations from these norms and furthermore – deteriorations due to aging also have a strong effect on transmission coefficients. For the purpose of testing the algorithm, however, these effects were neglected.

It becomes clear from the typology construction that even with the two sources mentioned above, many values still had to be assumed - for buildings built before 1969 the values were taken from the available data from the SOFENA typology, similarly, U values for windows of buildings between 1969 and 1999 were also assumed to be equal to the ones of single-family houses in this period from the SOFENA typology. Apart from U values, the algorithm has a number of additional values that need to be specified (e.g. air change rate, internal temperature etc), the values used in the case study and their sources were mentioned in Table. 2.

"MIXED TYPOLOGY" OVERVIEW							
SOFENA Typology – types considered plausible							
Epoch	**Building Type**	**U Values** Walls/Windows/Roof/Base					**Assigning principle**
1918-1939	Multifamily	1.39	2.32	2.10	2.10		BuildingType: *Multifamily*; Construction Year: *1918-1939*; Material: Not *Prefabricated Panels;* Roof Type: *Flat*
1960-1968	Single-family	1.39	2.63	0.59	2.10		BuildingType: *Single-family*; Construction Year: *1960-1998*; Roof Type: *Hip*
1960-1968	Multifamily, prefabricated block of flats	2.12	2.63	1.98	2.10		BuildingType: *Multifamily*; Construction Year: *1960-1968*; Material: *Prefabricated Panels;* Roof Type: *Flat*
ORDINANCE 16 – Assignment of all buildings, not covered by the above types							
Epoch	**Building Type**	**Walls Massive/ Panels**		**Win/Roof/Base**			**Assigning principle**
1969-1980	All	1.61	***1.61***	***2.63***	1.25	1.04	BuildingType: *any*; Construction Year: *according to epoch*; Material: Not *Prefabricated Panels/Prefabricated panels* – were applicable Roof Type: *any*
1980-1999	All	1.25	0.9	***2.63***	1	0.66	
1999-2004	All	0.5	-*	2.65	***0.3***	0.5	
2004-2009	All	0.45	-*	2	0.3	0.5	
2009-	All	0.35	-*	1.7	0.3	0.5	
OTHER TYPES – buildings not covered above,							
Epoch	**Building Type**	**Walls**		**Win/Roof/Base**			**Assigning principle**
Before 1969	Multifamily	***1.39***		***2.32***	***2.10***	***2.10***	BuildingType: *Multifamily*; Construction Year: *before 1969*; Material: Not *Prefabricated Panels;* Roof Type: *any*
Before 1969	Single-family	***1.39***		***2.63***	***0.59***	***2.10***	BuildingType: *Single-family*; Construction Year: *before 1969*; Roof Type: *any*

Table 3: Typology Construction. *Not applicable. "1.61"-value not given and assumed according to other values.

A tendency that energy-efficiency gradually increased with time is observable. Exceptions are present however – for example, according to the SOFENA typology, multifamily buildings, built between 1939 and 1950, have lower U values (1.39) than residential buildings in the period 1969-1980 (1.61). On the other hand, a 0.9 U value for walls of prefabricated blocks of flats (Material: Prefabricated Panels) built after 1980 is surprisingly low and such high energy-efficiency of these buildings can be questioned.[3]

The data on renovation levels was in the form of: "number of dwelling units per building with energy-efficiency insulation" and "number of dwelling units per building with energy-efficiency windows" and in

[3] Not low enough, however, to be considered implausible, since energy-efficiency was indeed increasing through the 1970s.

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order to translate these into U values some assumptions again had to be made. According to the SOFENA (SOFENA, 2012, p.8), most refurbishments in the period 1999-2009 involved the decrease of the U values of insulated walls and energy-efficient windows down to 0.5 W/m2.K, and 1.8 W/m2.K respectively. On the other hand, U values of renovations decreased to 0.35 W/m2.K for walls and 1.1 – 2.0 W/m2.K for windows in the period after 2009. However, the census data acquired dated from 2011 and since no indication of the date of renovation was given, it was assumed that most renovations took place in the longer period – 1999-2009 rather than the shorter - 2009-2011. An argument in favour of taking the higher values is also the questionable quality of the renovations undertaken.

7 RESULTS OF CASE STUDY

The python script was ran on a 6 GB RAM and Intel Core i5 1.8 Ghz Processor computer and it took it approx. 1 hour to compute heat demand values for 5500 buildings. Steps are foreseen to increase efficiency and speed of the script.

7.1 Plausibility Check

Before the results of the python script can be discussed, a plausiblity check is required to ensure that observed patterns are not caused by computational mistakes. In order to do that, a comparison was made between values, computed with the python script and values taken from the TABULA project for the same building type (Table 4). The building type in question is a prefabricated block of flats from the 1960s (Source).

Prefabricated block of flats, built between 1960-1969 (Variables according to the TABULA web tool (Source))		
U value Walls / U value Windows / U value Roof / U value Base	0.93 / 2.60 / 1.98 / 1.29 W/m^2.K	
Air Change rate	0.6 h^{-1}	
Internal Gains / Internal Temperature	3 W/m^2 / 20^{o}C	
	Python Script	TABULA calculator
Estimated Heat Demand kWh/m^2*a	114.3	108.9

Table 4: Comparison between computed values with script and TABULA calculator

Although a small difference is observable, this could be contributed to the nature of the computation. The TABULA project uses an yearly computation, while the DIN-4108-6, on the basis of which the python script operates, is a monthly calculation, which leads to some discrepancies – the yearly demand is based on a 192 days of heating season, while the monthly computation is based on a six month heating season – 182 days. Furthermore, the TABULA computation assumes a ground floor bordering earth, while the python script assumes that the ground floor borders unheated basements with a temperature of 10oC. These differences lead to discrepancies, however the results of the python script are definitely plausible and quite close to the calculation of the TABULA project.

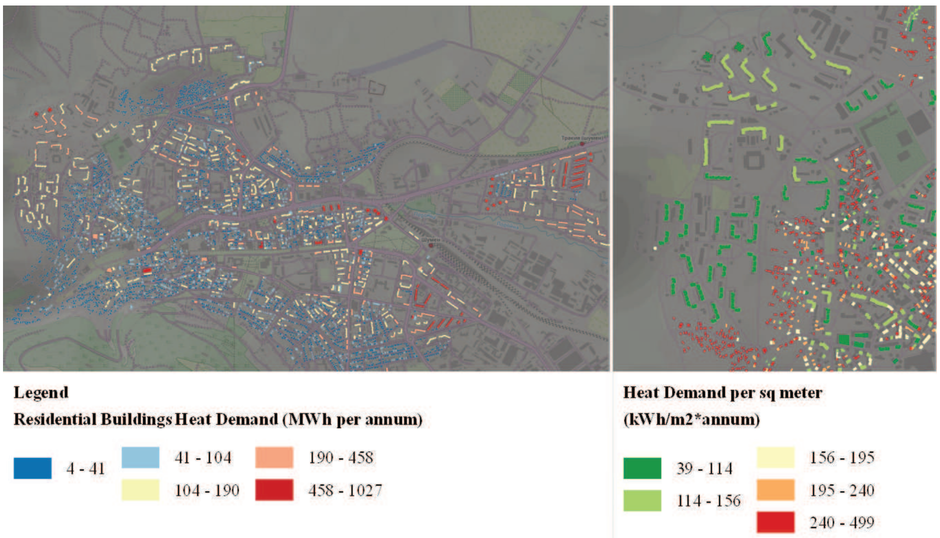

Fig. 1: (A) Residential buildings heat demand meter per annum in MWh; (B) Heat demand per square meter per annum of residential buildings. City of Shumen, Bulgaria. Own calculation, Basemap source: OpenStreetMap Landscape

7.2 Spatial pattern of heat demand

Computing heat demand for the building stock of the city of Shumen with the procedure presented above produces the following pattern (Fig.1(A)): The largest demand (in absolute terms) comes, not surprisingly, from the prefabricated blocks to the north, northwest and east of the city. However, there is some heterogeneity in building heat demand, even in relatively homogeneous-looking neighbourhoods (neighbourhoods having relatively uniform urban fabric – only prefabricated blocks, or only single-family houses etc).

Normalizing absolute heat demand by buildings with building gross floor area reveals an additional pattern (Fig.1(B)). Heat demand per square meter gross floor area is lower for larger buildings. This could be traced back to the construction epochs. More than 70% of the single-family houses of Shumen (that is: small buildings) were built before 1969, while only 16% of multifamily buildings (prefabricated blocks of flats included) were built before 1969. However, this reasoning, presupposes that energy-efficiency increased with time, which could have exceptions that were not acounted for in the process of the typology construction. Additionally, any of the assumptions made with regard to air-change-rate or internal temperature could also distort results.

One other parameter that influences specific (i.e. per square meter) heat demand is the surface-to-volume ratio (S/V), the ratio between the surface area of a building and its volume. The lower this ratio, the more compact a building, the lower the heat transmission losses throught the shell. Multifamily buildings have a smaller S/V ratio than single-family buildings which decreases their specific (i.e. per m2) heat demand, all else equal. – Inspecting specific heat demand of single-vs multifamily buildings separately shows that spatial heterogeneity is present within both groups.

7.3 Effects of large-scale computation of heat demand for individual buildings

As argued above, the benefit of computing heat demand for every single building, is the flexibility thus attained. This section presents an example of this flexibility with respect to “patchwork renovation” mentioned earlier – a phenomenon typical for former Eastern block countries that is not captured by building typologies for these countries (see section 4). A metric for the influence of this phenomenon on the spread of heat demand could be estimated by taking the average and standard deviation of the heat demand per square meter for different types of buildings with patchwork renovations (Table 5.). By controlling for materials (via construction epoch) and the S/V ratio (via construction type) one can estimate the effect of patchwork renovation on heat demand (complete renovations are excluded, all else equal). It becomes clear that a substantial standard deviation due to renovations exists with all construction types, apart from the prefabricated blocks of flats. This, however, could be due to the relatively high energy efficiency of newer generations of prefabricated blocks of flats according to the typology (U values of Walls equalling as low as 0.9), which is a questionable assumption (as mentioned earlier). The effects of any renovation would be much higher if these buildings are less energy-efficient in reality and that would make accounting for patchwork renovations all the more important.

Furthermore, as presented in chapter 5.2, many assumptions about buildings have to be taken into account in order to compute heat demand (e.g. air change rate, internal gains, etc), which means that variance would be even greater if these are not assumed to be uniform for all buildings (as in this case study).

Type	**Number of buildings**	**Average kWh/m^2*a**	**Standard Deviation**
SFH-before 1959	1485	271	57
SFH-1960-1969	1313	251	65
SFH-1970-1980	545	249	67
MFH-1970-1980	270	144	20
PFB-1970-1980	241	131	13
PFB-1981-1987	232	96	7

Table 5: Overview of average and standard deviation of kWh/m2*a per building type in the city of Shumen. SFH – single family house, MFH – multifamily house, PFB – prefabricated block of flats. Only the six most frequent types are included – sum of buildings adhering to these types amounts to 80% of the building stock. Buildings with complete renovation (whole building) are excluded.

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8 CONCLUSIONS

Computing heat demand for entire building stocks is a chalenging task. As presented in this paper, an assigning of heat demand types with kWh/m2*a values is based upon typologies that make use of numerous averaged values mirroring building characteristics and user behaviour. Although extensive data on all of the important variables that influence heat demand will very rarely be available and the typology approach is the usual basis for estimations, sample, empiric or census data could reveal spatial patterns, that averaged values obscure. Tools are therefore needed, that are flexible enough to allow one to account for a large number of variables. The python script presented in this paper is a step in this direction. Although it is still in a beta version and relatively time-consuming, it shows potential to be a flexible tool in the hands of analysts and planers. Being executed directly within a GIS is also beneficial, since this is the software environment in which spatial analysis is taking place and which provides decision support for spatial planning.

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Creative Capital for Smart Solutions: Toward a Liveable City

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1 ABSTRACT

Creative capital of a city is a stock of knowledge, talent and experiences possessed by individuals and the population at large. It presents not only concentration of creative people in a city, but also their organised social interaction that generates innovations and economic value. The importance of creative capital for city wealth, development and competitiveness is well known and proven. However, the relationship between creative capital and 'smart features' of a city has not been thoroughly analysed or sufficiently used in practice.

The smart city concept has a broad definition and understanding. It could refer to a city with high concentration of highly educated people, or to one which uses ICT for improving the efficiency of urban systems. In this paper the smart city concept will be considered in the context of sustainability and environmental protection, focusing on the development and implementation of ICT networks in key urban issues - environment, society and technology.

Creative capital has a special role in 'smart' development, especially considering available human resources, innovative potential, transfer of knowledge, and spill-over effects. Therefore, the aim of this paper is to identify and analyse the role which creative capital has in the development of a smart city. Focusing on the case of Belgrade and its emerging creative district Savamala, the paper will also propose some guidelines for possible development and implementation of smart solutions which could stimulate creative capital and/or use it for further 'smart' upgrading of the city.

Keywords: creative capital, innovation, cognitive-creative industry, knowledge, smart city

2 INTRODUCTION

The “Smart city” concept has become a popular urban paradigm between researchers and urban governments. The new challenges, confronting growing cities in contemporary society, ask for new solutions and responses. Although widely present, the term smart city does not have a precise definition and understanding. It refers to a city with high concentration of highly educated people, which uses ICT for improving the efficiency of urban systems and/or to ensure community empowerment and participation. In this paper, the smart city concept will be considered in the context of sustainability and environmental protection. Its elements will be addressed as an investment in social capital and new/innovative technology, providing and facilitating a sustainable economic growth and higher quality of life.

The creation of a smart city is not an easy task for urban government and it requires human and financial resources. Creative capital has a special role in 'smart' development, especially considering the available human resources, innovative potential, the transfer of knowledge, spill-over effects and the rising awareness of its influence on sustainable growth and overall wellbeing. Richard Florida (2002) introduced the “creative capital” theory, claiming that creative class represents the core of successful urban development in post-Fordist society. Creative capital is not simply the concentration of creative people. It is a stock of knowledge, talent and experiences possessed by individuals and populations which through social interaction generate innovations and economic value.

The improvement of the creative capital of a city and its engagement in the development of smart solutions is crucial for the creation of a smart city. For a better understanding of this process, the paper uses the case study of the Savamala quarter in Belgrade. Belgrade is the capital of Serbia and the leading centre of creative industry in the country and the region. It has strong creative capital, but the smart development of the city is questionable. Savamala is a district of Belgrade, recognised as the centre of alternative culture, creativity and innovation at the global level. It has contributed to Belgrade's attractiveness to the creative class. In general, the creative capital of Belgrade and its creative district Savamala could be used as generators of smart solutions for the improvement of sustainability, environmental quality and urban efficiency. Additionally, they could be used to raise awareness of the smart city concept, its importance and modes. The paper proposes some guidelines for possible development and implementation of smart solutions which could stimulate creative capital and/or use it for further 'smart' upgrading of the city.

3 THE CREATIVE CAPITAL FOR A SMART CITY

3.1 Creative capital

In 2002, Richard Florida developed the "creative capital" theory claiming that creative people i.e. the 'creative class' represents the main driving force of cities' development in the contemporary (post-Fordist) economy. The concentration of creativity in cities is the precondition for their growth and their source of competitiveness. Jobs and companies follow the creative class and if a city wants to be successful it needs to attract it. Although this theory has become widely popular in literature and urban policies, it gives a simplified presentation of a city's creative capital. The pure presence of creative people in a city is not creative capital. Creativity is not an individual quality of one person, but rather a social product. To generate creative capital people need to be connected, producing knowledge and value. Stefan Krätke defines creative capital as "the ability of urban economic actors to produce scientific, technological and artistic innovations on the basis of relational assets that are socially produced within a city or a region" (2011:3).

Creative capital is connected with the human capital theory. Human capital is defined as "any form of acquired skills or knowledge that could be used to improve the individual's ability to perform productive work" (Abrokwaa 1999: 653). Human capital, as a social stock of knowledge, a generator of jobs and an attractor for foreign companies. Human and creative capital complement each other but there is an important difference. Human capital applies to all the knowledge of citizens that generate production, while creative capital emphasises the sector of creative industries that highly contributes to the wealth of a city in contemporary society. Creative capital presents a stock of creative people (artists, highly educated people, researchers...) able to generate innovation and economic value.

3.2 The Smart city concept

During the last two decades, the concept of „smart city" has become increasingly popular in theoretical literature and urban policies. The rising urban population, the role of cities in national and global economies and their consequential environmental impact have emphasised the search for smarter ways of urban management and development. However, the understanding and definition of the 'smart city' concept are blurred. From the technological perspective, the smart city has been understood as a city with available high-quality ICT infrastructure enabling information sharing and collaboration of all inhabitants no matter the location in the city (Nam and Pardo, 2011). From the angle of economy and business development, the smart city is perceived as a city where technological and ICT solutions create a business-friendly atmosphere and make entrepreneurialism easier (Kitchin, 2014). When interpreted from the human perspective, smart cities could be defined as "metropolitan areas with a large share of the adult population with a college degree" (Winters, 2011: 254). Another approach puts emphasis on community, describing the smart city as a community which uses ICT and E-governance in order to ensure its social cohesion, empowerment and participation in city functioning (Caragliu et al., 2011).

In this paper, the emphasis will be on the understanding of the 'smart city concept' from the perspective of sustainability and environmental protection. The smart city is seen as a city that uses technology to lower its energy consumption, its pollution and the expenditure of resources. An adequate definition could be the one given by Caragliu et al. (2011:70) claiming that a city is smart "when investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance". If a city aims to improve its sustainability by using ICT networks and modern technologies, it is not possible to separate environmental, social and economic sustainability.

3.3 The role of creative capital in smart city development

The term smart city is sometimes used as the synonym for the creative city. For example, Thite defines smart city as a city that "aimed at nurturing a creative economy through investment in quality of life which in turn attracts knowledge workers to live and work in smart cities" (2011: 623). Although there are some common elements between these two concepts, in this paper the term 'smart city' will not be equated with 'creative city'. Instead, the paper will try to find the causal relationship between the creative capital of a city and the use of technology and modern telecommunication for sustainable growth, environmental protection and increased quality of life.

Nam and Pardo (2011) define technology (infrastructure of hardware and software), people (creativity, diversity and education) and institutions (governance and policy) as the key components of the smart city. Technology is not enough by itself to create the smart city. People, as human capital, are the most important element for the smart city (Holland, 2008). In the concept of the creative city, Richard Florida (2002) underlines the importance of 3Ts for economic development – technology, talent and tolerance. He recognises that technology, although a required component, does not generate city development, while people represent engines of city growth. The concentration of creative and highly educated people is the precondition for innovation and creativity in the city, while creative capital is the precondition for the development of the smart city. If there are no people to use technology and modern communication for value production, the city cannot be recognized as a 'smart' one - no matter how intelligent systems in the city are.

The strength of creative capital is proportional to the generation of innovation in the city. The more creative and high-educated people are in the city, the higher the chance for the city to generate new technological, IT and E-solution for sustainable growth. If creative capital is directed and coordinated in an adequate manner, sustainable development and success can be achieved (Scott, 2006). The presence of creative capital in the city means it can make its own smart city solutions, which can improve governance, transportation and environmental quality.The city can draw resources from itself, having the possibility to hire local companies and institutions. On the other hand, creative industries, knowledge dependent industries and R&D are the prime sectors of the economy of cities in the global post-Fordist society (Florida, 2002, Scott 2007, Kratke 2011). Consequently, creative capital has an important impact on cities' wealth. The economic strength of the city determines the money available for investment in 'smart city upgrading' and environmental protection.

The creative capital plays the role of spill-over effects in smart city development. The spill-over effect is most evident in the sphere of innovation and knowledge. The concentration of creative and knowledge workers in the city, and even more in specialized clusters, induces the diffusion of knowledge, know-how and the creation of new ideas and new companies (Feldman, 2001). Diffusion happens through interaction between people and companies. Interaction can be face-to-face in spatial clusters or through internet networkers in “cyber” clusters. The higher the production of innovation in the city the more favourable conditions for the smart improvement of the city it creates. Furthermore, the concentration of highly educated people in the city raises the general awareness of technological potentials and ways of their implementation for overall wellbeing. They require effective e-solutions from city government, especially related to administrative activities and everyday situations. Their requests urge cities to implement smart technology, while their use of technology, applications and E-Systems encourages other citizens to accept innovative ways of urban life and its improvement. A healthy and green urban environment, with available public spaces and recreation areas, is one of the main attractors for the creative class (Florida 2012). Therefore, cities invest in sustainable urban design and environmental improvements, simultaneously strengthening their smart city status. These changes influence the whole city, introducing new environmental trends and advanced technological solutions for sustainable transport, business, recycling and - living.

4 THE IMPROVEMENT OF CREATIVE CAPITAL IN BELGRADE

In order to understand better the role of creative capital in smart city development the paper uses the case study of Belgrade and its creative district Savamala.

4.1 Belgrade creative capital

Belgrade is the capital city of Serbia, located in the southeast of Europe. Situated on the riverbanks of the Danube and the Sava, it is the largest city in Serbia and the third largest city on the river Danube, after Vienna and Budapest. It is the fourth largest city in Southeast Europe, after Istanbul, Athens and Bucharest (Hirt, 2009). Belgrade is a vibrant metropolis of 1,23 million people in the city area and 1,7 million within the administrative region. It is the main university centre of Serbia with 3 public and 6 private universities. The number of graduate students has increased - from 10,789 in 2007 to 25,334 in 2013. The University of Belgrade is ranked among 400 top universities according to the 2014 Academic Ranking of World Universities (Shanghai List).

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Belgrade is the leading centre of creative industry and advanced service sector (especially ICT), not only in Serbia, but in the region as well. Creative industry experienced rapid growth in the Belgrade region. At the beginning of 2005 the added value of the creative sector was 97 billion and in 2013 it was 196 billion Euros. In less than 10 years it doubled, indicating the importance of the creative sector for Belgrade's development. In 2009 there were 7733 companies from the creative industry sector and in 2013 - 9266 (Statistical Office of the Republic of Serbia, 2011, 2015). The increase in number of enterprises, as well as their share in total numbers, suggests steady increase. It can be expected that the number of enterprises will grow continuously. The most important sector of the creative economy is ICT. In Serbia there are 1786 active companies performing ICT, employing 11003 people with a turnover of around 62 million Euros. Two thirds are located in Belgrade, i.e. 1088 companies which employ 7280 people, proving the importance of Belgrade in the ICT sector. The ICT sector is the fastest growing in Belgrade, generating approximately 200 new companies yearly (SIEPA,2015) and 1/3 of added value of creative industry.

Year	Enterprises		Persons employed		Turnover		Value added at factor costs	
	Number	Percent	Number	Percent	Mil RSD	Percent	Mil RSD	Percent
2009	7733	22	74022	16,2	393401	14,2	168498	23,2
2010	8158	22,4	71425	16,1	418842	13,6	179111	23,6
2013	9266	23,6	74671	17	438264	11,8	196453	25,8

Table 1: Rise of companies and employees in creative industry in Belgrade region-years 2009-2013 (Statistical Office of the Republic of Serbia, 2011, 2012, 2015).

To gain some understanding of Belgrade's creative capital, we need first to explore human capital in general. Among 1,6 million people in Belgrade in 2002 there were 276,611 with higher education, which is only 21% of the adult population. In 2011, among 1,7 million people in the Belgrade region 396,779 (or 27,8%) had higher education (Statistical Office of the Republic of Serbia, 2002, 2012). Among the people with higher degrees approximately 1/4 are people with education in the creative sector. Creative capital constitutes an important element of Belgrade’s development.The data shows a solid increase for the period of one decade, but the percentage is still significantly lower than the European cities average (for ex. the average for 2013 was 37% - Eurostat, 2014). This shows that creative and human capital of Belgrade have to be improved in order to generate smart and sustainable growth and wealth.

4.2 Creative capital in Savamala district

The period of intense generation of creative companies overlaps with the establishment and development of a creative district in the Savamala quarter in Belgrade. The Savamala district is regionally and globally recognized as a new attractive cultural and creative node. In 2015, The Guardian labelled Belgrade as one of top 10 alternative culture cities in Europe, especially due to the Savamala district which was recognized as the hub where creativity blossoms. Savamala is one of the oldest districts in Belgrade, built at the beginning of the 18th century. It is positioned in an ideal location on the riverbank, next to the railway and bus station and near the city centre. In spite of its superb location, Savamala was one of the most neglected and unattractive areas of Belgrade with decaying houses and heavy truck traffic, disconnected from the centre and the rest of the city (Vanista Lazarevic et al., 2016). In the last decade, it has been under transformation. It has become an attractive quarter with cultural amenities and a specific group of inhabitants - the creative class of Belgrade.

The transformation of the Savamala district started in 2007, with the opening of the new cultural centre “Magacin” in an old abandoned warehouse. It became the place for alternative artist gatherings, exchange of ideas and creativity. Afterwards, in 2009, “Cultural centre Grad” also founded a place in Savamala. It transformed an old house from 1884 into a gallery, bar, designers’ selling area and art library. The concentration of creative people in Savamala has intensified from 2012, when the first Mixer festival was held there. Originally, the Mixer festival was established in 2009 as a regional event dedicated to creative industries aiming at the exchange of experiences, knowledge and ideas. It was also a good opportunity for presenting creative work to a wider audience. Moving to Savamala, the Mixer festival has triggered a number of changes in this area, generating a new creative hub which has become a synonym for creativity and culture. The organisation of the Mixer festival, Mixer house, established its centre in an old warehouse, which is, at the moment, the cultural and creative focus of Savamala, spreading out new ideas to a wider audience and the citizens of Belgrade. The move of Mixer house instigated the opening of other creative 'units', and some of them - especially Gallery 12HUB and Nova Iskra, represent important multidisciplinary nodes. Gallery 12HUB connects art and technology. It makes technology available to artists and scientist. Nova Iskra is a co-working space that connects young creative workers, from software developers to architects.

Savamala has become the centre of creative entrepreneurs in Belgrade. As such, it plays an important role in empowering creative workers of the city and rising awareness of the presence and importance of creative people for city development and success.

5 GUIDELINES FOR THE IMPROVEMENT OF CREATIVE CAPITAL FOR SMART SOLUTIONS IN BELGRADE

The creative capital of Belgrade is in constant rise, and its presence and importance is becoming more and more evident. However, the effect of creative capital on Belgrade's development as a smart city is questionable. If a city wants to become 'smart' it needs to have four possible dimensions: application of a wide range of electronic and digital technologies - digital, wired and informational networks; use of information technology to transform life and work; embedding ICT in the city infrastructure; bringing ICT and people together to enhance innovation, learning and knowledge (Komninos, 2011). Belgrade is covered with digital networks and even widely covered with free Wi-Fi in open public areas and public transport.There is progress in the use of ICT for the improvement of quality of life and work. E-government makes some elements of administration for entrepreneurial activities easier and quicker. Smart solutions are used for public transport and for infrastructure management, especially in the field of electronic power supply. The use of ICT to enhance innovation, learning and knowledge is still in the initial phase. The use of ICT for knowledge and innovation is present at the level of university research, but there is still a lot that can be improved in this area if Belgrade wants to prosper.

The most important element of Belgrade's smart development is its creative capital. ICT and smart solutions can be used in many different ways and levels to improve the creative capital of Belgrade, from the simple creation of virtual networks of creative workers to governmental e-platforms for the support of innovations. Specialised virtual networks that would connect creative and high-technology workers in Belgrade is the first thing that needs to be established. This virtual collaborative space (Komninos, 2011) should enable efficient exchange of ideas and knowledge, as well as co-working of possibly all workers in the creative and ICT industries. It is an easy, simple and relatively inexpensive solution that provides an opportunity to interconnect creative workers from all over the city, no matter their location, size of company and status. It would be a single virtual space where they can find necessary information and needed partners for the next job. The other, better solution would be the creation of specialised networks for specific creative industries and sectors (for example architecture, furniture design, web-design, banking software development, computer games development ...). More specific networks will better connect targeted groups of creative workers and instigate their collaboration.

The next step of ICT support for the improvement of the creative capital in Belgrade needs to be the creation of virtual creative clusters. Besides connecting creative workers through virtual networks a virtual cluster needs to offer promotion of companies and their products. The virtual cluster should help companies and individuals of the creative industry to become more visible and recognised inside the city, country, but also at the global level. In the informational and digitalised global society, striking presence on the internet is equal to having the store in the top location of the city. The socio-technical network among entrepreneurs is likely to stimulate knowledge spill-over and innovation (Sauer, 2012), and generate new companies and new jobs. New companies and new jobs expand clusters, but unlike the clusters which have a spatial envelope, virtual clusters have no limits for the number of companies they include.

Most of the companies in the creative industries are small companies and start-ups. Start-ups are generators of innovation and need special attention from the city government. The use of ICT can be the first and less expensive step for supporting start-up companies via the E-platform established in Belgrade. In Serbia, where starting a company is administratively very complicated and financially risky, an electronic platform that makes the process easier and quicker is extremely needed. The platform needs to give legal support for the establishment of companies and to advise on finding financial support. If the Belgrade government wants to give further support for innovativeness in the city, the electronic system for patent and design protection

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would be very beneficial. The process of patent protection, like many other administrative processes in Serbia, is very complicated and time consuming. The system that allows easy online information and patent registration would encourage more entrepreneurs to legally protect their innovation and have higher financial returns from their products.

After the improvement of the creative capital in Belgrade, it is important to engage it in the creation of smart solutions for improvement of city sustainability and quality of life. The ways to do that can be multiple, from the use of existing IT sectors for smart software design to the establishment of specialised "smart" clusters. At first city should offer "incentives for solving problems in specific areas that could help attract a critical mass of interest around them" (Kraus et al., 2015: 611). For example, the intensively developed IT industry of Belgrade could be used for the creation of smart solutions for the city. Instead of importing foreign smart technology, local companies could be stimulated to produce new solutions, adjusted to the needs and local conditions of Belgrade. Stimulation could range from financial subsides for work on smart technology, tax revenues for companies who create smart technology or free support for marketing and patenting. The city government should encourage companies from different sectors by facilitating and stimulating their cooperation in the areas of sustainability and environmental awareness. Finally, Belgrade could create smart technology specialisation using the existing preconditions for smart technology development. As a result, the city could become globally recognisable as an exporter of smart solutions and technology.

The other approach for enhancing smart development in the city could be the establishment of smart creative clusters, virtual or real. "Such a cluster could be more useful than having generic clusters or a university nearby, accelerating knowledge spill-overs and collaborations" (Kraus et al., 2015: 611). Rounding up of creative companies and individuals interested in the production of smart solutions for sustainable development should result in higher knowledge and higher innovation outputs. The concentration of professionals interested in the smart city enhances chances for the creation of co-working teams, start-ups and new projects in the sphere of smart technology and design.

One of very important elements is the spread of knowledge about the smart city, it's the importance of sustainable development and available smart solutions that can be implemented in the city. Many implemented smart solutions in Belgrade remain under-used because people are not informed adequately or do not understand the possibilities and outcomes of their use. Therefore, creative people in Belgrade have the crucial role in changing this situation. They need to be engaged in informing citizens of Belgrade about the smart city concept, what it is, what it brings, how it improves their ordinary life and their work, and what the long-term benefits are for the city and the environment. Creative people should raise awareness and spur the use of smart solutions around the city. To engage them as the forefronts of knowledge dissemination, the city needs to give special financial support to creative professionals and companies, especially those related to marketing and education. In practice, it would mean to give support to events that promote smart solutions (especially the ones improving quality of life) and to support e-platforms for dissemination of information and knowledge. The possibilities of transferring knowledge are numerous. The other ways of engaging creative people in public education could be related to providing free working space for professionals who will be in charge of raising awareness of smart solutions.

Finally, what is the role of the creative district Savamala in the development of Belgrade as a smart city? Its main role should be the promotion of smart solutions for the sustainable development of Belgrade and its improvement of life. Savamala, as the established (alternative) creative centre of Belgrade, has the best potential for dissemination of knowledge and information on the smart city. Its role and position could be, therefore, easily used and exploited. The special place for promotion should include Mixer house, the most prominent cultural node in Savamala, while the city could consider offering specific collaboration - providing financial or organisational support, or offering space for promotion and inclusion of smart solutions. The Mixer festival, as well as the programmes of the Cultural centre Grad and other district nodes, could be devoted to the exchange of ideas and knowledge on smart technology, solutions and sustainable growth.

Besides using it for promotion of the smart city concept, Savamala can be used as the polygon for implementation of smart technology and solutions. Consequently, this area would get its true shape as a creative cluster - via open public areas furnished with smart technology and design. Attracting creative workers from the area to gather, it would allow them to work outside and share their ideas in informal surroundings. On the other hand, these open spaces will be interesting for other citizens, offering places where they could see actual applications of smart solutions. The creative quarter Savamala needs to get its E-platform connecting all the creative workers and their potential clients/users. Consequently, the virtual cluster Savamala would bring benefits to creative and cultural companies and individuals, presenting their work to local and global audiences and customers. This will bring more attention to the district and spur its further growth.

The Savamala district could be used, partially, for the establishment of a specialised smart creative district. Nova Iskra could have a special role in that process. As the co-working space of local and regional ICT professionals, designers and architects, it could be a perfect partner in the process of launching a smart creative district. However, the city needs to motivate their participation. For example, if Nova Iskra becomes the first multidisciplinary centre for research, development and production of smart solutions in Belgrade and its region, it would attract other companies and freelancers to join. A spill-over effect could be expected, and new start-ups would sprout in the area. However, Savamala should not become just a smart creative cluster. It needs to stay the creative district which could be used as a unique platform for developing new smart creative clusters.

6 CONCLUSION

Belgrade does not use its creative capital optimally, but there are many ways to engage the creative capital for desired aims of the city. In this paper we propose possible directions applicable in Savamala district, focusing on the relationship between the creative capital of the city and its 'smart' performances. Although the specificities of the local context have influenced these guidelines, some of them could be used in other cities, with similar social and economical background. It is obvious that there are no universal solutions, but each of them leads to a specific model of a smart city. However, it is important to underline the link between local governments and the creative capital of a city, which has to be truly functional and efficient. Only then, will the creative sector be able to express its full potential as a reliable partner for sustainable economic, social and environmental development.

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Crowd Delivery als neues Lieferkonzept zur Stärkung des „Lokalen Marktplatzes“

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1 ABSTRACT

Für viele Menschen scheint es mittlerweile komfortabler, beim Shopping das Internet zu nutzen, anstatt mehrere Geschäfte aufzusuchen. Studien belegen, dass Kunden immer häufiger den Onlinehandel wählen, der die Waren dann auch gleich bis vor die Haustür liefert. Dieser Trend hat dazu beigetragen, dass einerseits der stationäre Einzelhandel in den vergangenen Jahren erheblich unter Druck geraten ist und dass sich andererseits gleichzeitig eine höchst aufwändige Logistik entwickelte. Produkte werden einzeln von entlegenen Logistikzentren zu Kunden gebracht, anstatt sie gesammelt an den innerstädtischen Handel zu schicken. Ein virtueller Zusammenschluss innerstädtischer Händler zu einem „Lokalen Marktplatz“ scheint zukunftsweisend, können doch so die Vorzüge des Online-Handels mit dem physischen Shopping-Erlebnis verknüpft, sowie neue Absatzkanäle für innerstädtische Unternehmen geschaffen werden. Doch wie lassen sich die Vorzüge der Zulieferung durch den Online-Handel mit dem lokalen Marktplatz in der Innenstadt verbinden? Neue Konzepte in Bezug auf kollaborativen Konsum und nachhaltigen Güterverkehr versuchen dieser Hürde mit einem Lieferkonzept durch Privatpersonen zu begegnen – die Rede ist von Crowd Delivery als einer spezifischen Form des Crowdsourcings. Hierbei wird die Crowd Delivery meist im Einkaufsverkehr vom Einzelhändler zum Kunden auf der letzten Meile angewandt: Dieser Mitbringservice ermöglicht Kundinnen und Kunden zu Hause, Einkäufe von anderen Kundinnen und Kunden mitbringen zu lassen, die ohnehin einkaufen gehen. Die Herausforderung besteht darin, die „Crowd“ als Zusteller zu gewinnen und deren Motive zu verstehen. Dies verlangt eine fundierte empirische Analyse zu Bedürfnissen, Anforderungen und potenziellen Anreizen dieser Nutzerinnen- und Nutzergruppen.

Keywords: Crowd Delivery, Kollaborativer Konsum, Lokaler Marktplatz, Mitbring-Service, Smarte Logistik

2 HERAUSFORDERUNGEN

„Immer mehr Waren werden in immer kleineren Losgrößen über immer größere Entfernungen transportiert“ (Stallmann 2014, Miodrag 2013). Es muss sogar noch mit einem Anstieg im Lieferverkehr über alle Verkehrsträger hinweg gerechnet werden. Klimawandel, Ressourcenknappheit, verkehrliche Belastungen, Feinstaub etc. haben bereits in Ansätzen zu einem Umdenken im Bereich der Logistik- und Transportleistungen geführt, das sich teils in alternativen Antriebsarten in Form von Elektrofahrzeugen oder auch Lastenrädern niederschlägt. Vor allem der Lieferverkehr für Paketzustellungen und Retouren stellt besonders städtische Gebiete vor Herausforderungen (VCÖ 2014). Verantwortlich hierfür ist vor allem der Online-Handel, da Waren nun von weit weg bestellt werden können. Neben der aufwendigen Logistik und der Verkehrsbelastung durch Lieferdienste ist der Online-Handel vor allem eine Bedrohung für den stationären städtischen Einzelhandel, der immer mehr über Umsatzeinbußen und sinkende Kundenzahlen klagt. „[I]nsbesondere alteingesessene, inhabergeführte Geschäfte tun sich aufgrund mangelnder digitaler Kompetenz, fehlender finanzieller Mittel sowie mangelndem Interesse an Neuerungen schwer, mit der notwendigen Flexibilität zu reagieren“ (Hengst & Steinebach 2012).

3 LOKALER MARKTPLATZ UND CROWD DELIVERY ALS OPTION

Der Zusammenschluss lokaler Einzelhändler auf einer Online-Plattform zu einem „Lokalen Marktplatz“ bietet eine Option den oben genannten Herausforderungen zu begegnen. Marktplätze, die sich sowohl nach der Art der Kunden- als auch der Wettbewerbsbeziehung unterscheiden, gewinnen derzeit an Relevanz im Online-Handel. Ein lokaler Marktplatz zeichnet sich durch eine direkte Beziehung zwischen dem lokalen Händler und den Kundinnen und Kunden sowie durch die Konkurrenz zu anderen Händlern in direkter Wettbewerbsbeziehung in einem räumlich abgegrenzten Gebiet (Region, Stadt, etc.) aus (Heinemann & Haug 2010). Dies bedeutet, dass Händler, die auf der Online-Plattform vertreten sind, Kundschaft aus dem räumlichen Einzugsbereich anstreben (Fuchs 2003). Diese Marktplätze bauen auf Vertrauensbildung zwischen Händler und Kunde vor dem Hintergrund einer räumlichen Nähe: „[Räumliche] Nähe schafft Vertrauen, Distanz das Gegenteil“ (ebd.).

Wenn „Lokale Marktplätze“ außerdem mit innovativen Lieferkonzepten für die lokale Bevölkerung mit alternativen Mobilitätsformen wie dem Fahrrad, Lastenfahrrad etc. kombiniert werden, so können sowohl die Innenstädte wieder belebt als auch verkehrlich entlastet werden, was wiederum deren Attraktivität durch Verbesserung der Aufenthaltsqualität und Erreichbarkeit steigert.

4 CROWD DELIVERY ALS ZULIEFERUNG AUF DER LETZTEN MEILE

Crowd Delivery (auch als Crowd Shipping oder kollaborative Logistik bezeichnet, Botsmann 2014, Carbone et al. 2015) stellt ein innovatives Lieferkonzept dar: Privatpersonen sind als Auslieferer tätig, womit ein Brückenschlag zwischen dem „Lokalen Marktplatz“ und den Vorzügen des Online-Handels durch eine zeitnahe Lieferung erreicht werden kann. Außerdem generiert der „Lokale Marktplatz“ die notwendige Lieferfrequenz, um eine Crowd zu etablieren. In der Literatur wird die Crowd als ein Netzwerk von freiwilligen Personen bezeichnet (Estelles-Arolas et al. 2012). Die Crowd wird meist erst aktiv, wenn sie durch eine bestimmte Aufgabe dazu aufgerufen wird. Neue Technologien wie Smartphone, Internet und das Web 2.0 spielen somit bei der Aktivierung der Crowd eine elementare Rolle, da sie eine Voraussetzung zur breiten Involvierung darstellen. Eine neue Begrifflichkeit im Zusammenhang mit der Crowd ist „Crowdphysics“, welcher impliziert, dass es sich um Aufgaben handelt, die von einer Crowd durch körperliche Aktivität erfüllt wird (Sadilek et al. 2013), wo sich auch die Crowd Delivery einordnen lässt. Crowd Delivery bedeutet, dass die Lieferung zum Kunden durch Privatpersonen auf der letzten Meile übernommen wird. Als Mitbringservice ermöglichst es Kundinnen und Kunden, Einkäufe von anderen Kundinnen und Kunden des stationären Einzelhandels einfach mitbringen zu lassen, die ohnehin einkaufen gehen. Die Crowd wird aktiv, wenn eine Lieferung gewünscht ist. Somit haben Kundinnen und Kunden die Möglichkeit auf verschiedene private Lieferpersonen zuzugreifen und von konventionellen Paket- und Kurier-Diensten abzusehen (Carbone et al. 2015). Dabei kann der Lieferant als Teil der Crowd auch gleichzeitig Kunde sein und umgekehrt. Dadurch werden effektiv Wege gespart. Durch die hohe Anzahl der Fahrerinnen und Fahrer eignet sich Fahrradlogistik mit Fahrrädern oder Lastenrädern speziell für Crowd Delivery, da keine Routenplanung oder Bündelung notwendig ist. Fahrradlogistik ist in Europa – von Positivbeispielen wie Kopenhagen und Amsterdam abgesehen – noch relativ unbedeutend (Reiter et al. 2012). Vereinzelt wird Fahrradlogistik auch in Österreich erfolgreich im gewerblichen Bereich eingesetzt (Stadlbauer 2014, BMVIT 2013, Riehle 2012) und dessen Potenzial hinsichtlich der Substituierung des motorisierten Lieferverkehrs in Forschungsprojekten wie beispielsweise Cyclelogistics und „Ich ersetze ein Auto“ ausgelotet. Ausschlaggebend für das Funktionieren von Crowd Delivery ist das Erreichen einer kritischen Masse, d. h. nur wenn eine umfassende „Crowd“ bzw. eine große Anzahl an Lieferantinnen und Lieferanten vorhanden ist, kann das Konzept funktionieren und Zuverlässigkeit bieten. Ergänzende professionelle Lieferantinnen und Lieferanten bzw. Fahrradkuriere können diese Herausforderung etwas abfedern. Trotz des von der Trendstudie „Logistik Trend Radar 2014” (DHL 2014) attestierten großen Potenzials von Crowd Delivery ist mit bringbee (http://www.bringbee.ch/) aus der Schweiz das erste europäische Crowd-Delivery-Projekt zunächst gescheitert: zu wenige Mitbringerinnen und Mitbringer in der Crowd, aber auch das Fehlen von strategischen Partnern im Handel werden als wesentliche Gründe genannt (Schieffer 2014).

4.1 Crowd-Delivery als Zuverdienst

Crowd-Delivery kann als Teil des Crowdworkings betrachtet werden. Kundenprojekte wie Amazon Mechanical Turk (AMT), Clickworker, Fancy Hands oder Task rabbits etc. nutzen die menschliche Kreativität, Intelligenz oder physische Arbeit, um viele kleine, wenig spezielle Vorkenntnisse benötigende Einzeljobs aufzuteilen und gegen Bezahlung erledigen zu lassen. Dieses Vorgehen wird allerdings zunehmend auf Grund von Ausbeutungstendenzen billiger Arbeitskräfte ohne Zahlung von Sozialabgaben, Arbeitnehmerschutz, Krankengeld, etc. kritisiert (Thiel 2015). Die Arbeiten werden meist vom PC aus erledigt und der Stundenlohn beträgt bei etwas mehr Routine maximal 8 USD. Die Crowd als eine Gemeinschaft spielt keine wesentliche Rolle, ist doch jeder Crowdworker ein Einzelkämpfer. Das Arbeitsmodell wird in Indien immer beliebter und stellt ein Zubrot für einkommensschwache Schichten dar. In den USA hingegen sind die Motive unabhängig von Jahresabkommen und variieren von Zeitvertreib, über Unabhängigkeit bis hin zum Verdienst eines kleinen extra Taschengelds (Teodoro et al. 2014). Auch die meisten kommerziellen Anbieter von Crowd Delivery locken private Lieferantinnen und Lieferanten mit dem Argument des kleinen Zuverdiensts. Es ist allerdings schwierig die Einnahmen von den privaten Zuliefererinnen und Zulieferern zu eruieren (in Studien zu Crowd Working stellt dieser Bereich nur ein Randthema dar).

4.2 Crowd Delivery als Teil des kollaborativen Konsums und der Nachbarschaftshilfe

Crowd Delivery ist auch ein Teil des kollaborativen Konsums im Sinne der Share Economy („Teilen und Tauschen"), was in Bezug auf die Motive der Crowd-Mitglieder im Gegensatz zum Crowdworking eine ganz andere Blickrichtung darstellt. Kollaborativer Konsum beruht auf Fairness, Vertrauen und einem Gemeinschaftsgefühl (Botsman 2011). Viele Plattformen im Bereich des kollaborativen Konsums oder auch ganz konkret im Falle des Crowd Delivery setzen zur Vertrauensbildung auf Community-Bildung und ein Review-System, das den Nutzerinnen und Nutzern ermöglicht, Bewertungen auszusprechen und Profile anzulegen.

Rachel Botsman hat 2010 in ihrem Buch „What's yours is mine" den gemeinsamen Konsum einem breiteren Publikum bekannt gemacht. Darin schreibt sie: „[P]eople are sharing again with their community – be it an office, a neighborhood, an apartment building [...]. But the sharing and collaboration are happening in ways and at a scale never before possible" (Botsman 2010). Auch attestiert sie der kollaborativen Logistik Potenziale als nächster Hype in diesem Bereich (Botsman 2014).

Besondere Beachtung findet aktuell der gemeinsame Konsum auf Quartiers- und Nachbarschaftsebene. Die räumliche Nähe ist bei immateriellen und materiellen Tausch-Geschäften sehr wichtig (Schnur & Günter 2014), was aber nicht zwangsläufig Gemeinschaft bzw. starke nachbarschaftliche Beziehungen schafft. Räumliche Nähe ergibt somit keinesfalls automatisch eine soziale Nähe (vgl. u. a. Häußermann/ Kapphan 2010). Dennoch beinhaltet das Konzept der Crowd Delivery eine starke nachbarschaftliche Komponente, ist es doch am geschicktesten und effizientesten dem Nachbarn/der Nachbarin von seinem Einkauf in der Innenstadt etwas mitzubringen. Die Wechselwirkung zwischen Crowd Delivery und Nachbarschaft scheint besonders spannend. Könnte Crowd Delivery nachbarschaftliche Beziehungen stärken? Kann Crowd Delivery durch den nachbarschaftlichen Kontext gefördert werden? Die Plattform „frag nebenan" baut auf die sozialen Beziehungen innerhalb eines nachbarschaftlichen Einzugsgebiets und verfügt mittlerweile bereits über 20.000 Mitglieder. Nachbarschaft umfasst bei „frag nebenan" einen Umkreis von 750 Meter, wo gegenseitige Unterstützungen geleistet, Empfehlungen ausgetauscht oder auch Nachbarschaftstreffen organisiert werden (ORF 2015). Darüber hinaus ist die Verortung von gesellschaftlichen Potenzialen auf der Quartiersebene (resp. Mikroebene) „Bestandteil eines gegenwärtigen Local Shifts" (Schnur & Günter 2014), welcher Lösungsmöglichkeiten für makrostrukturelle Problemlagen wie z. B. (Über-)Konsum auf die Mikroebene überträgt.

Die Literatur gibt nur wenige Hinweise zu den Beweggründen für kollaborativen Konsum bzw. der Sharing-Teilnahme, vor allem in Hinblick auf Forschung und Empirie (Lamberton & Rose 2012). Bei Unternehmen wird meist von „Business opportunities" gesprochen, doch in Bezug auf Personen sind es vielfältige soziale, umweltrelevante und besonders finanzielle und ökonomische Motive (Bardhi et al. 2012). Der kulturelle Wandel in Zusammenhang mit Besitz von Objekten und die Einstellung gegenüber Konsum sowie das Bedürfnis zu einer „Community" zu gehören sind ebenso von Bedeutung. Eine Studie in UK über Beweggründe zur Benutzung einer Sharing-Plattform fand heraus, dass vor allem die Offenheit gegenüber Neuem eine ausschlaggebende Rolle spielt (Belk 2010).

4.3 Beispiele crowd-basierter Lieferkonzept

Es existieren mittlerweile zahlreiche Lieferkonzepte, die die Crowd als Lieferantinnen und Lieferanten einschließt. Dabei werden Lieferantinnen und Lieferanten rekrutiert, wenn Bedarf seitens der Kundinnen und Kunden besteht. Bezüglich der Zahlungssysteme bestehen Unterschiede zwischen den Plattformen. Kundin oder Kunde und Lieferantin oder Lieferant können beispielsweise einen Preis aushandeln (meemeep.com), die Plattform schneidet dann einen gewissen Anteil mit. Es gibt auch Konzepte mit festgesetzten Preisen oder „Credits" (z. B. DHL MyWays) für Wegstrecken, Volumen bzw. Gewicht des Paketes, Zustellzeit etc.

Viele Plattformen bauen auf private Kundenbeziehungen (Customer-to-Customer). Checkrobin ist mit mehr als 133.000 Fahrten seit der Gründung 2013 ein erfolgreiches Beispiel aus Österreich (checkrobin 2016). In einem ersten Schritt wird die Sendung eingetragen und ein passender Fahrer dazu gesucht. Der Fahrer holt

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die Sendung ab, ein Geo-Tracking erlaubt es dem Sender den Verlauf der Sendung zu verfolgen und über eine App wird die Kommunikation zwischen Sender und Fahrer ermöglicht (Hell 2014).

Es existieren auch Crowd Delivery-Plattformen, die zwischen dem Einzelhandel und Privatpersonen den Versand vermitteln (Buisness-to-Costumer). Einzelhandelsunternehmen können zu einem gewissen Preis (z. B. bei deliv, kanga oder clickshipit) auf die Crowd-Dienste zurückgreifen, wobei hier ganz unterschiedliche Business-Modelle vertreten sind. Ebenso variieren die Dienste bezüglich der transportierten Güter und in ihrer Reichweite. PiggyBee beispielsweise ist spezialisiert auf den Transport von Waren über lange Strecken durch Privatreisende. Im Gegenzug wird ein Trinkgeld oder eine andere Belohnung vorgeschlagen (z. B. Abholung vom Flughafen).

Der lokale Marktplatz spielt eher eine untergeordnete Rolle für die Crowd-Delivery-Plattformen. Zwar wird häufig mit dem Attribut „lokal“ geworben, die Etablierung eines virtuell und sogleich räumlich verbundenen Marktplatzes wird eher selten angestrebt. Atalanda beispielsweise setzt auf „Same Day Delivery“ vom lokalen Händler zum Kunden und kreiert dadurch den lokalen Marktplatz auf der Webseite. Die Lieferung geschieht allerdings durch das firmeneigenen Kuriersystem atalogics (Kolbrück 2015) und nicht durch eine Crowd.

Aufbauend auf den oben genannten Studien und Beispielen analysiert, konzipiert und evaluiert das Forschungsprojekt LoMaCro+ am Fallbeispiel Graz, wie der „Lokale Marktplatz“ mit dem innovativen Lieferkonzept der Crowd Delivery verknüpft werden kann. Dieser Ansatz kann somit als neuer Beitrag zum „Multi-Channel-Marketing“, das Kommunikations- und Distributionswege gemeinsam denkt, betrachtet werden. Unterschiedlichste Stakeholder und Nutzerinnen- und Nutzergruppen, die vom Einzelhandel über Konsumentinnen und Konsumenten, Logistikunternehmen wie Radlogistiker sowie die Crowd als Zusteller reichen, gilt es dabei zu verknüpfen und die Anreize zum Kooperieren zu verdeutlichen.

5 EMPIRISCHE UNTERSUCHUNG ZU CROWD DELIVERY

Als einer der ersten Projektbausteine wurde im Rahmen des Forschungsprojektes „LoMaCro+“ eine quantitative Online-Umfrage realisiert. Themenschwerpunkt war die Einkaufsmobilität in Zusammenhang mit Mitbring-Bereitschaft und Nachbarschaft, so dass Bedürfnisse und Motive der potenziellen Liefer-Crowd eruiert werden konnten. Die Online-Umfrage ist in einen Living-Lab-Ansatz mit einem großen Methodenrepertoire eingebettet, der sich sehr gut zur Identifizierung von Anforderungen, Motiven und Bedürfnissen von potenziellen „Crowd-Lieferanten“ eignet. Aufbauend auf den Erkenntnissen der Umfrage erfolgt die Planung, Konzeption und Evaluation der innovativen Lieferungslösung.

Die Stichprobe der Online-Umfrage setzt sich aus 61 Personen zusammen, die Teil des Evolaris User Panels sind. Dieses Panel ist eine Online-Community mit ca. 500 Teilnehmerinnen und Teilnehmern als Grundgesamtheit, die bei der Entwicklung von Produkten und Services rekrutiert wird. Somit beträgt die Rücklaufquote 13 %. Wie aus Tabelle 1 entnommen werden kann, ist die Stichprobenzusammensetzung nicht repräsentativ für die österreichische Bevölkerung. Während das Geschlechterverhältnis der Stichprobe noch annähernd jenem der Gesamtbevölkerung entspricht, gibt es bei Alter und Bildungsgrad deutliche Abweichungen zugunsten jüngerer und besser gebildeter Teilnehmerinnen und Teilnehmer.

Merkmal	Gliederung	Stichprobe	Österr. Gesamtbevölkerung
Geschlecht	**männlich**	**52,5%**	**48,9%**
	weiblich	**47,5%**	**51,1%**
Formaler Bildungsgrad	**Pflichtschule**	**1,6%**	**27,6%**
	Lehre	**9,8%**	**31,9%**
	Berufsbildende Schulen	**6,6%**	**14,3%**
	Matura	**34,4%**	**14,4%**
	Akademische Ausbildung	**47,5%**	**11,9%**
Alter	**<20**	**0,0%**	**19,7%**
	20-29	**37,7%**	**13,0%**
	30-39	**26,2%**	**13,2%**
	40-49	**19,7%**	**15,3%**
	50-59	**9,8%**	**14,8%**
	60-69	**4,9%**	**10,5%**
	70-79	**1,6%**	**8,5%**
	>79	**0,0**	**5,0%**

Tabelle 1: Stichprobenzusammensetzung [n = 61] im Vergleich zur österreichischen Gesamtbevölkerung (Statistik Austria 2015)

5.1 Liefern von Privatpersonen

Die Ergebnisse zeigen, dass Crowd Delivery noch kein allgemein bekanntes Lieferkonzept ist. Lediglich 15% der Befragten können mit dem Begriff etwas anfangen. Abbildung 1 zeigt, dass Mitbringbereitschaft und soziale bzw. räumliche Nähe zusammenhängen: Je größer die soziale bzw. räumliche Nähe ist, desto eher sind die Befragten bereit als nachbarschaftliche bzw. persönliche Warenkuriere zu fungieren. Die allgemeine Bereitschaft etwas mitzubringen, lag bei ca. 60% – allerdings nur wenn der/die Befragte diese Person persönlich kennt.

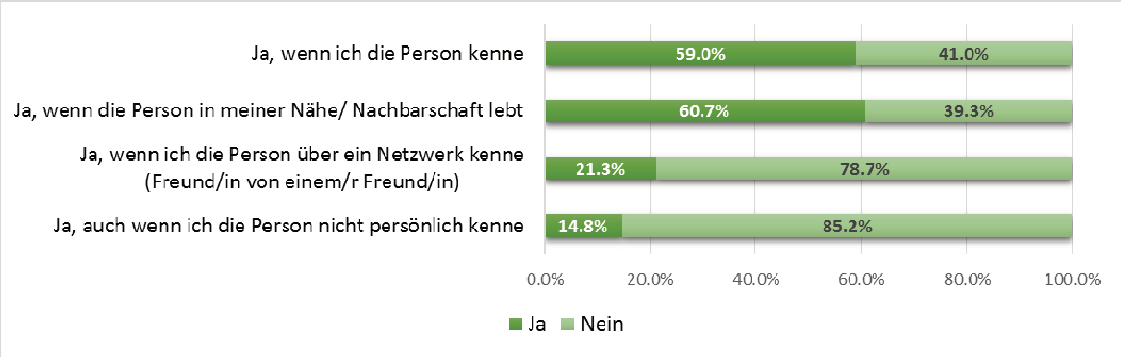

Abbildung 1: Bereitschaft für Mitbringen in Bezug auf soziale und räumliche Nähe (Frage: Würden Sie jemandem aus einem Laden etwas mitbringen, den Sie eh aufsuchen wollten?) [n = 61]

Interessant ist dabei die Differenzierung in Abhängigkeit zur Vorkenntnis von Crowd Delivery (vgl. Abbildung 2):

- Wenn Personen mit dem Crowd-Delivery-Konzept vertraut sind, steigt die Bereitschaft, auch Bekannten über Dritte (44,4 %) oder Unbekannten (22 %) etwas mitzubringen.
- Personen, denen Crowd Delivery unbekannt ist, schließen eher aus, unbekannte Person (13,5 %) zu beliefern.

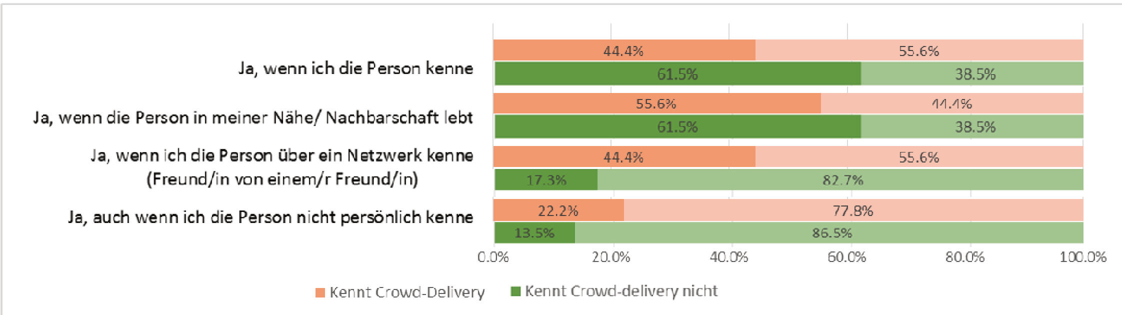

Abbildung 2: Mitbringbereitschaft und vorherige Kenntnisse des Crowd Delivery-Konzepts (Mehrfachnennungen) [n = 61]

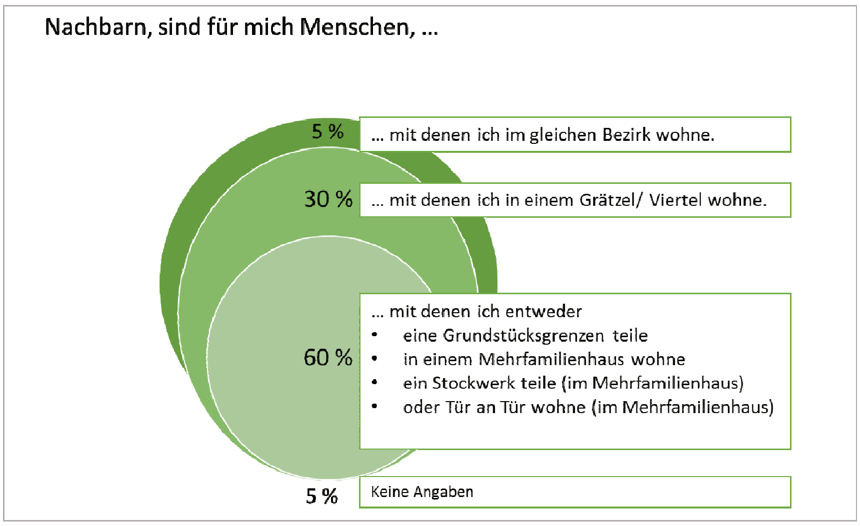

Abbildung 3: Räumliche Ausprägung von Nachbarschaft (Mehrfachnennungen) [n = 61]

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Crowd-Delivery ist im Hinblick nachbarschaftlicher Hilfeleistungen ein relevantes Konzept, da vor allem in diesem Fall kurze Wege für den Lieferanten gegeben sind und auch eventuell ein sozialer Kontakt bereits vorhanden ist (beides wirkt sich positiv auf die Bereitschaft einer Mitbringleistung aus). Interessant dabei ist, wie Nachbarschaft von den Befragten wahrgenommen wird, um gegebenenfalls Rückschlüsse auf das Einzugsgebiet der Crowd Delivery treffen zu können. Nachbarschaft hört für die meisten der Befragten an bzw. über der Grundstücksgrenze auf. Das heißt im Umkehrschluss, dass das Wohnviertel/das Grätzl nur noch für 30 % zur Nachbarschaft gehört. Nicht relevant ist der Bezirk als Nachbarschaftskategorie mit 5 %.

Die Umfrage zeigt auch, dass die Mehrzahl der Befragten nicht besonders viel über ihre Nachbarn weiß, auch Hilfeleistungen unter Nachbarn sind eher selten (was sich negativ auf das Crowd-Delivery-Konzept auswirken könnte). Allerdings wird nach der Frage von konkreten Hilfeleistungen durchaus von einem Viertel der Befragten u. a. Mitbringdienste von beispielsweise Einkäufen und Abholung von Paketen genannt. Dies sind neben Briefkasten leeren die meist genannten nachbarschaftlichen Unterstützungen seitens der Befragten (ohne Abbildung).

5.2 Incentivierung

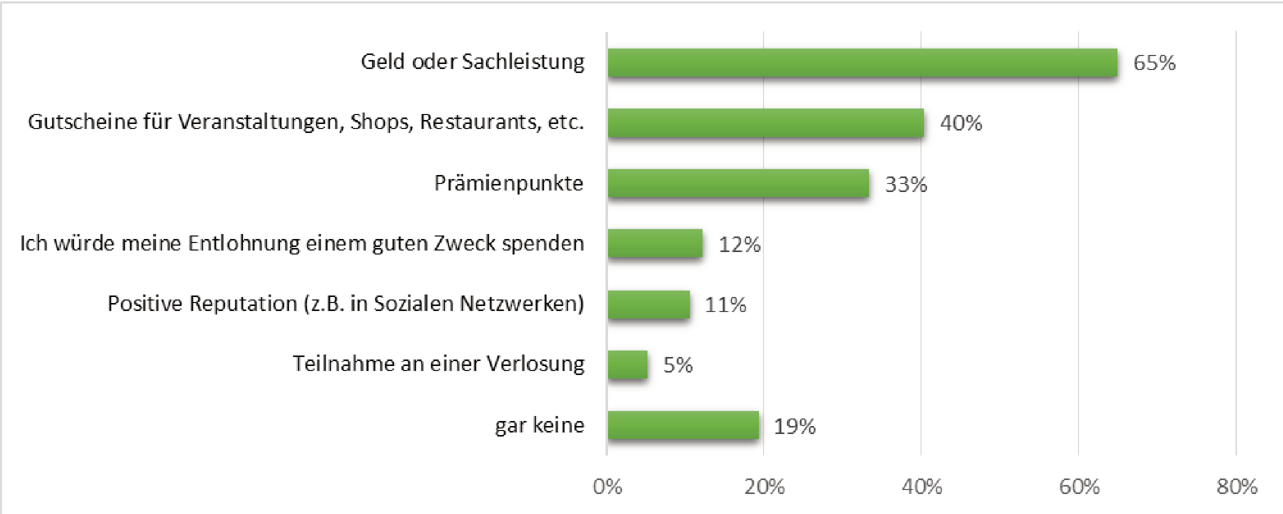

Abbildung 4: Gewünschte Incentivierung (Mehrfachnennungen) [n = 61]

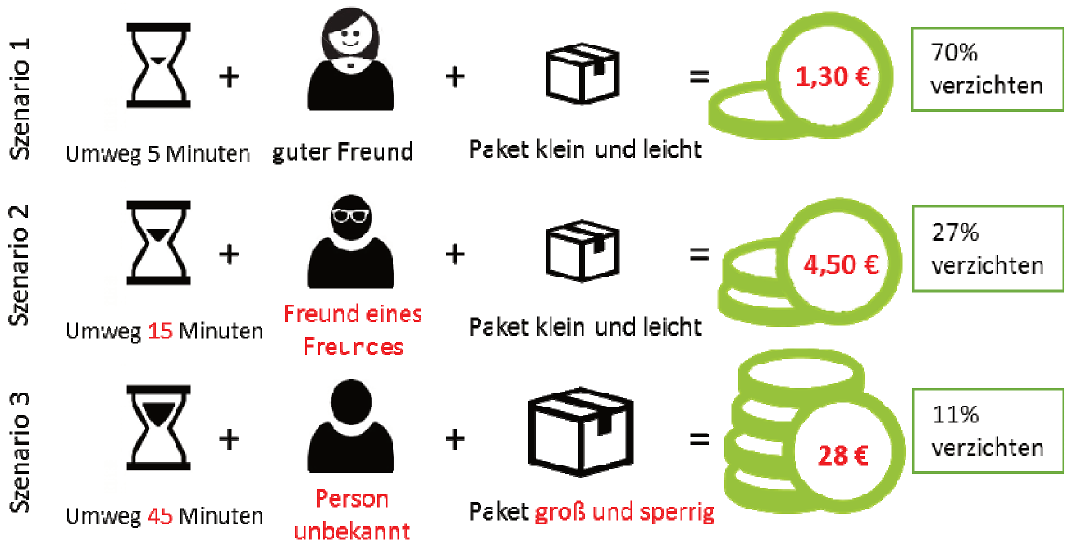

Abbildung 5: Durchschnittliche, geforderte Entlohnung bei drei Szenarien [n = 61]

Abgesehen von den nachbarschaftlichen Hilfeleistungen aus rein sozialen Motiven heraus war die Frage von Bedeutung, in wie weit eine monetäre Vergütung der Mitbring-Leistung gewünscht ist. Es lässt sich feststellen, dass 19 % der Befragten auf eine Vergütung beim Mitbringen von Waren verzichten würden, 65 % der Befragten möchten Geld oder Sachleistungen, 40 % Gutscheine und 33 % Prämienpunkte. Nur 12 % würden die Entlohnung einem guten Zweck spenden.

Die Höhe der Entlohnung wird bei bestehenden Crowd Delivery-Konzepten sehr unterschiedlich gehandhabt und ist eher vom Warenpreis abhängig (z.B. 10 % des Warenpreises, vgl. Schieffer 2014). Für das Forschungsprojekt ist im Sinne der nachbarschaftlichen und sozialen Komponente, die Grenze der Bereitschaft (z.B. Person unbekannt) wichtig. Generell ist festzuhalten, dass bei einem guten Freund (sowie geringem zeitlichen Mehraufwand von 5 Minuten) 70 % der Befragten auf eine monetäre Vergütung verzichten und die restlichen Personen im Schnitt 1,30 € verlangen würden. Befindet sich die Person in einem sozialen Netzwerk (z.B. Freund von Freund), steigt die Forderung nach Vergütung bei einem kleinen und leichten Paket im Mittel auf 4,50 Euro und nur noch 27 % würden auf eine Entlohnung verzichten. Bei einer fremden Person in Kombination mit einem großen, sperrigen Paket und großem zeitlichem Mehraufwand wird durchschnittlich 28 Euro verlangt.

5.3 Hemmnis- und Begünstigungsfaktoren des Mitbringens

Neben der sozialen Komponente wirken eine Vielzahl anderer Faktoren auf die Bereitschaft der Liefer-Crowd Waren aus einem Geschäft mitzubringen. Mehr als die Hälfte der Befragten möchte ausreichend versichert sein, wenn sie einem Kunden etwas aus dem Laden mitbringen.

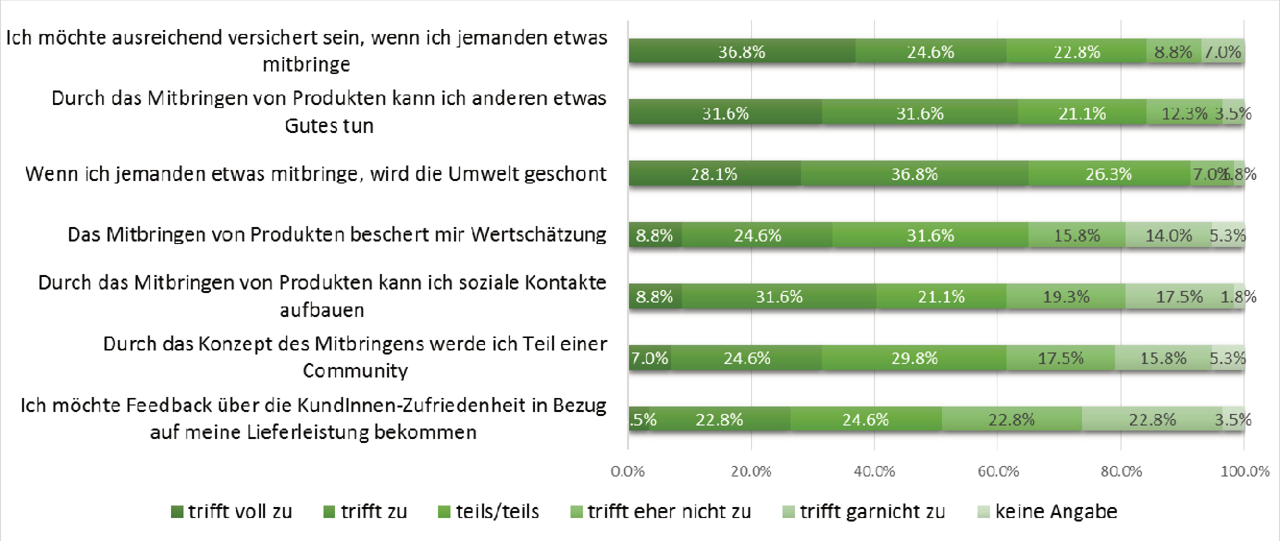

Abbildung 6: Hemmnis- und Begünstigungsfaktoren für das Teilwerden der Liefer-Crowd [n = 61]

Es lassen sich sowohl intrinsische als auch extrinsische Motive identifizieren: Jemandem „etwas Gutes zu tun“ sowie positive Umweltaspekte sind für die Hälfte der Befragten wichtige Faktoren, wohingegen die Wertschätzung, der Aufbau von sozialen Kontakten und das Teilwerden einer Community als weniger bedeutend von den Befragten eingestuft wurde.

5.4 Fahrradnutzung

Die Fahrradnutzung ist für eine emissionslose, umweltfreundliche Zustellung im Rahmen der Crowd Delivery sehr bedeutend, kann aber aufgrund der vorhandenen Mobilitätswerkzeuge der Befragten nicht ausschließlich forciert werden. Ca. 1/3 der Befragten nutzt das Fahrrad täglich bis fast täglich, 35,2 % hingegen seltener als 1-3 Tage im Monat, was somit einen Großteil der Befragten als Mitbring-Zielgruppe ausschließen würde.

Auch bei verschiedenen Mobilitätsszenarien ist das Fahrrad nicht unbedingt das präferierte Fortbewegungsmittel. Bei Einkäufen am lokalen Markt bzw. im Zentrum des jeweiligen Wohnortes, bevorzugen 37,5 % bzw. 49,2 % den MIV – im Umkehrschluss allerdings fällt die Wahl zu 62,5 % und 50,8 % auf umweltfreundliche Verkehrsmittel des Umweltverbundes. Deutlicher wird die Präferenz zum MIV beim Transport von schweren Gegenständen (90 %). Einen Brief auf dem Postamt aufgeben wird von beinahe 2/3 mit ÖV, Fuß und Fahrrad erledigt.

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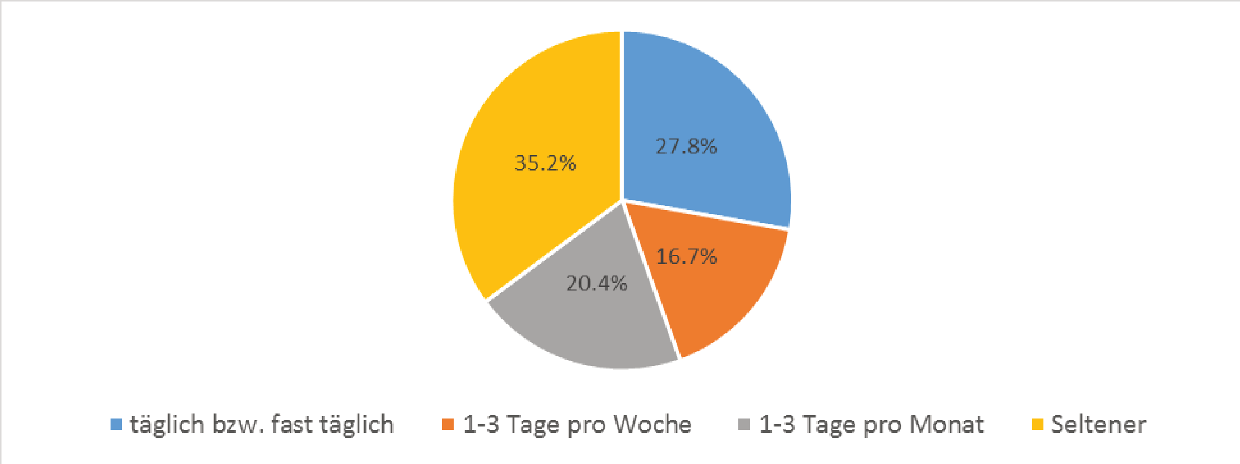

Abbildung 7: Häufigkeit der Fahrradnutzung [n = 61]

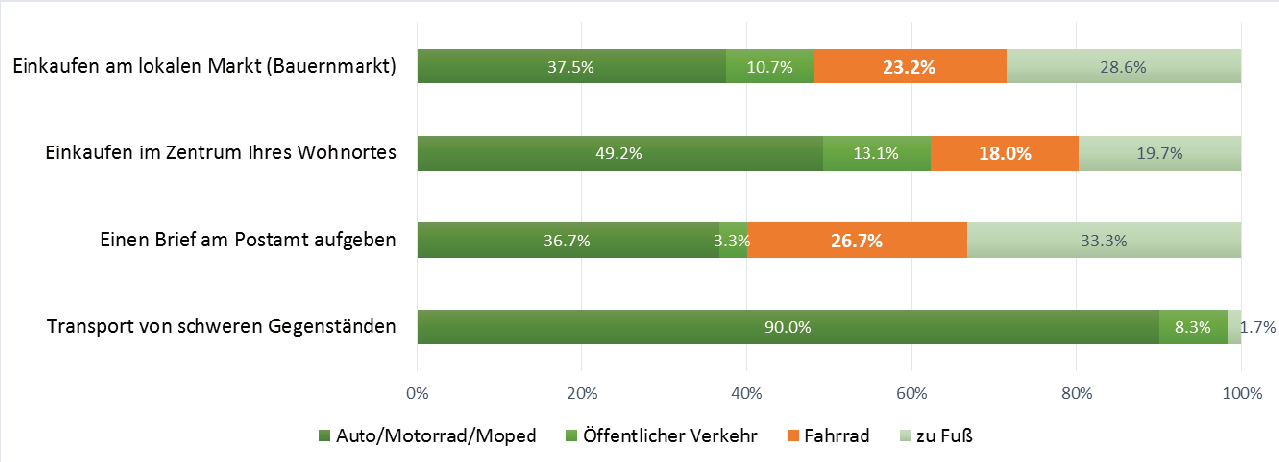

Abbildung 8: Routinen der Verkehrsmittelnutzung bei typischen Aktivitäten [n = 61]

5.5 Wie setzt sich so eine Liefer-Crowd zusammen?

Die Crowd als Forschungsgestand ist schwierig zu erfassen, da sich die Beweggründe, Teil einer Crowd bzw. einer Community zu werden, stark unterscheiden. Anhand der Online-Umfrage und Literaturrecherche lassen sich für das Crowd-Delivery-Konzept unterschiedliche Typen identifizieren, die als Mitbringerinnen und Mitbringer fungieren können:

- Nachbarschaftshelfer (ca. 60 % der Befragten), die bereits soziale Unterstützung bei alltäglichen Problemen im Wohnumfeld leisten, worunter auch das Mitbringen von Waren zählen würde. Die Grenzen der „Nachbarschaftshelfer“ sind, dass der zusätzliche Zeitaufwand gering sein muss, das Paket klein und leicht ist sowie eine soziale und räumliche Nähe besteht. Auch wenn sich nachbarschaftliche Hilfestellungen meist im Hintergrund von emotionaler und materieller Reziprozität, soziale Verpflichtung, helfende Persönlichkeit und Freundschaft abspielen (Pleschberger 2014), wird auf eine Incentivierung nicht verzichtet werden können. Unter diesen Typ fallen auch:
    - Fahrrad-affine, die überdurchschnittlich häufig mit dem Fahrrad unterwegs sind. Etwa jeder Vierte der Befragten geht mit dem Fahrrad einkaufen. Diese Zielgruppe ist im Kontext der umweltfreundlichen Zustellung von Waren besonders interessant für das Projekt.
    - Fuß & ÖV: Einkäufe werden zu einem geringen Anteil (13,1 %) mit dem ÖV erledigt und nur gering mehr erledigen diese zu Fuß (19,7 %). Beim lokalen Markt verändern sich die Werte allerdings deutliche zugunsten der Verkehrsmittel des Umweltverbundes.
    - Auto-orientierte: Beinahe die Hälfte der Befragten erledigt Einkäufe mit dem Auto. Somit stellen die Auto-orientierten eine nicht zu vernachlässigende Zielgruppe dar, die bei ihren Einkäufen Waren mitbringen können. Durch das Auto als Transportmittel können größere und schwerere Waren einfacher und komfortabler transportiert werden, was auch die

Bereitschaft des Mitbringens zum positiven beeinflussen könnte. Eine umweltfreundliche Lieferung ist dadurch nicht gegeben, trotzdem werden dadurch Wege eingespart.

- Professionelle Kuriere, die Kleintransporte mit Hilfe von Fahrrädern durchführen und eine fixe, eventuell hauptberufliche Anstellung bei einem Rad-Logistiker haben. Dieser Typ wäre vor allem zum „Abfedern" der Crowd wertvoll, um Lieferengpässen entgegenzuwirken.

6 FAZIT

Crowd Delivery bietet eine umwelt- und ressourcenschonende Möglichkeit, den Versand bzw. das Mitbringen von vielen Einkäufern von Personen erledigen zu lassen, die bereits unterwegs sind. Dieses alternative Versandsystem vom stationären Einzelhandel stärkt den lokalen Einzelhandel, wenn er Multi-Channel-Retailing als Verknüpfung des stationären Handels mit dem Online-Handel nutzt. Das Mitbringen als Einsparung von Wegen in Kombination mit dem Fahrrad als Transportmittel ist ein Beitrag zur umweltfreundlichen Logistik, welche darüber hinaus die lokale Bevölkerung einbindet. Bewohnerinnen und Bewohner bekommen die Möglichkeit, logistische Prozesse mit zu steuern und durch die Anlieferung aus der heimischen Stadt den lokalen Marktplatz zu stärken. Ein erster Schritt ist es die Mitbring-Idee zu verbreiten und bekannter zu machen, denn im Gegensatz zum kollaborativen Konsum, steht Crowd Delivery noch recht an den Anfängen und die Begrifflichkeit ist vielen noch unbekannt. Die Bereitschaft jemandem Waren aus einem Geschäft mitzubringen hängt deutlich davon ab, wie nahe man der Person steht. Die zwischenmenschliche Beziehung zwischen dem privaten Lieferanten und dem „Kunden" spielt somit eine ausschlaggebende Rolle. Die Erreichung der kritischen Masse kann somit aus aktueller Sicht nur über die Etablierung einer Gemeinschaft mit starken persönlichen Bindungen und eventuell mit einem Belohnungssystem (Geld oder Sachleistungen) erreicht werden. Aufzubauen auf nachbarschaftliche und soziale Beziehungen ist womöglich zu wenig, um eine zuverlässige und zeitnahe Lieferung durch Privatpersonen zu gewährleisten.

7 ANMERKUNG

Das Forschungsprojekt „LoMaCro+" wird im Rahmen von „Mobilität der Zukunft" vom BMVIT für 30 Monate gefördert und von der FFG administriert. Das Konsortium besteht aus evolaris next level GmbH (Projektleitung), TU Wien Fachbereich Verkehrssystemplanung (IVS), Büro Mathias Mitteregger e.U., Fuhrwerk Logistik GmbH sowie EN GARDE Interdisciplinary GmbH.

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Das Konzept der quattromodalen Knoten

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1 ABSTRACT

Die Verknüpfung der vier Verkehrsträger Straße, Schiene, Wasserstraße und Luft an einem quattromodalen Güterverkehrsknoten ist derzeit noch ein Randthema mit vielen Unbekannten. Das österreichische Forschungsprojekt „Q4“ widmet sich dieser Wissenslücke und stellt das Potential sowie die Grenzen quattromodaler Knoten im Güterverkehr in den Fokus der Forschung. Im Zuge dessen werden beispielhaft Möglichkeiten der Umsetzung für den österreichischen Zentralraum Linz-Wels-Steyr und die Metropolregion Wien aufgezeigt.

Keywords: Güterverkehr, Knoten, Kooperation, Logistik, quattromodal

2 AUSGANGSLAGE

Zahlreiche Studien (u.a. KOM, 2014, S. 7 und S. 16; Lambrecht, M. et al., 2009, S. 45f; Kayikci, Y., 2014, S. 135) verweisen darauf, dass durch verkehrsträgerübergreifende Transporte negative, durch den Güterverkehr verursachte Umweltwirkungen reduziert werden können. Dabei wird insbesondere auf jene Güterverkehre verwiesen, bei denen für den Hauptlauf der Supply Chain ein umweltfreundlicherer Verkehrsträger, wie die Schiene oder die Binnenwasserstraße, zur Anwendung kommt. Angespornt durch das Bestreben, negative Umweltwirkungen zu reduzieren, fordern verkehrspolitische Strategiepapiere – u.a. das Weißbuch Verkehr (KOM, 2011), das Grünbuch der nachhaltigen Logistik (Gregori, G. und Wimmer, Th., 2011) und das Grünbuch Nachhaltige Logistik in urbanen Räumen (BVL, 2014) – daher eine verkehrsträgerübergreifende Transportorganisation im Güterverkehr und greifen in diesem Kontext häufig den Begriff der „Multimodalität“ auf. Die genauere Betrachtung zeigt, dass sich diese Strategiepapiere zumeist auf bi-, teilweise auf tri-, jedoch kaum auf quattromodale Verkehre beziehen.

In der logistischen Praxis schlägt sich diese Forderung zurzeit vorwiegend in der Bereitstellung trimodaler Güterverkehrsknoten nieder. Die Besonderheit dieser bereits weit verbreiten Güterverkehrsknoten liegt in der Integration von drei Verkehrsträgern. Wobei zumeist die Verkehrsträger Straße, Schiene und Wasserstraße, mit dem Ziel eines unkomplizierten und schnellen Wechsels von Gutarten und Ladeeinheiten, durch verkehrstechnische, technologische und/oder organisatorische Maßnahmen aufeinander abgestimmt werden. In Analogie dazu besteht die Idee des quattromodalen Güterverkehrsknoten in der verkehrstechnischen, technologischen und/oder organisatorischen Integration von vier Verkehrsträgern. Wenngleich das Konzept quattromodaler Knoten einen gewissen Interpretationsspielraum lässt – so werden etwa die Pipeline, Normal- und Breitspur sowie die Binnen- und Seewasserstraße jeweils als eingener Verkehrsträger zur Kombination verstanden – scheint vor allem die Kombination Straße, Schiene, Wasserstraße und Luft für einen gesamtwirtschaftlichen Ansatz sinnvoll. Dies ist einerseits in den Unterschieden der vier Verkehrsträger hinsichtlich ihrer Systemeigenschaften begründet, welche bei der Unterscheidung zwischen Normal- und Breitspur sowie Binnen- und Seewasserstraße nicht eindeutig sind. Andererseits lässt diese Verkehrsträgerkombination, im Gegensatz zu einer Kombination mit einer Pipeline als Verkehrsträger, auch den Wechsel von Ladeeinheiten zu.

3 UMSETZUNGSPERSPEKTIVEN QUATTROMODALER KNOTEN

Derzeit sind quattromodale Knoten im Güterverkehr noch ein Randthema, mit dem sich zwar bereits einzelne, nicht jedoch die Mehrheit der am Güterverkehr beteiligten Akteure beschäftigen. In Zukunft könnten quattromodale Knoten jedoch dramiatisch an Bedeutung gewinnen, insbesondere da Trends wie Synchromodalität und Physical Internet einen geeigneten Umschlagsknotenpunkt benötigen (Hauger, G., 2016). Eine nähere Auseinandersetzung mit den derzeit raren Praxisbeispielen zeigt, dass das Konzept häufiger im Kontext der Beschreibung von Regionen als von Logistikzentren seine Anwendung findet. Als Beispiele hierfür können unter anderem die deutschen Bundesländer Bremen (Handelskammer Bremen, 2010, S. 12ff) und Nordrhein-Westfalen (IHK, 2009, S. 103) sowie in Österreich die Region Linz (Mey, St., 2009) und der Hafen Wien, welcher in diesem Kontext seine geographische Lage (Mutz, R., zitiert nach BVL, 2012) anführt, genannt werden. In einigen wissenschaftlichen Artikeln (z.B. Zhang et al., 2007) werden zwar mögliche Modelle und Auswirkungen einer regionalen und/oder organisatorischen Verbindung mehrerer Verkehrsträger unter besonderer Berücksichtigung des Verkehrsträgers Luft beschrieben, Umsetzungsperspektiven für quattromodale Knoten spielen dabei jedoch kaum eine Rolle.

Das österreichische Forschungsprojekt Q4, gefördert durch das Bundesministerium für Verkehr, Innovation und Technologie, erarbeitet einen Beitrag zur Abschätzung theoretischer Potentiale und Grenzen des Konzepts quattromodaler Knoten. Da derzeit kaum quattromodale Güterverkehrsknoten existieren, die eine Integration der vier Verkehrsträger Straße, Schiene, Wasserstraße und Luft auf verkehrstechnischer, technologischer und/oder organisatorischer Ebene aufweisen, muss für die Potentialabschätzung eine iterative Herangehensweise gewählt werden. Dabei wurde im Rahmen des Forschungsprojekts Q4 versucht Umsetzungsperspektiven in den österreichischen Regionen Wels-Linz-Steyr sowie in der Metropolregion Wien herauszufiltern. Zur Abschätzung dieser theoretischen Potentiale, die sich durch das Konzept quattromodaler Knoten für den Güterverkehr ergeben, wurden zunächst bimodale (z.B. Flughafen Wien, Flughafen Linz) sowie trimodale Praxisbeispiele (z.B. Hafen Hamburg, Hafen Constanța) zur Analyse herangezogen sowie Experten-Interviews mit Logistikdienstleistern, Infrastrukturbetreibern, Forschern und Interessensvertretern geführt. Besonderes Augenmerk wurde auf Aspekte zur Integration der Luftfracht in ein Güterverkehrssystem (Operabilität), Potentiale bzw. Grenzen durch die Erweiterung von Transportoptionen (Diversität) und mögliche Synergien bzw. Hindernisse durch eine räumliche Nähe der vier Verkehrsträger (Opportunität) gelegt.

Anhand dieser analytischen Betrachtung des Konzeptes konnten theoretische Potentiale und Grenzen aus raumplanerischer (u.a. Flächennutzung, emittierende Nutzungen), verkehrstechnischer (u.a. Infra- und Suprastrukturausstattung), gesamtwirtschaftlicher (u.a. Wettbewerb, Resilienz) sowie betriebswirtschaftli¬cher (u.a. Kooperationen, Wirtschaftlichkeit) Sicht abgeleitet werden.

3.1 Potentiale quattromodaler Knoten

Die Erhöhung der Verkehrssicherheit kann durch die Integration der Luftfracht in ein Güterverkehrssystem (Operabilität) ein mögliches Potential des Konzeptes quattromodaler Knoten darstellen. So besteht einerseits die Möglichkeit, durch die Lage des quattromodalen Knotens in der Peripherie (z.B. bei Flughäfen) Verkehr in sensiblen bzw. urbanen Räumen zu reduzieren, während andererseits durch die Konzentration des Güterverkehrs gezielt Maßnahmen für Verkehrssicherheit und Verlagerung auf sicherere Verkehrsträger (wie z.B. auf Bahn, Schiff oder Flugzeug) ergriffen werden können.

Insbesondere in Hinblick auf den Aspekt der Diversität des Transportangebots und im Zusammenhang mit dem Konzept der Synchromodalität sind Potentiale aus verkehrstechnischer, gesamtwirtschaftlicher sowie betriebswirtschaftlicher Sicht durch das Konzept quattromodaler Knoten denkbar. So wird etwa der Begriff Diversität im technischen Kontext häufig mit der Erhöhung der Ausfallsicherheit oder auch Resilienz in Verbindung gebracht und dem Konzept der Synchromodalität eine:

(1) modalitäts-offene Buchung von Transportleistungen,

(2) gemeinsame Planung und Koordination eines Netzwerkes von Supply Chains,

(3) Bündelung von Warenströmen und Dienstleistungen,

(4) flexibele Verlagerung zwischen verschiedenen Verkehrsträgern und eine

(5) nachvollziehbare, der jeweiligen Situation entsprechende Verkehrsträgerwahl mit entsprechenden Inforamationsaustausch (Ixolution und PTV, 2013) zugeschrieben.

Damit dieses Konzept allerdings in der transportwirtschaftlichen Praxis funktionieren kann, braucht es zumindest tri-, besser jedoch quattromodale Umschlagsknotenpunkte. Folglich könnten auch gesamtwirtschaftlich betrachtet quattromodale Knoten sowohl durch die Erweiterung der Optionen in der Transportträgerwahl (und -mittelwahl) als auch durch die Steigerung der Resilienz für einen Wirtschaftsraum attraktivitätssteigend wirken, vor allem wenn diese Eigenschaft ein Alleinstellungsmerkmal darstellt. Die dadurch ausgelösten positiven Effekte auf beispielsweise Betriebsansiedlungen oder Verladeraktivitäten werden vor allem durch die Erweiterungsmöglichkeit des Produktportfolios von Transporteuren und Spediteuren begründet.

Des Weiteren könnten quattromodale Knoten einen Beitrag dazu leisten, die Auslastungsgrade der Transportmittel zu erhöhen, wodurch auch in der Luftfracht zu vergleichsweise geringen Mehrkosten ressourcenschonendere Transporte möglich werden. Damit könnten Güter flexibel jeweils dem Transportmittel eines Verkehrsträgers zugeordnet werden, das noch über entsprechende freie Kapazitäten verfügt. Einen ersten Hinweis auf das durch die Integration der Luftfracht bestehende Potential kann der Geschäftsbericht der Lufthanse Group liefern. Der unternehmensinternen Statistik zufolge verzeichnete die Lufthanse Group im Jahr 2014 eine weltweit durchschnittliche Auslastung ihrer Frachtflieger von knapp 70% (Deutsche Lufthansa AG, 2014, S. 46) und einen europaweiten Rückgang des Auslastungsgrades von 2013 auf 2014 um 3,2% auf 50% (ebenda, 2014, S. 74).

Je nach Opportunität können quattromodale Konzepte, die auf eine räumliche Bündelung verzichten, u.a. auf strategischer und prozessualer Ebene profitieren. Als Beispiel können Knotenpunkte angeführt werden, die durch eine gemeinsame und abgestimmte Flächennutzung Synergien schaffen, indem sie Prozesse mit übergeordneter Funktion (wie Zollabfertigung), besonderer Anforderungen (wie z.B. Gefahrengut- und Kühllager, Infrastruktur für die Abwicklung von Lebendtiertransporten) oder mit hohen Emissionen (wie Schotterumschlag, Ankopplungsvorgänge oder Rangiermanöver von Zügen) räumlich bündeln. Zudem können solche durch gemeinschaftliche Nutzung geprägte Knotenpunkte auch Systemvorteile des jeweils anderen Knotenpunktes nutzen und ihr Angebotsspektrum erweitern. Damit wären zwar nicht die einzelnen Knotenpunkte, jedoch die Region quattromodal.

3.2 Grenzen quattromodaler Knoten

Bezugnehmend auf den Aspekt der Operabilität wird dem Konzept quattromodaler Knoten kaum Verbesserungspotential zugeschrieben. Ein Grund hierfür liegt in der aus verkehrstechnischer Sicht eingeschränkten Einsetzbarkeit üblicher Ladeeinheiten in der Luftfracht. Während etwa die derzeit verwendeten Container bereits für den Transport auf der Straße, der Schiene oder dem Schiff optimiert sind, ist die Operabilität für den Umschlag in der Luftfracht eingeschränkt. Damit werden zusätzliche Handlings etwa durch neuerliches komissionieren bzw. aus- und einladen der Container notwendig, welche mit zusätzlichen Kosten und Zeitverlust einhergehen. Da es derzeit jedoch nur vereinzelt zu Anwendungsfällen kommt und es somit defacto keinen Bedarf für derartige Umschläge gibt, werden aktuell auch keine Verbesserungen angestrebt. Beispiele für eine derart bedrafsbedingte Verbesserung hinsichtlich der Integration der Luftfracht in den Güterverkehr durch technologische Innovationen, stellen die Abstimmung von Tracking- und Tracing-Systemen auf unterschiedlichen Verkehrsträgern (TAGnology RFID GmbH, 2015) sowie die Entwicklung spezieller Umschlagstechnologien und Informationserhebungen, wie RFID-Systemen, dar.

Grenzen in Bezug auf die Erweiterung von Transportoptionen (Diversität) können sich hinsichtlich des erhöhten Abstimmungsaufwands (insbesondere zu Beginn der Kooperation) bzw. der Datenintegrität verschiedener Unternehmen ergeben. Eine verkehrsträgerübergreifende Kooperation begründet nicht nur ein notwendiges Alignment von Managementsystemen, Informationssystemen und Prozessen, sondern auch eine Festlegung von Kontrollorganen (Erfolgskontrolle), ein verstärktes internes Qualitätsmanagement sowie eine Festlegung von Kompetenzen (v.a. von jenen, die sich im Spannungsfeld zwischen Kundenattraktivität des Angebotes einerseits und Kostendeckung andererseits befinden).

Just-in-Time-Produktion und Outsourcing führten zu Suburbanisierungsprozessen (Ansiedeln benötigter Flächen außerhalb einer Stadt) und veränderten logistische Anforderungen seitens der unterschiedlichen

Verkehrsträger. Unter anderem stellt Schubert, A. (2010, S. 36) fest, dass im Gegensatz zum Transport auf der Schiene vor allem der Straßengüterverkehr, aber auch die Luftfracht bzw. der Transport auf dem Binnenschiff aufgrund ihrer Systemeigenschaften (insbesondere aufgrund der hohen Netzdichte) flexibler auf veränderte Bedingungen reagieren können. Damit werden beide Verkehrsträger den hohen Anforderungen seitens der Kunden hinsichtlich Schnelligkeit, Netzbildung und Flexibilität gerecht und können das Transportangebot von Logistikdienstleistern gut ergänzen. Zudem sind aufgrund ihrer unterschiedlichen Systemeigenschaften auch positive Effekte hinsichtlich der Resilienz des Güterverkehrssystems zu erwarten, wenn etwa Störungen entlang eines Verkehrsträgers schlagend werden, wie beispielsweise massive Verzögerungen an Grenzübergängen. Kritisch muss die Transportoption „Luftfracht" vor allem in Hinblick auf ihre aus finanzieller und ressourceneffizienter Perspektive sinnvoll zu bewältigenden Transportmengen betrachtet werden.

Je nach Opportunität bergen quattromodale Konzepte durch den erleichterten Zugang zu vier Verkehrsträgern die Gefahr eines steigenden Fahrzeugaufkommens auf verkehrspolitisch unerwünschten (aufgrund ihres Emissionsausstoßes) Verkehrsträgern. Dies gilt insbesondere, wenn durch die Verlagerung zusätzliche („hausgemachte") Verkehre verursacht werden.

4 PRAKTISCHE RELEVANZ QUATTROMODALER KNOTEN

Neben organisatorischen und technologischen, spielen vor allem auch räumliche Aspekte eine wichtige Rolle für die Beurteilung der praktischen Relevanz des Konzepts von quattromodalen Knoten im Güterverkehr. Die Vielfalt des begrifflichen Verständnisses von Quattromodalität (siehe Punkt 2) hinsichtlich ihrer räumlichen Ebenen (Region vs. Standort) erschwert diese Beurteilung. Im Rahmen des Forschungsprojektes Q4 werden erstmals aus dem Konzept quattromodaler Knoten abgeleitete Handlungsempfehlungen für die Umsetzung auf konkrete österreichische Regionen geprüft.

Im Zuge dessen wirft die praktische Anwendung quattromodaler Knoten die Frage auf, ob der Notwendigkeit der räumlichen Bündelung von Infrastrukturen der verschiedenen Verkehrsträger für die Planung und Durchführung des Güterverkehrs (eventuell sogar intuitiv) eine zu große Bedeutung beigemessen wird. Um diese zu beantworten, werden mögliche Synergien bzw. Hindernisse durch eine räumliche Bündelung in Hinblick auf folgende Aspekte berücksichtigt:

- Wirtschaftlichkeit im Transport-/Logistiksektor (betriebs- und gesamtökonomische Betrachtung)
- Optimierung der Verkehrsorganisation (Abstimmungs- bzw. Kooperationsbedarf, Zuverlässigkeit, Sicherheit etc.)
- Zusammenwirken von Verkehr, Raumstrukturen und Umwelt (Vor- und Rückwärtsverflechtungen, nachhaltige Durchführung von Transport- und Logistikdienstleistungen etc.)

Wenngleich Dubai häufig als internationales Beispiel für die Integration der Luftfracht angeführt wird, ist vor allem zur Beurteilung der Wirtschaftlichkeit eine kritische Beleuchtung der Hintergründe und Rahmenbedingungen notwendig. Der politische Wille stellt hierbei einen wesentlichen Faktor dar, da die Luftfracht in Dubai aus geopolitischen Motiven heraus (z.B. Positionierung als Umschlagsplatz, Schaffung eines zweiten wirtschaftlichen Standbeins) etwa durch geringe Lande- und Flugsicherungsgebühren staatlich gefördert wird (Lohmann, G. et al., 2008, S. 210).

Besonders interessant scheint die Frage, für welche Gutarten sich die Anbindung an quattromodale Knotenpunkte eignen würde. Einerseits besitzt jeder Verkehrsträger Gutarten mit besonderer Affinität (z.B. Stückgut, Massengüter, Schwerlast-Güter), weshalb die Kombination bestimmter Verkehrstäger unter vereinfachten Bedingungen möglich ist (z.B. Umschlag ohne Wechsel des Transportgefäßes). Andererseits können etwa aus historischen Stadtentwicklungsprozessen oder speziellen Produktions-/Vertriebssituationen heraus Transportströme entstehen, die vorerst atypisch oder gar unrealistisch erscheinen. Beispielsweise hat sich Hamburg als „Drehscheibe des deutschen und europäischen Teppichhandels" (Fründt, St., 2014) etabliert. Die handgeknüften Teppiche, deren Wert bei bis zu 4.000 Euro pro Quadratmeter liegen kann, werden häufig nicht nur per LKW, sondern auch per Luftfracht transportiert (Fründt, St., 2014).

Die Vor- und Nachteile eines räumlich gebündelten quattromodalen Knotenpunktes werden von den jeweiligen Akteuren sehr unterschiedlich eingeschätzt. Knotenpunktbetreiber sehen die räumliche Bündelung der Verkehrsträger als maßgeblich, Logistikdienstleister und andere, nicht an einen bestimmten Standort gebundene Akteure messen wiederum der organisatorischen und technologischen Anbindung einen höheren Stellenwert bei.

Zudem ist unter Betrachtung der räumlichen Aspekte die bereits in 3.1 angeführte Option der Auslagerung von dringend benötigten Lagerflächen seitens der Häfen (aufgrund der zunehmenden Schiffsgrößen sehen sich Häfen wie z.B. Hamburg mit Flächenproblemen konfrontiert) auf Flughafenstandorte nicht immer realisierbar. Nicht nur die Expansionsmöglichkeit an einem Standort, sondern auch die infra- und suprastrukturelle Ausstattung vor Ort sowie der raumstrukturelle Kontext (z.B. Lage des Flughafens im Vergleich zu jener des Hafen) spielen hierbei eine wesentliche Rolle. Theoretisch wäre eine Auslagerung von Flächen vom Hafen auf den Flughafen beispielsweise in Wien denkbar; in Hamburg wiederum sind Flächen für ein derartiges Vorhaben insbesondere aufgrund der räumlichen Nähe des Flughafenstandortes zum Stadtzentrum schlichtweg nicht gegeben.

Für die Abschätzung der Relevanz der Einrichtung eines quattromodalen Knotenpunktes spielt aus organisatorischer Sicht die Positionierung des potentiellen Verkehrsträgers Luft in der Supply Chain (im Vor- oder Nachlauf) eine Rolle. Beispielsweise wäre im Zuge der Verwendung der Luftfracht im Vorlauf einer Supply Chain mit einer Vielzahl unterschiedlicher Akteure sowie mit häufig unregelmäßigen Transporten von vergleichsweise geringen Mengen eines Gutes zu rechnen. Als Grund hierfür sind unter anderem die Transportkosten, die im Vergleich zum Transport auf anderen Verkehrsträgern sehr hoch ausfallen, zu nennen. Während für den Nachlauf der mittels Luftfracht ankommenden Transporte angenommen werden kann, dass eine Verlagerung von der Straße auf beispielsweise die Schiene aufgrund der Distributionsfunktion dieser Transporte (Last-Mile) eher unwahrscheinlich ist. Anders hingegen stellt sich diese Einschätzung für die Potentialabschätzung der Relevanz quattromodaler Knoten für jenen nicht unwesentlichen Teil der Luftfracht dar, welcher zwar mit Flugnummer jedoch per LKW durchgeführt wird (Trucking). Als Voraussetzung für die Verlagerung von Trucking-Transporten auf die Schiene müsste jedoch vorab die Organisation von Einzelwagenverkehren (z.B. räumliche Nähe zu einem Rangierbahnhof) geprüft werden.

Insbesondere hinsichtlich der technologischen Abstimmung der Verkehrsträger könnte großes Potential für die Integration der Luftfracht verborgen sein. Technologische Neuerungen, die durch vereinfachen oder beschleunigen von Prozessen eine rasche und unkomplizierte Kooperation einer Vielzahl von Akteuren ermöglichen, können konventionelle Modelle im Güterverkehrs revolutionieren (z.B. Physical Internet) und damit ein Umdenken einleiten.

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Defining Smart Cities: a Relative and Dynamic Approach

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1 ABSTRACT

Although the level of interest in smart cities is growing, the main issue – the smart city concept – is still open. The definition of smart city is not shared as well as the way to measure city's smartness. The main approach has developed the concept of an "ideal" city which every city should tend because it represents the optimal standard.

In this context, the aim of our paper is to break with the traditional point of view in favour of a new concept of smartness which identifies a city specific value of smartness, based on the efficient use of its own resources and related to the different context in which a city is situated. Thus, in this way, the concept of smartness becomes relative. Moreover when a city is very close to optimal value (i.e. maximum efficient frontier) then the frontier will shift upward because of the more attractiveness of the city but after a while the performance of the city goes down and a new adjustment mechanism should be followed to become efficient again (virtuous cycle). The needed time to be close again to the frontier will be correlated to the degree of inertia (reaction time) of urban government. So the smartness concept becomes dynamic as well as relative because it depends on how long the city takes to react and change the direction of its own performance to become smart again.

Keywords: city, efficiency, efficient frontier, planning, smart city

2 CITY'S SMARTNESS VS FIRM'S PRODUCTION

In these recent years, innovation processes, i.e. the application of knowledge, have been implemented mainly at the local level. Although the production of new knowledge is available on a global scale, only in a restricted territorial area collaborations among individuals are more effective. These innovation processes lead to the creation, hybridisation, and spread of knowledge and technology from the world of scientific research to production and services sectors and in a more broad way knowledge is spread about all citizens. Due to the gradual de-materialisation of the infrastructures, the progressive digitisation of innovation, the new forms of online learning and the advent of ever more virtual technologies, new theoretical models have emerged where innovation should be combined with talented people and with social cohesion at urban level.[1] Human capital, technology, and innovation are the main resources of a smart city. Moreover, the definition of smartness is widened by Caragliu, et al. (2009) where they consider the role of interconnected infrastructures to improve economic and political efficiency. A city, thus, should be business-friendly to attract and accommodate business projects, should stimulate the coexistence and complementarity of high-tech and soft infrastructure, and, finally, should promote the social and relational capital within the urban area.

From a concept related to energy saving and efficiency use issues, the smart city notion has been developed to include different aspects such as quality of life, environment, human capital, education, employment and so on. Consequently, smart city has become more close to the efficient assumption of a firm.[2] A city is smart not because is necessarily technological advanced but because is able to use in an efficient way all the available resources. In Figure 1, a comparison between firm's production and city's smartness is represented.

[1] For a more detailed analysis of smart city see Auci and Mundula (2015).

[2] This assumption leads back to the concept of the "socio-economic metabolism" of human systems. This framework has been developed in the EU countries' official statistics especially in the last fifteen years to study the interactions between socio-economic systems and other dimensions. Concerning the environmental dimension, a Satellite Environmental Accounts System within National Accounting was constructed ad hoc and it is currently compiled by each EU country. According to the approach of the socio-economic metabolism, urban systems (considered at different territorial scale: nation, region or city) are compared to a living organism needing inputs (such as natural resource flows, capital, labor, energy, soil) either for its functioning and growth and to produce some results as output (such as products, services, waste and pollution) that can identify the degree of well-being of a system.

On the basis of the neoclassical theory, a firm can be considered as a black box, where the attention is primarily on inputs and outputs without deepening any knowledge of its internal workings. In this view, resources or inputs are selected with respect to the outputs that should be produced by a firm. The black box, even if is unknown, can be represented by a function where several inputs are combined to obtain the final goods or services. This analysis based on profit-maximizing assumption implies that firm's behavior is always efficient. Given market prices, a firm's owner chooses the optimal output to maximize its own profit.

Similarly, a city to be smart should use in an efficient way its own resources. These resources are necessary to obtain as "output" the optimal urban well-being for all citizens. In other words, city's resources are combined within the public governance to ameliorate the well-being at urban level. Following a well-being-maximizing assumption, the city's mayor should behave in an efficient way reaching a fair and sustainable output for all citizens. Given market and no-market prices, a city chooses the optimal output such as an optimal well-being level to maximize its own smartness level.

If smartness means, as in Giffinger et al. (2007), a "combination of endowments and activities of self-decisive, independent and aware citizens", then it comes straightforward the parallelism with a firm of the neoclassical theory. For this reason, the efficient combination of resources can be measured by a production function and the fair and sustainable output can be captured by a specific indicator such as UrBes or a measurement of happiness. The first indicator is preferred because is a wider concept which can capture different aspects of citizens' well-being.

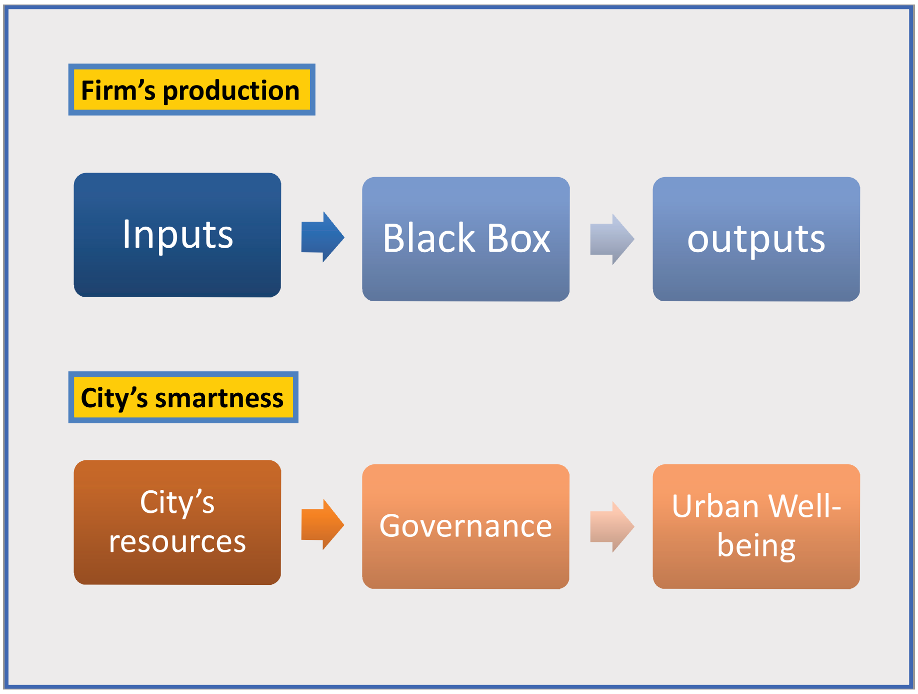

Figure 1: A comparison between firm's production and city's smartness

3 URBAN PRODUCTION FUNCTION AND URBAN RESOURCES.

Analysing urban efficiency is not a new debate. In fact, in the urban economy literature, urban efficiency is closely related to the so called "optimal city size". Urban size, considered as a target by government interested in efficiency of the urban system, can be reached when urban marginal costs are greater or equal to marginal benefits. This optimal point represents the way urban can contribute to national income (Alonso, 1971; Richardson, 1978). However, the optimal urban size is a threshold because before this maximum point net increasing returns to scale create positive externalities and the size of a city increases while beyond the maximum size negative externalities dominates and economies becomes diseconomies with net decreasing returns to scale. In this paradigm, the main hypothesis is that all cities have similar cost functions and production functions. The main result is that all cities search for a single urban size, optimizing costs, or incomes or net urban benefits. Actually, the common observation shows that city sizes are different and each city can reach a its own static or dynamic equilibrium.

Starting from the observation that cities perform different functions, are characterized by different specializations, and consequently operate with different resources, many criticisms arose against the theory of the optimal city size (Henderson, 1974, 1985, 1996). “We may expect the efficient range of city sizes to vary, possibly dramatically, according to the functions and the structure of the cities in question” (Richardson 1972, pp. 30). Similarly to firms, for which should be impossible to obtain the same output or income even if they can be identical in terms of inputs used, two cities cannot have the same size o level of population even if they start from the same level of resources.

The optimal level of urban size, in fact, may change over time because of exogenous shocks, a different industrial composition and the ensuing growing income curve profile, and the introduction of new technologies, with the consequent falling transport prices (Partridge, 2010).

Finally, Bechmann and McPherson, (1970) propose a model – the so called central place model – as an alternative between only one optimal size and infinite sizes where higher rank cities are expected to have a wider size with respect to lower rank ones, while cities belonging to the same rank show the same size.

Summarizing with the word of Camagni et al., (2013), “cities are supposed to share the same, complex cost and production functions with heterogeneous, substitutable factors linked not just to economic functions but to other context conditions. Therefore each of them maintains its specificity and consequently its ‘equilibrium’ size, but comparability (and possibility of running cross-sectional analyses) is saved and also possibility of devising policy strategies for urban growth or containment” (Camagni et al., 2013, pag 4).

Thus, the problem becomes to find the production function. To do that, we can consider that as the existence of a firm is related to positive transaction costs (Coase, 1937), the existence of a city is the result of human needs and objects. These necessities are strictly associated to three main categories of individuals who live in a city and represent the city’s resources. As usual they can be subdivided in: families (residential and not residential), firms, and public institutions. In Figure 2, we show how these three categories are related each others.

Within the first group, residential families and city users or no residential families are included. Residential families mean only families that permanently live in the city while with city users all the individuals that are interested in coming in the city such as tourists or commuters are considered. The first need of a residential family is inhabiting within the city, but for both residential families and city users, buying goods and services from firms is also a necessity. In return, residential families and commuters supply their labour force to firms. For an entrepreneur producing near the market is its first necessity. A firm supplies goods and services but also builds houses for residential families and finally gives in return capital and labour income to families.

The main role of public institutions is the production of the so-called “public goods”. Because these goods are non-rivalrous and non-excludable in consumption, there is a free-rider problem, meaning that a rational person has no incentive to contribute to the provision of the public good because he/she always gains benefits. Public institutions are necessary to firms, families, and city users even because they satisfy the need for a welfare state and infrastructures such as road-network, hydro-network, electric-network and so on and so forth. Firms, families, and city users paying taxes obtain in return all the public goods necessary for their transactions.

These three categories of individuals represent the resources of a city. From an economic point of view, the needs and objects of residential and no-residential families can be considered as inputs of a city’s production function. Through the governance of public institutions these inputs are combined in an efficient way to obtain an optimal level of well-being for all citizens.

In Table 1, needs, targets and individuals of a city have a correspondence with the three main inputs of a firm (land, capital and labour). From the entrepreneur point of view, human, physical and financial capital, labour and land are the necessary inputs to maximize his own profit. Similarly, even for cities capital, labour and land represent the three main inputs of a production function to maximize the well-being of citizens to become more smart. For a city, land means the extension of the area in which citizens live and work. But which is the extension to consider? Should be considered the administrative or the contiguity area of a city? For the empirical analysis the administrative area is the more appropriate but the contiguity area should be more correct from a theoretical point of view. The contiguity area in fact can capture the congestion effect related to the neighboring areas that are attracted by the main areas of the city. Moreover, as already pointed out, several authors (Alonso, 1971; Richardson, 1978), according to the optimal size city theory, underline the link between city's extension and city's efficiency. They find that at the beginning an increase of the extension of the city means a raise of efficiency but after a certain point of extension, congestion, commuting and lack of adequate networks implies more inefficiency.

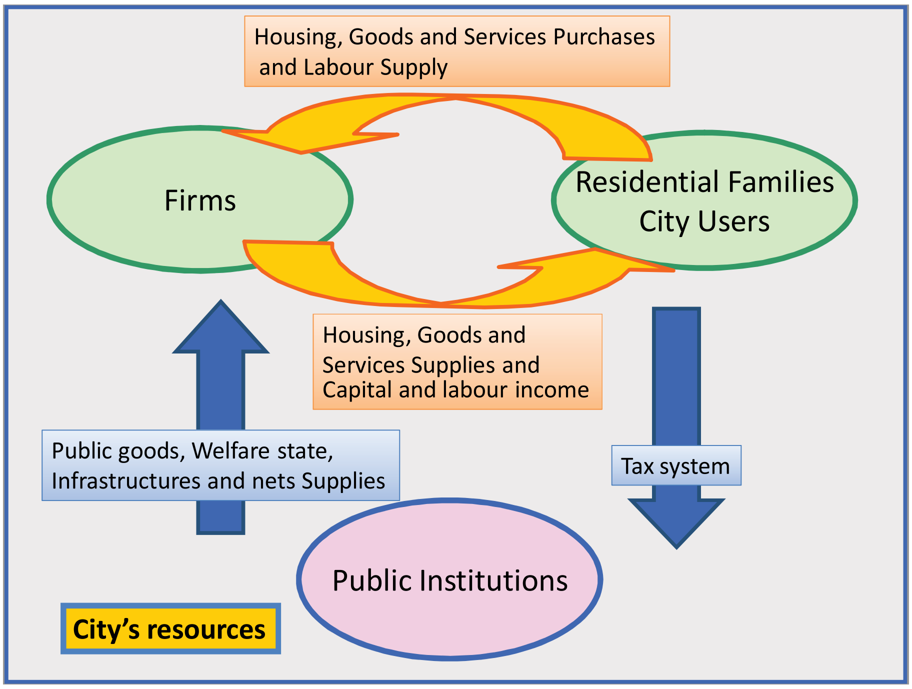

Figure 2: Model of the circular flow of income and expenditure of city's resources

In particular, analyzing a city from an economic point of view means considering a city like a unique entity maximizing its final object, i.e. the wellness of citizens. To describe a city's production function several variables representing the inputs should be considered. Starting from the primary needs of a society (inhabiting, producing and social provision) and crossing with the traditional productive factors as shown in Table 1, we can identify the inputs of the urban production function. So, because for residential families inhabiting is a primarily need, the surface per housing could be a good indicator for land input. Measuring land consumption could capture the extension of a city and this in turn can reduce the efficiency. At the same way subdividing capital into human, physical and financial allow to capture the different characteristics of the three typologies of individuals who live in a city.

NEEDS		**inhabiting**	**producing**	**social**
TARGETS		**utilities**	**profits**	**public goods**
INDIVIDUALS		**families and city users**	**firms**	**institutions**
LAND (La)		surface per housing (Sh)	surface per firms (Sf)	surface per public utilities (Sp=Stot-[Sh+Sf])
CAPITAL	Human (HK)	# of inhabitants (Ih)+ # tourists (T)+ # of commuters or temporary residential inhabitants (TIh)	# entrepreneurs (E)	# politicians (P)
	Physical (PK)	# of houses (apartment, villas, etc.) (H)	# of warehouses (small, medium and big) (W)	public infrastructures (PubInf) [networks (hydro, electric, roads, informatics, etc.), buildings (schools, hospitals, post offices, etc.)]
	Financial (FK)	labour income (LI)	capital income (CI)	public transfer payments (PubTr)+ tax payments (Tpay)
LABOUR (L)		underground economy (taking care of old men, children, houses, etc.) (UEc)	# of employees in the private sector (PrE)	# of employees in the public sector (PubE)

Table 1: The correspondence between city's resources and firm's inputs.

Thus, it is important to know not only the number of inhabitants or tourists of a city but even the number of commuters that every day come into the city for work. Moreover, both entrepreneurs and politicians represent a good resource for the city and its improving in well-being. As for physical capital, it could be measured by the number of buildings within the city both in terms of houses and warehouses, without forgetting the main role of public infrastructures of which good indicators should be constructed. Labour income, capital income, public transfer payments and tax payments should be useful to capture the financial capital within a city.

Finally, as regards labour inputs, the number of employees in the private and public sectors is the main indicator for capturing the role of firms and institutions of a city. A measure of underground work for family can be represented by the taking care of old men, children, houses and so on.

Finding a correspondence between city's behavior and firm's behavior is the basis for the analysis of the dynamic smartness of a city's performance. In other words, a city could be smart if and only if the use of all its resources is efficient. A city should behave like a firm and maximize its production function to reach its own target: a more high level of performance i.e. a more widespread urban well-being.

4 URBAN OUTPUT AS URBAN WELL-BEING

The progress of a social system occurs when an increase in social well-being is achieved. The final goal of a urban system is to obtain the highest collective well-being that represents the typical objective of a government. In accordance with this definition, in our view it is appropriate to consider as output of the urban production function the urban well-being that involves several domains. According to the system theory (Von Bertalanffy, 1968; Le Moigne 1977) an urban aggregate can be seen as a complex living system characterized by specific relations among its components and with the outside world. For this reason, sustainability issues have to consider simultaneously the internal sustainability of each dimension, the sustainability among different dimensions and the sustainability of the interactions between the system analyzed (country, region or city) and the outside world.

As well-being is a complex magnitude, UrBes statistical indicator (Urban equitable and sustainable well-being) developed and produced by Istat since 2014 seems a suitable measurement tool for the evaluation of the output of the urban production function. Because of its methodological characteristics, this indicator is useful to measure the relative smartness of a city - the new concept we propose in this paper - as the city's ability to use in an efficient way its own resources and to react to endogenous factors and exogenous shocks in order to move, as closer and faster as possible, to its own maximum efficient frontier by a new adjustment mechanism (virtuous cycle).

UrBes indicator has been developed applying definitions and methodologies used in the equitable and sustainable well-being indicator (Bes) project. This project was born from a joint initiative between Istat and National Council of Economic Labour (CNEL) in 2010 to measure the well-being of Italian society, as recommended by OECD tickled by the Stiglitz Commission Report. The Bes project also is part of the international debate on "beyond GDP" based on the awareness that parameters on which to assess the progress of a socio-economic system cannot be exclusively economic, but they should also take into account other key dimensions of the well-being, therefore accompanied by measures of inequality and sustainability.[3] Underlying the Bes, a list of 134 indicators has been set up and classified in 12 key-domains previously identified to capture the most significance aspects of well-being: Health, Education, Labour and life-time conflict resolution, Well-being, Social relations, Politics and Institutions, Security, Subjective well-being, Landscape and Cultural heritage, Environment, Research and Innovation, Quality of services. The result of this inter-institutional work was finally issued in 2013 with the first Report of Italian Equitable and Sustainable well-being (Bes). This initiative positions Italy in line with the most advanced international efforts to implement and develop a comprehensive measure of progress which goes beyond the quantitative metric on macroeconomic activities namely gross domestic product (GDP).[4] In particular, GDP appears an inadequate tool to evaluate progress of national and urban systems in terms of smart growth/development that in the last decade has also become one of the main EU policy objective. Concerning the measurement of well-being in the urban system, UrBes indicator has integrated some advanced information on well-being at city level strengthening the network of municipalities which participate to the UrBes project. In particular, the second edition of the UrBes Report (2015) the number of municipalities involved has increased from 15

[3] For this reason, due to the different dimensions involved, assimilating well-being to economic growth only represents an inaccuracy as well-being and GDP increase can be (partially) independent.

[4] ISTAT CNEL, Proposal for domains by the Cnel Istat Steering Committee on the measurement of progress in Italy, 26 September 2011 (http://www.misuredelbenessere.it)

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up to 29[5] while the number of indicators used to measure urban well-being has grown from 25 provided in 2014 to 54 in 2015.). This is due either to the availability of final data of the Census of 2011 and to the use of information from various statistical surveys previously unavailable.

Moreover, the report is accompanied by a summary sheet for each municipality participating in the UrBes project, that report general consideration on data and explore the theme of the relationship between the indicators and the specific political action planned in the specific urban context. In addition, in the Report 2015 there are also in-depth focus with which 12 municipalities have enriched the analysis of their chapter, including through the use of its administrative or statistical sources (surveys). The focus reported on sustainable mobility (Milan), school meals (Naples), management waste (Cesena), management of municipal services (Bologna and Reggio Emilia), involvement of minors and non-EU citizens in political participation in the elections of district (Brescia), labor market (Florence), the distribution of income and economic deprivation (Trieste and Prato), petty crime (Pesaro). These focuses are very interesting because they describe Italian living conditions along the territory and highlight great differences among italian cities - as expected - about the level of current well-being, critical issues in different dimensions, political decisions and availability of the set of data and information according to the phenomena investigated

Underlying the importance of the UrBes indicator methodology and of the results presented by Istat in the last Report of 2015, more efforts are necessary to complete the information in all the domains, to construct a homogeneous time series of data and to make more comparable the data especially at the spatial level to make this indicator a more effective tool for the analysis of the performance of the urban smartness.

5 MEASURING THE URBAN SMARTNESS: A NEW WAY

Having stated the UrBES index as output of the urban production function its important to underline that each city is different and the difference in terms of output is not only in terms of absolute value over the time, but also in terms of priority assigned to the different components of it. To solve this problem, each city' administration, through a survey, should ask to its citizen its preferences in order to assign a relative weight to each indicator of the UrBES index. The survey should be repeated at least every 5 years to capture the evolving needs of the population depending on the modification of the society' age structure and on the changing of the global (economic situations, social conflicts, cultural trends, and so on) context.

The first step in order to calculate the measure of the urban smartness is to define the path of the ideal urban performance in terms of relationship between output and production function. As argued in the previous paragraph, because there is not yet a synthetic measure of the UrBES index nor a full dataset that makes possible to calculate it with some statistical method (for instance OECD, 2008), we will describe the process merely from a theoretical point of view.

The trend of the ideal performance in the long run could have constant (linear), increasing (eg. exponential) or decreasing (eg. parabolic) returns of scale. This depends if there is, as assumed by growth theory, an infinite increase in productivity due to the potential of the human capital and technological innovation, rather than, as hypothesized by the degrowth or anti-capitalistic theories, a peak in the accumulation process of capital and then a decrease of the factor productivity due to a congestion effect. However in the short term we can assume to assume the path of the ideal performance of the production function is consistent with the neoclassical theory showing increasing returns to scale and therefore can be represented, using a Cobb-Douglas function with land, labour and (physical, human and financial) capital as main factors according to the variables showed in table 2. Finally, to find the ideal and optimal value of the urban production function it has to be maximized it under the constraint of efficient use of all the resources (i.e. for each factor, sum of the variable equal to 1). The ideal performance path has to be calculated for each city, because the values of the UrBES index are specific, as above argued, for each context.

The second step, to calculate the measure of the urban smartness, consist in defining the path of the actual performance of each city in terms of UrBES values. This path is sinusoidal because the inertia of the public

[5] Along the national territory, the network of municipalities comprises ten Big Metropolitan Cities such as Torino, Genova, Milano, Venezia, Bologna, Firenze, Roma, Napoli, Bari and Reggio di Calabria. Moreover it comprises four Metropolitan Cities such as Palermo, Messina, Catania and Cagliari. Finally, it comprises other fifteen Municipalities such as Brescia, Bolzano, Verona, Trieste, Parma, Reggio Emilia, Cesena, Forlì, Livorno, Prato, Perugia, Terni, Pesaro, Potenza, Catanzaro.

administration contributes to diverge the actual performance from the ideal one while either the pressure of citizenship or the alternation of different parties to government (typical of a democratic system) or the dialectic of the majority, generate reactions to status quo, inverting, if is decreasing, the trend. The sinusoidal pattern, however, may be increasing, stationary or decreasing on average, depending on the adopted solutions are more or less efficient in terms of performance. Moreover, given the increasing nature of the ideal performance, even a rising trend of the actual performance could be divergent from the ideal threshold.

From this point of view the benefits associated with an increase of city productivity inputs are only potential, that they are contingent upon the quality of management (i.e. the speed of reaction to exogenous shocks or internal pressures). Urban production function therefore defines an efficiency frontier, with effective efficiency often significantly below this frontier,. The distance between a particular point (that is a city actual performance) and the frontier is a measure of the quality of its management or, in other word, of the city smartness.

More in detail, having defined the two patterns, ideal and effective, of UrBES (see Figure 3) it's possible to evaluate the smartness of a city in terms of capability to react to a downgrade of its performance, defining:

- E actual reaction
- I ideal reaction
- E/I smartness
- $(E/I)/\Delta t$ dynamic smartness
- Δpx unexpressed potential at a given time
- $\Delta p1/\Delta p2$ potential reaction

A comparison among cities in terms of smartness, or better in terms of dynamic smartness, is no more based on resources endowment but it's relative to the distance from the actual performance to the ideal one (which is specific for each city) and to the speed with which the city reaches its maximum value of performance.

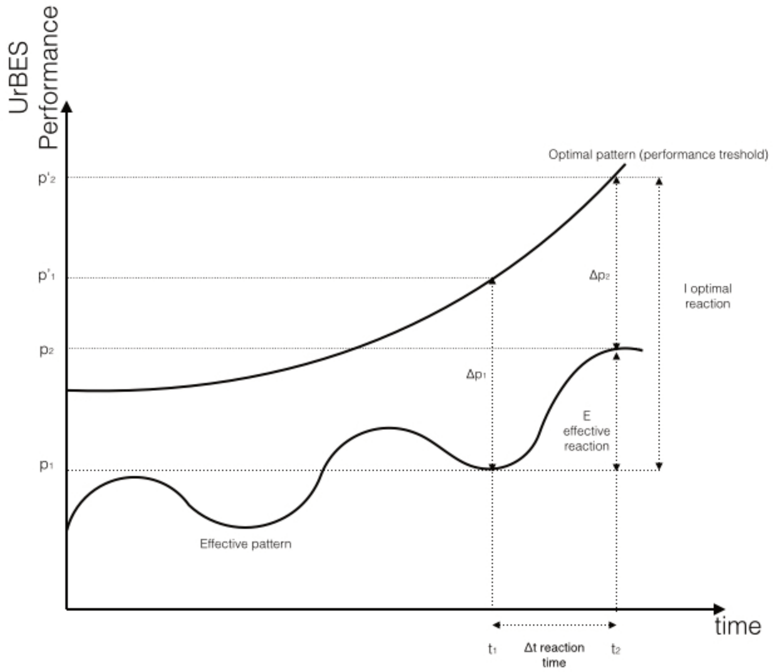

Figure 3: Dynamic smartness of a city's performance

6 CONCLUSIONS

The idea of Smart City is gaining consensus on the political and industrial and is about to become one of the central issues around which will be organized planning efforts not only of the major Italian and European cities, but also of many other forms of territorial aggregation. This trend is already materializing in a multitude of initiatives to transform the lives of millions of people, starting with simple projects that improve

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digital access to public services (such as the use of pc or smart phones to enjoy of a wide range of services), up to innovative infrastructures (i.e. to recycle waste water or for heating). However, even before being a set of technological solutions, the smart city is both the product of emerging social needs of urban scale, and the concrete manifestation of the need for a new generation of innovation policies: that is, it is a governance issue. The basic idea is that the great ability to access and processing of information offered by ICT technologies can contribute to building a community model much more cooperative than in the past, and therefore more "able" to pursue solutions more efficient, more competitive and more inclusive. The challenge is to combine in a single urban model environmental protection, energy efficiency and economic sustainability, with the aim of improving the quality of life of people who live there and create new services for citizens and for the public administrations, reflecting at the same time the different needs of the population without imposing a general structure. It has to be ensured that all social groups which form the urban centers are known in their behavioral patterns as these do not always confirm the stereotypes. It is important that cities are intelligent not in itself but for the people who live in.

In this perpective the measure of the smartness of a city should not be based on an ideal and homogeneous value, but rather on a relative value able of taking into account the specific endowments and resources of the different contexts and the identity of its inhabitants.

It is essential, therefore, that the different actors (local institutions, citizens and businesses), agree on the definition of smart city that they aim to achieve, that is, agree on objectives and on the definition of a medium-term strategy able to organize the various production factors of the city, in order to increase growth and ensuring happiness and welfare of the citizens. Such a perspective higlights the need for a new measure of the urban smartness, in order to choice which projects are more able to achieve it. Currently the various attempts that are moving in this direction are characterized by a single reference value to catch up and by a consequent ranking of cities in terms of distance from this ideal value. However, it seems evident that it is not only simplistic but conceptually incorrect to referring to an optimal value of smartness, unique and static that all cities should strive for. It must instead identify a specific value for each city, linked to its resources. This relative approach to the smartness concept shifts the study and analysis perspective on the subjective/perceptive component in order to take account of the fact that the same indicator has different value and weight in different contexts because of the historical memory (the genius loci, the milieu) of that context and of the identity of its inhabitants.

So what could be now called relative smartness it must also be a value strongly linked to the temporal dimension because when a given context will approach or reach to its optimum value, as maximally efficient (or nearly so), it will become more attractive so capturing new shares of the different forms of capital (social, physical, etc.). However, due to inertia (more or less marked) of the governance' action of each urban system, there will be a gap between the acquisition of these new inputs and the capacity of the same system in the handle efficiently. This will cause the cities to move away from the frontier of efficiency (or optimum value of relative smartness) previously identified. More precisely, given the new resources, it will be defined a new frontier that will result in a new adjustment path in terms of efficiency according to the new conditions (in this sense such a dynamic relies bonth on the theory of optimal size of the city ond of the business cycles).

From the above it appears clear that the lower the amount of time a given context will employ to adapt to the new conditions the more efficient in using their resources it will be. Here then emerge the dynamic character, as well as relative, of the smartness which can then be identified in the time in which a city takes to reach its efficient frontier (function of its resources) in the different cycles. This approach, shifting the problem from the endowment (the latest technology) to the performance (obtained through the use of the most appropriate technologies), yet will allow to build ranking of cities that will incorporate, however, the specific nature and objectives of the different urban contexts.

7 ACKNOWLEDGEMENTS

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reviewed paper

Die smarte Vision auf den Boden bringen

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1 ABSTRACT

Die Stadt Graz verfolgt seit einigen Jahren gezielt die schrittweise Entwicklung in Richtung einer "Smart City". Begonnen hat der Prozess mit dem Projekt I LIVE GRAZ – smart people create their smart city. Das Projekt wurde mit Unterstützung der nationalen Förderschiene Klima und Energie Fonds in der Zeit von 18. 04. 2011 bis 17.07.2012 unter der Federführung der Stadt Graz abgewickelt. Im Rahmen des Projektes wurden die Vision für die Smart City Graz im Jahre 2050, eine Roadmap für die schrittweise Umsetzung der Vision und Handlungsempfehlungen transdizilinär mit Beteiligung von über 130 Expertinnen und Experten erabeitet. Im Kern von I LIVE GRAZ stand der Zugang zu einer lebenswerten Stadt 2050 – der Smart City Graz – im Sinne einer umfassend lebenswerten (smarten) Stadt.[1]

Um die in I LIVE GRAZ erarbeitete Vision erstmalig für „die Bürgerinnen und Bürger von Graz erlebbar zu machen", wurde von einem ausgewählten Grazer Konsortium mit 13 Projektpartnerinnen und Projektpartnern das Demonstrationsbauvorhaben Smart City Graz Waagner Biro erfolgreich beim ersten Smart City Demo Call der nationalen Förderschiene Klima und Energie Fonds eingreicht und von einer internationalen Jury zur Förderung empfohlen. In der Projekteinreichung wurde als Hauptziel des Projektes „...die innovative Umsetzung zum Erlangen eines zukunftsfähigen, lebenswerten und intelligenten Stadtteils mit geringstmöglichen Emissionen (Zero Emission als Ziel) und niedrigem Ressourcenverbrauch, der nicht nur nachhaltige Energien nutzt, sondern auch auf nachhaltige Mobilität und soziale Durchmischung abzielt..." angegeben.[2] Zur Zeit läuft erfolgreich die schrittweise Realisierung.

Keywords: smart City, smart Cityquartier, smart Urbanism, smarte formelle und informelle Planungsmethoden, smarter intergrativer Stadtplanungsprozess

2 SMARTE INTEGRIERTE STADTPLANUNG

2.1 Integrierte Stadtplanung

Im Rahmen des Projektes Smart City Graz Waagner Biro sollen neue Erkenntnisse und Modelle für integrierte und ganzheitliche Stadtplanungs- und -entwicklungsprozesse entwickelt werden, die auf weitere Stadtteile der Zielgebiete in Graz übertrag- und anwendbar sind. Im Zuge des Arbeitspaketes AP1 Smarte Stadtplanung wurde ein umfassender Stakeholderbeteiligungsprozess initiiert und der Aufbau einer stadtinternen interdisziplinären Expertengruppe mit Unterstützung ausgewählter Expertinnen und Experten der TU Graz und vom StadtLABOR Graz umgesetzt. In laufenden wöchentlichen Jour-Fixe-Terminen werden aktuelle Entwicklungen des Projektes interdisziplinär analysiert und notwendige Abstimmungen innerhalb der involvierten Planungsämter eingeleitet.

2.2 Formelle und informelle Instrumente

Im Zuge des Projektes stellte sich mehrfach heraus, dass die in Österreich geltenden formellen Instrumente der Raumplanung nicht ausreichend sind, um einen smarten Entwicklungsprozess eines Stadtteiles einzuleiten und zu steuern. Abbildung 1 zeigt das Zusammenspiel der in Zuge von Smart City Graz Waagner Biro angewandten formellen und informellen Planungsinstrumente. Klar ersichtlich ist, dass allein die Anzahl der angewandten informellen Instrumente die der formellen Instrumente übersteigt. Hervorzuheben ist, dass der strukturelle Dialog mit den Bewohnerinnen und Bewohnern vor Ort und den betroffenen Aktuerinnen und Akteuren bereits am Beginn des Projektes angewandt wurde. Um mit den betroffenen Grundbesitzerinnen und Grundbesitzern die stadträumlichen Zielvorstellungen abszustimmen zu können, wurde von der Stadtplanung Graz die Erstellung eins Rahmenplanes in Auftrag gegeben. Im Rahmenplan sind die möglichen Baufelder, die stadtbildverträgliche Dichte, der Zuschnitt des öffentlichen Raumes, die notwendigen Verkehrswege und Parkierungsflächen, Parkanlagen und Grünräume etc. zwischen den

[1] Kai-Uwe Hoffer, I Live Graz Team: I LIVE GRAZ smart people create their smart city. Graz, 2013
[2] Smart-Future-Graz-Team: Projektbeschreibung Einreichung, Smart City Project Graz Mitte. Graz, 2014

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Vertragspartnerinnen und Vertragspartnern (Stadtverwaltung Graz und Grundeigentümerinnen und Grundeigentümern) festgelegt.

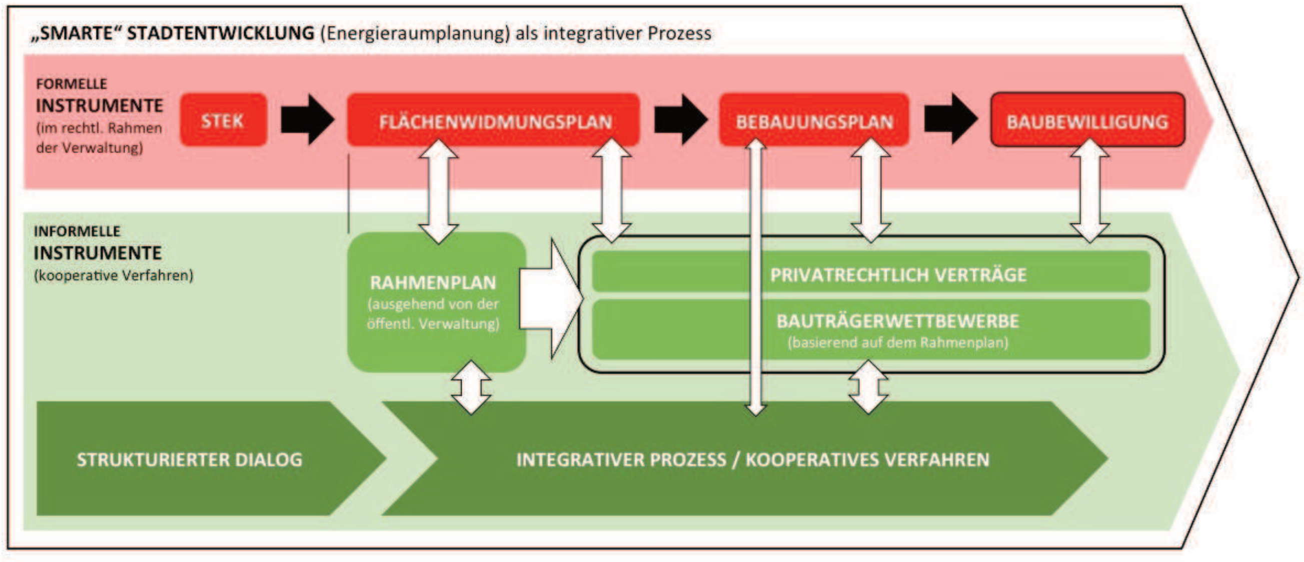

Abbildung 1: “Smarte Stadtentwicklung als integrativer Prozess”, Quelle: Ernst Rainer, Michael Malderle, Martin Grabner, 2016

Der Einsatz dieses informellen Instrumentes ermöglichte die stufenweise Ausschreibung eigenständiger Architektur- und Städtebauwettbewerbe für einzeln definierte Baufelder des Entwicklungsgebietes. Basierend auf den Ergebnissen des Rahmenplanes wurden Flächenwidmungspländerungsverfahren inklusive privatrechtlicher Vereinbarungen eingeleitet.

Hoheitsrechtlich können in der Stadt Graz Flächenwidmungspläne und Bebauungspläne mit jeweiliger Verordung erlassen werden. Die darin aufgeführten verordenbaren Parameter sind im Steiermärkischen Raumordnungsgesetz geregelt. So umfasst dies zum Beispiel auf Ebene des Flächenwidmungsplanes die Einteilung in Freiland, Bauland mit entsprechenden Bebauungsdichte-Ausweisungen und Verkehrsflächen und auf Ebene des Bebauungsplanes zum Beispiel Gebäudehöhen, Baukörperausrichtungen, Unterbringung von PKW´s, Zufahrten, Grünraumausstattung, usw. Darüber hinausführende Smart City Qualitäten wie Baukultur, soziale Nachhaltigkeit, Stadtteilmanagement, weiterführende Mobilitätsmaßnahmen (sanfte Mobilität), Energie oder Qualitäten von öffentlichkeitswirksamen Flächen können hoheitsrechtlich nicht geregelt werden. Um diese Lücke zu schließen und somit keinen Qualitätsverlust zu erleiden, bedient sich die Stadt Graz, wie bereits auch diverse Städte in Deutschland, dem Instrument städtebaulicher Verträge, die privatrechtlich zwischen den Eigentümerinnen und Eigentümern und der Stadt Graz abgeschlossen werden. Um möglichst durchgehende Qualitäten zu erreichen und die Komplexität so gut wie möglich zu erfassen, wurden die städtebaulichen Verträge in zwei Teilbereiche gegliedert:

- Verträge auf Ebene Flächenwidmungsplan (Grundsatzvereinbarungen)
- Verträge auf Ebene Bebauungspläne (Umsetzungsvereinbarungen)

Abbildung 2: Rahmenplan Smart City Graz Waagner Biro, Quelle: Stadt Graz / kleboth lindinger dollnig, 2013

2.3 Städtebauliche Verträge im Projekt Smart City Graz Waagner Biro

Ein besonderes Merkmal des Smart City Graz Stadtteilentwicklungsprojektes besteht darin, die Sicherstellung der erforderlichen Smart City Umsetzungsqualitäten schrittweise und entsprechend den Planungsphasen zu vereinbaren. Dadurch soll ein höchstmöglicher Realiserungsanteil von innovativen Smart City Maßnahmen erzielt werden. An dieser Stelle sei erwähnt, dass die Stadt Graz selbst auf diesem Stadtentwicklungsareal nur ein Grundstück (Schulcampus) besitzt, und alle anderen Grundstücke auschließlich im Besitz von privaten Grundeigentümerinnen und Grundeigentümern sind.

Bisher erfolgte Planungsschritte und Vereinbarungen:

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Editors: Manfred SCHRENK, Vasily V. POPOVICH, Peter ZEILE, Pietro ELISEI, Clemens BEYER

- Smart-City-Grundsatzvereinbarung Flächenwidmungsplan Änderungsverfahren Ostseite (11.2013)
- Smart-City-Grundsatzvereinbarung Flächenwidmungsplan Änderungsverfahren Westseite (11.2014)
- Smart-City-Umsetzungsvereinbarung Bebauungsplan Ostseite (12.2015)
- Smart-City-Umsetzungsvereinabrung Bebauungsplan Westseite (02.2016)

2.3.1 Grundsatzvereinbarungen im Zuge der Änderungsverfahren Flächenwidmungsplan

Im Zuge der Änderungsverfahren zum Flächenwidmungsplan wurden für die Ost- als auch Westseite zwischen der Stadt Graz und den Grundeigentümern folgende Regelungen vereinbart:

Regelung Smart-City-Investitionen

Die Grundeigentümerinnen und Grundeigentümerverpflichten sich einen finaziellen Beitrag zur Entwicklung und Umsetzung der erforderlichen nachhaltigen Energietechnologien und E-Mobilität zu leisten. Dies erfolgt in der Form und Höhe, dass bei Veräußerung von Grundflächen oder Teilfächen von dem über den Basiswert hinausreichenden Veräußerungserlös 50% in die zuvor genannten Bereiche investiert werden (Wertschöpfungsabgabe).

Planungs- und Umsetzungsqualitäten, Nutzungsdurchmischung

Im Zuge der Realiserung der Flächen sind auf Basis des Rahmenplanes und des Flächenwidmungsplanes verpflichtende Wettbewerbe (städtebauliche und baukünstlerische) in Abstimmung mit der Stadt Graz durchzuführen. Daraus abgleitet erfolgt dann die Erstellung der jeweiligen Bebauungspläne mit weiteren privatrechtlichen Vereinbarungen (Umsetzungsvereinbarungen).

Eine urbane Nutzungsdurchmischung mit den Funktionsbereichen Wohnen, Arbeiten, Handel, Dienstleistungen, sozialer Infrastruktur und Freizeitangeboten sind die wesentlichen Voraussetzungen für die Stadtteilentwicklung. Die Grundeigentümerinnen und Grundeigentümer haben sich verplichtet, eine urbane Nutzungsdurchmischung im Ausmaß von 60% Wohnnutzung (~87.000m² BGF), 20% Nicht-Wohnnutzung (Gewerbe, Büro, Handel, Dienstleistungen, Forschung, etc., ~30.000m² BGF) und 20% Nebenflächen (PKW Abstellplätze in Hochgaragen, Kellerersatzräume, etc., ~30.000m² BGF) zu erzielen.

Mobilitätsregelungen

Die Verkehrsregelung durch den motorisierten Individualverkehr (MIV) gilt als minimiert, wenn zwischen der Stadt Graz und den Grundeigentümerinnen und Grundeigentümern ein Mobilitätsvertrag mit Fördermaßnahmen für den Fuß- und Radverkehr, ÖV bzw. alternative Mobilitätsangebote (Car Sharing, Bike Sharing, E-Mobilität, etc.) sowie restriktive Maßnahmen wie reduzierter KFZ-Stellplatzschlüssel oder Parkraummangementmaßnahmen vertraglich vereinbart werden. Die detailierten Festlegungen dazu wurden in den Umsetzungsvereinbarungen auf Ebene der Bebauungspläne geregelt.

Grünraum und Verkehr, Grundabtretungen

Die Grundeigentümerinnen und Grundeigentümer haben sich verpflichtet, Infrastruktureinrichtungen für Grünraum (öffentlich zugängliche Parkanlagen, Wege, Bänke, Leuchten, Trinkbrunnen, Pflanzen, etc.) und Verkehr- bzw. Straßenanlagen (Errichtung und Ausbau von Kreuzungen, Erschließungsstraßen, etc.) nach Vorgaben der Stadt Graz auf eigene Kosten zu errichten und danach in das Eigentum der Stadt Graz zu übertragen. Die Vorgaben der Stadt werden durch den Wettbewerb Öffentlicher Raum definiert. Die Stadt Graz übernimmt dann für jene Flächen, die ins öffentliche Gut kommen die Erhaltung und Pflege.

2.3.2 Umsetzungsvereinbarungen im Zuge der Bebauungspläne

In Ergänzung zu den Grundsatzvereinbarungen wurden auf den Flächen des Projektgebietes detailierte Vereinbarungen im Zusammenhang mit den notwendigen Bebauungsplänen zwischen den Eigentümerinnen und Eigentümern und der Stadt Graz geschlossen.

Baukultur, öffentlicher Raum, Grünraum

Die Grundeigentümerinnen und Grundeigentümer verpflichten sich, die Umsetzung der städtebaulichen Schwerpunktsetzungen für das Projektgebiet auf Basis von Wettbewerben zu gestalten. So müssen unter anderem entsprechende Fassadengestaltungen entsprechend den Wettbewerbssiegerprojekten oder das Verwenden von nachhaltigen Baustoffen im Sinne der EU-Bauproduktverordnung garantiert werden.

Auch Regelungen bezüglich Erschließungsgänge und der nicht direkten Erreichbarkeit (50%) von Sammelgaragen aus Gründen der Chancengleichheit der Distanz zur nächstgelegen ÖV-Haltestelle sind Regelungsgegenstand dieses Bereiches. Für den öffentlichen Raum (Plätze, Parkanlagen, etc.) haben sich die Grundeigentümerinnen und Grundeigentümer bereits im Zuge der Grundsatzvereinbarung verpflichtet diese zu errichten und der Stadt Graz zu übergegeben. In der Umsetzungsvereinbarung wurde dieser Pflichtenpunkt weiter konkretisiert hinsichtlich Kostendeckelung, Oberflächengestaltungen und finanziellen Beiträgen zum Wettbewerbsverfahren für den öffentlichen Raum.

Ein weiterer Vertragspunkt in diesem Bereich waren Regelungen bezüglich Kinderspielplätzen, wo die Regelung unter anderem eine Mindestbreite von 8m definiert wurde, die nicht unterschritten werden darf.

Soziale Nachhaltigkeit, Stadtteilmangement

Die Grundeigentümerinnen und Grundeigentümer verpflichten sich, bedarfsgerechte Wohntypologien für Familien, Singles, Studierende, Modelle für Mehrgenerationen oder Wohngemeinschaften zu errichten. Dadruch soll ein möglichst hoher Grad an sozialer Durchmischung entstehen.

In den Erdgeschoßzonen, die von einer Wohnnutzung frei zu halten sind, verpflichten sich die Grundeigentümer einen Branchen- und Produktemix anzubieten. Die Stadt Graz beabsichtigt die Einrrichtung eines Mietfördermodells im neu enstehenden Stadtteil, um die urbane Nutzungsdurchmischung von Beginn an gewährleisten zu können.

Die Grundeigentümerinnen und Grundeigentümer haben sich auch zur Umsetzung von Gemeinschaftsräumen und Sozialräumen im Projektgebiet verpflichtet. So müssen etwa 4 Gemeinschaftsräume zu je mind. 100m² Grundrissgröße für die Bewohnerinnen und Bewohner im Quartier zur Verfügung gestellt werden. Diese Gemeinschaftsräume dienen ausschließlich der Benutzung durch die Bewohnerinnen und Bewohner vor Ort und stellen eine Aufwertung der Wohnungen dar und sollen zum Beispiel für Versammlungen, Freizeitgestaltung, handwerkliche oder künstlerische Betätigung, Sport, Wellness und dergleichen dienen. Damit auch stadtteilfremde Personengruppen, Vereine, etc. vor Ort die Möglichkeiten vorfinden, verpflichteten sich die Grundeigentümer einen Sozialraum im Ausmaß von 200m² zur Verfügung zu stellen. In dieser Geschäftsfläche (diese muss im Erdgeschoß situiert werden) ist zukünftig auch das Stadtteilmanagement beheimatet und übernimmt auch die Verwaltung/Bespielung des Sozialraumes.

Das Stadtteilmanagement wird neben der Stadt Graz durch die Grundeigentümerinnen und Grundeigentümern co-finanziert. Die zentralen Aufgabenbereiche des Stadtteilmanagements umfassen: Die Förderung einer gemeinsamen Stadtteilidentität, bewusstseinsbildende Maßnahmen (z.B.: Mobilitätsberatungen, Abfallvermeidungsberatungen, etc.), Organisation von Veranstaltungen und Beteiligungsformaten, Willkommens-Service für neue Bewohnerinnen und Bewohner und Nutzerinnen und Nutzer, Erdgeschoßzonenbelegungen, usw.

Mobilität

Neben den hoheitsrechtlich verordneten Aspekte wie Mindestanzahl an Fahrradabstellplätzen, Höchstzahl an PKW-Abstellplätzen und deren Unterbringung wurden über die privatrechtlichen Verträge vor allem jene Punkte geregelt die unter dem Begriff „sanfte Mobilität“ fallen. So haben sich die Grundeigentümerinnen und Grundeigentümer verpflichtet, eine Mindestanzahl an Fahrradserviceschränken und Servicestationen zu errichten. Darüber hinaus werden durch die Grundeigentümerinnen und Grundeigentümer auch zweimal jährlich Fahrradservicetage angeboten.

Die Lademöglichkeiten und die baulichen Vorraussetzungen von E-Mobiltät sind verpflichtend vorzubereiten. Diese Festlegung ist bis zur Ladeinfrastruktur genau geregelt. Im Stadtteil wird durch die Grundeigentümerinnen und Grundeigentümer auch eine Mindestanzahl an Car Sharing Fahrzeugen (mind. 9 Fahrzeuge) installiert. Ähnlich wie beim Car Sharing verpflichteten sich die Eigentümer auch zur Installierung eines Bike-Sharing-Systems, das in das bestehende Bike Sharing System der Stadt Graz eingebettet werden soll.

Weitere Maßnahmen im Mobilitätsbereich sind die Umsetzung von Taxistandorten und Leihwagenabstellplätzen. Durch eine Vielzahl an Angeboten soll die Multimodalität gewährleistet sein.

Die ÖV-Anbindung spielt für ein Stadtteilzentrum eine wichtige Rolle. Die Stadt Graz plant die Einbindung des Stadtteils in das Straßenbahnnetz der Stadt. Die Grundeigentümerinnen und Grundeigentümer

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verpflichten sich im Bereich des öffentlichen Verkehrs für Bewohnerinnen und Bewohner und Nutzerinnen und Nutzer im Stadtteil-Infofolder, Jahreskarten für den öffentlichen Verkehr (Erstbezug, Erstmieter/nutzerinnen und Erstmieter/nutzer) und elektronische Anzeigen (bei jeden Eingang) zur Verfügung zu stellen.

Auch die Ausführung von Paketboxen (eine je 1.000m² BGF Wohnnutzung) ist verpflichtend durchzuführen.

Sämtliche Mobiltätsmaßnahmen müssen einer Evaluierung zugeführt werden, wobei die Grundeigentümerinnen und Grundeigentümer dafür, der Stadt Graz Zugang zu den privaten Stellflächen und dergleichen ermöglichen.

Um auch zukünftige Mobiltätsangebote (die derzeit noch nicht marktreif oder entwickelt sind) schaffen zu können, wurde von der Stadt Graz ein Mobilitätsfond eingerichtet, in dem die Grundeigentümerinnen und Grundeigentümer einen Beitrag (je nach Realisierung m² BGF) einzahlen müssen.

Parkraum

Ein- und Ausgänge zu den gemeinsamen Sammelgaragen müssen auch direkt von allgemein zugäglichen Freiflächen erreichbar sein, d.h. über direkte Übergänge von Treppen, Verbindungsgängen, Liftanlagen dürfen nur maximal 50% aller oberirdischen Bruttogeschoßflächen für Wohnnutzung und Nicht-Wohnnutzung im Projektgebiet erreichbar sein.

Verkehr

Die Grundeigentümerinnen und Grundeigentümer verpflichten sich auf Grund der Leistungsfähigkeitsberechnung aus dem Mobilitätskonzept zu Umbauten von insgesamt 3 Kreuzungen. Sämtliche notwendige Verkehrsflächen, unter anderem auch für die zukünftige Straßenbahn, wurden von den Grundeigentümerinnen und Grundeigentümer an die Stadt Graz kostenfrei abgetreten.

Energie

Für Teile des Projektgebietes ist die Umsetzung eines „smarten" Energiekonzeptes geplant. Das Energiekonzept beruht auf einer nachhaltigen Energieversorgung (Heizwärme inklusive Warmwasser, sowie teilweise Kälte) auf Basis 100% erneuerbarer Energie. Eine Energiezentrale gewährleistet den effizienten, gebäudeübergreifenden Ausgleich zwischen lokaler Erzeugung und öffentlichen Energienetzen. Ziel des Geschäftsmodelles ist es, die Energielieferung bzw. Dienstleistungen zu marktüblichen Preisen zu ermöglichen.

Die Grundeigentümerinnen und Grundeigentümer verpflichten sich eine jährliche Abnahme (kWh/m²) Heizwärme inkl. Warmwasser für Wohn- bzw. gewerbliche Nutzungen gewährleisten zu können.

Aus der Wertschöpfungsabgabe, die bereits in der Grundsatzvereinbarung geregelt wurde, verpflichten sich die Eigentümerinnen und Eigentümer zur Mitfinanzierung der Energiezentrale.

3 QUALITÄTSKONTROLLE DURCH INDIKATOREN

Zur Planung und Steuerung von Entwicklungsstrategien und -prozessen in der Stadtentwicklung haben sich Indikatoren als ein hilfreiches Werkzeug erwiesen, um den Status quo und Planungsschritte besser beurteilen zu können, einen langfristigen Entwicklungsprozess zu evaluieren und Handlungsempfehlungen abgeben zu können. Die Indikatoren müssen zahlreiche Anforderungen allgemeiner und spezifischer Natur erfüllen, von ihrer Aussagekraft und Relevanz über die Praktikabilität und Flexibilität bis hin zur Übertragbarkeit.

3.1 Erstellung des Smart City Graz Indikatorensets für Quartiere/Stadtteile

Das Projekt Smart City Graz Waagner Biro beschäftigt sich mit der Entwicklung eines Stadtquartiers. Aufgrund bestehender Stadtstrukturen kann die Entwicklung in Richtung einer Smart City nur schrittweise erfolgen. Durch vergleichende Recherche von Stadtentwicklungsstrategien in den Vorreiterstädten Zürich, Basel, Freiburg in Breisgau, Kopenhagen, Malmö, Stockholm etc. wurde die Erkenntnis gewonnen, dass die dafür sinnvolle „Schrittgröße" das Stadtquartier darstellt.

Die meisten bestehenden Bewertungsschemata und Indikatorensets sind jedoch entweder für Gesamtstädte oder für einzelne Gebäude konzipiert und daher für den vorliegenden Anwendungsbereich nur in Teilen nutzbar. Im Rahmen von Smart City Graz Waagner Biro wird daher ein Indikatorenset entwickelt und angewandt, das geeignet ist den Entwicklungsprozess eines Smart City Quartiers von der Planung über die schrittweise Realisierung bis zur Nutzung zu begleiten. Die Erkenntnisse liefern wertvolle Grundlagen für vergleichbare Quartiersentwicklungen, dienen aber auch der Information und Sensibilisierung der Öffentlichkeit. Außerdem können sie als Planungs- und Entscheidungsgrundlage im laufenden Entwicklungsprozess genutzt werden.

Jede Stadt hat nicht nur andere Voraussetzungen, sondern setzt auch individuelle Schwerpunkte in ihrer Entwicklung, was verschiedene Fragestellungen an ein Indikatorenset zur Folge hat. Zur Erstellung des Smart City Graz Indikatorensets werden die Empfehlungen zur Vorgehensweise bei der Indikatorenentwicklung des Klima- und Energiefonds berücksichtigt, die 2015 im Smart City STANDARDS Bericht[3] veröffentlicht wurden. Vor der eigentlichen Arbeit an den Indikatoren müssen zunächst die Aufgaben des zu entwickelnden Indikatorensets definiert werden, die Themenbereiche und Schwerpunktsetzungen bestimmt werden. Die Indikatorenentwicklung selbst läuft in mehreren Phasen ab: Zuerst wird eine vorläufige Liste an Indikatoren erstellt, die dann auf ihre Brauchbarkeit, Relevanz und Verständlichkeit hin bewertet werden. In einem weiteren Schritt können Kern- und Wahlindikatoren festgelegt werden. Auf Basis externer Inputs wird in einem iterativen Prozess eine weitere Bewertung und Adaptierung vorgenommen, die dann zu einem finalen Set an Indikatoren führen.

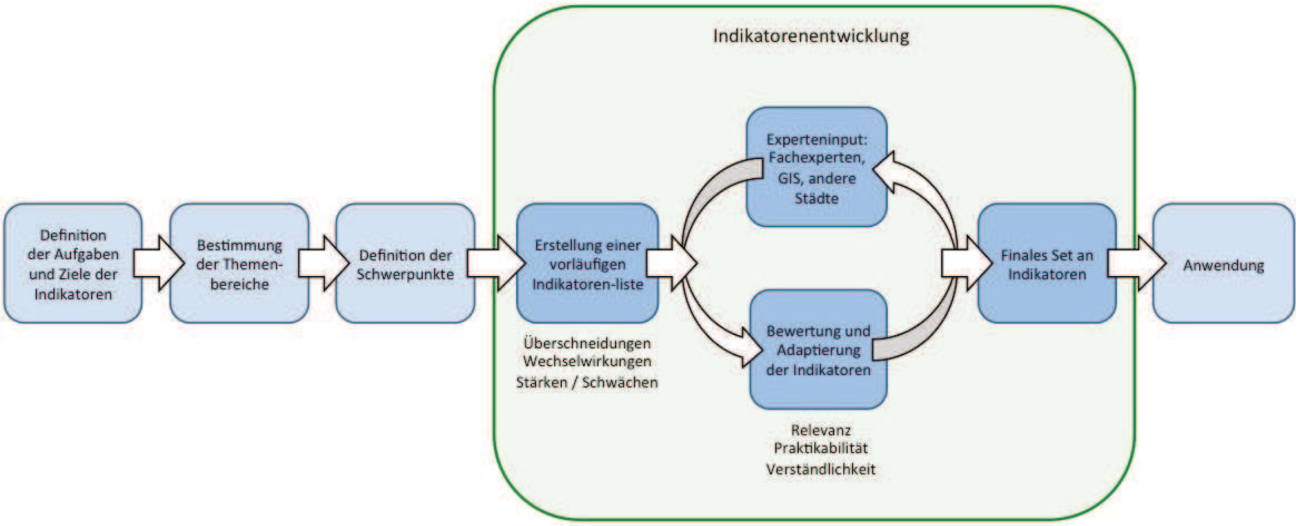

Abbildung 3: Prozess der Entwicklung der Smart-City-Graz-Indikatoren, Grafik: Martin Grabner, 2016

Während Stadtindikatoren (Indikatoren auf Gesamtstadtebene) oft aus statistischen Datenquellen (offizielle Dokumente, Statistiken, Studien) ermittelt werden, die bereits Vereinfachungen getroffen haben, spielen auf dem Maßstab der Quartiersentwicklung im Bereich der quantitativen Indikatoren verstärkt Flächenindikatoren eine wichtige Rolle, um räumliche Aspekte abbilden zu können. Für die Ermittlung von Flächenindikatoren werden mehrere Quellen herangezogen: Von der gesetzgebenden Seite der Katasterplan, der Flächenwidmungsplan und Bebauungspläne, aber auch je nach Stadium der Entwicklung Wettbewerbs- oder Einreichpläne, um Zugang zu detaillierteren Daten zu erlangen. Um die Ermittlung von Flächen-, aber auch zahlreichen statistischen Indikatoren zu systematisieren, wird eine enge Zusammenarbeit mit GIS-Experten angestrebt, um die Möglichkeiten der geodatenbasierten Werkzeuge auszuschöpfen und eine aufwandsminimierende Methodik der Datengewinnung zu entwickeln. Dazu ist eine Erhebung der auf GIS-Basis verfügbaren Daten ebenso erforderlich wie Überlegungen, welche Daten in verschiedenen Abteilungen der Stadt oder extern vorhandenen sind, aber noch nicht in ein GIS-System eingepflegt werden. Außerdem werden anhand der Fragestellungen an das Indikatorenset weitere Datenerhebungen und deren Einpflegung in GIS erforderlich sein. Diese gilt es sorgfältig zu erarbeiten und optimieren, um eine maximale Aussagekraft bei gleichzeitig minimalem Aufwand zu erzielen. Ein angestrebtes Ergebnis des vorliegenden Projekts sind deshalb Empfehlungen für ein optimiertes Set an Daten, die in Zukunft systematisch erhoben und in GIS eingepflegt werden sollten, um die formellen Planungsinstrumente um Aspekte der nachhaltigen Stadtentwicklung zu erweitern.

[3] Klima- und Energiefonds: Smart City STANDARDS, Teil 1: Nationale und internationale Indikatorensysteme, Wien, 2015

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Eine weitere Herausforderung stellt die methodisch gesicherte und gut messbare Darstellung qualitativer Faktoren dar, die mit zunehmender Betrachtungsnähe eine größere Bedeutung erhalten. Ziel ist es, die Anzahl qualitativer Indikatoren und damit den zur Ermittlung erforderlichen Expertenaufwand gering zu halten, ohne dadurch die qualitativen Aspekte zu vernachlässigen. Neben der Bewertung von Indikatoren durch Experten können hier Checklisten zum Einsatz kommen, um die Bewertung qualitativer Faktoren zu objektivieren.

3.2 Das Smart-City-Graz-Indikatorenset für Quartiere/Stadtteile

Die Struktur des Indikatorensets wurde von den – auf die Gesamtstadtebene bezogenen – Handlungsfeldern des Vorgänger-Projekts I LIVE GRAZ übernommen und adaptiert, da diese die Handlungsschwerpunkte der Stadt Graz bezüglich einer smarten Stadtentwicklung abbilden. Die wesentlichen Änderungen in der Struktur betreffen die Transformation des Themenfeldes Stadt zu Stadtstruktur und Stadtraum und die Aufteilung der Aspekte des Themenfeldes Gebäude auf die anderen Themenfelder sowie eine veränderte Reihung.

Handlungsfelder „I Live Graz“	**Handlungsfelder „Smart-City-Graz-Indikatoren“**
1. Ökonomie	1. Stadtstruktur und Stadtraum
2. Gesellschaft	2. Gesellschaft
3. Ökologie	3. Ökonomie
4. Mobilität	4. Ökologie
5. Energie	5. Mobilität
6. Versorgung/Entsorgung	6. Energie
7. Gebäude	7. Versorgung/Entsorgung
8. Stadt	

Im Rahmen von Smart City Graz Waagner Biro werden detaillierte Indikatoren für die Anwendung auf Stadtteilebene erarbeitet. Innerhalb der einzelnen Themenfeldern wird versucht, ein in mehreren Aspekten ausbalanciertes Set an Indikatoren zu erstellen. Es umfasst einerseits sowohl quantitative als auch qualitative Indikatoren, andererseits sowohl etablierte Meßgröße als auch neue, „innovative“ Indikatoren für eine nachhaltige Stadtteilentwicklung, die bisher in der traditionellen Stadtplanung noch keine Formalisierung erfahren haben.

Als Grundlage der entwickelten Indikatoren dienten neben der Erfahrung im laufenden Projekt die auf Gesamtstadtebene formulierten Indikatoren aus I LIVE GRAZ sowie eine Analyse bestehender Indikatorensets. Dazu wurden einerseits eine Analyse der Bewertungsschemata Smart Cities PROFILES, e5-Programm, Zertifizierung für 2000 Watt Quartiere, European Smart Cities Ranking und Urban Indicators Guideline in Smart City STANDARDS, andererseits Indikatorensets und Erfahrungen der Städte Zürich, Basel, Freiburg im Breisgau, Kopenhagen, Malmö, Stockholm, Almere, Bottrop und Hamburg herangezogen.

Durch einen vom Institut für Städtebau der TU Graz initiieren Erfahrungsaustausch mit dem international renommierten Stadtplanungsbüro Gehl Architects konnte insbesondere die Erarbeitung der Kriterien für den öffentlichen Raum positiv beeinflusst werden.

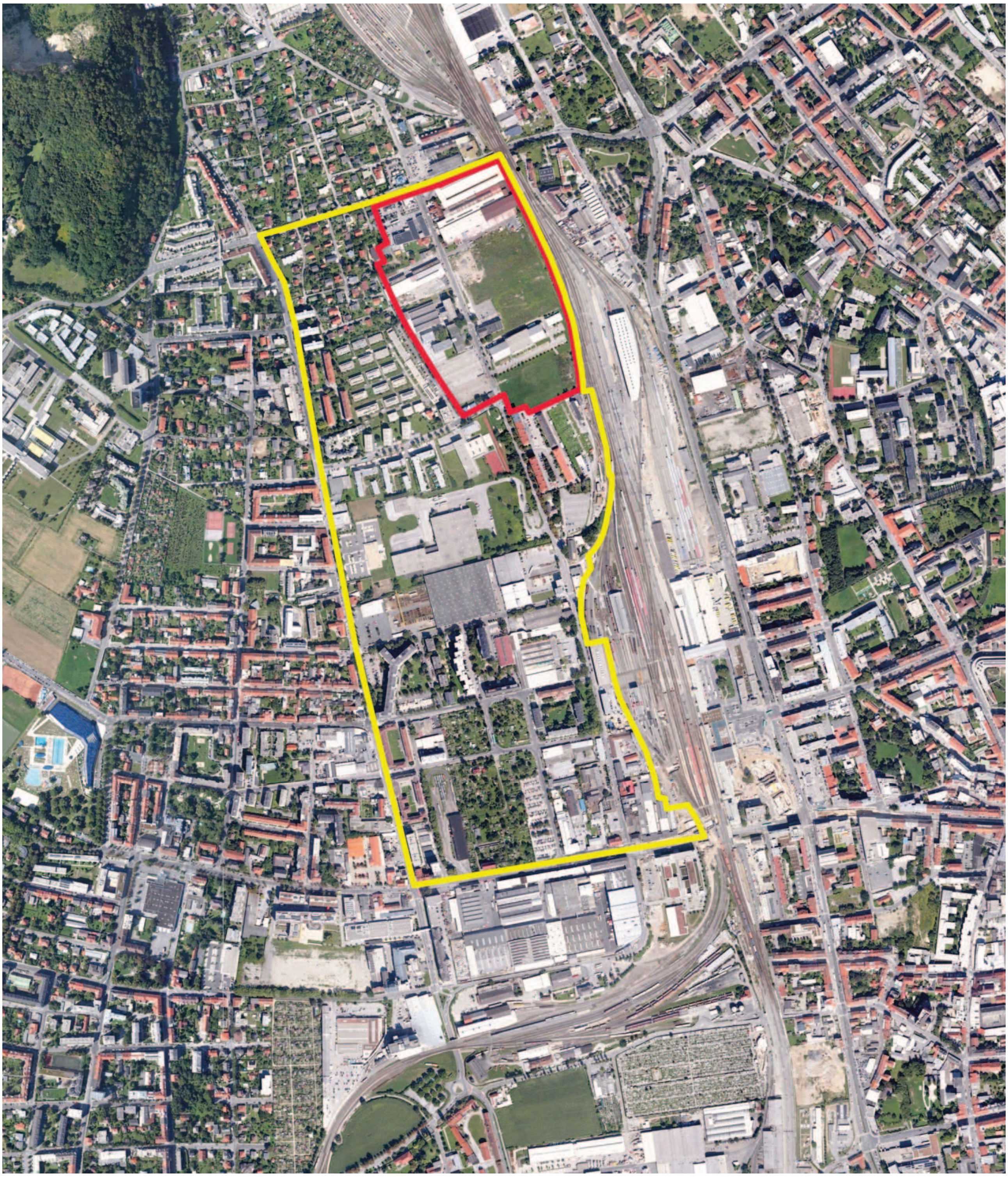

Abbildung 4: Das Stadtentwicklungsgebiet Smart City Graz Waagner Biro. Rot: Quartier, Gelb: Stadtteil. Grafik: Institut für Städtebau, TU Graz, Karte: Google 2013

In der Folge werden die Bewertungskriterien und einige der zugehörigen Indikatoren beschrieben um die Bandbreite des Indikatorensets aufgezeigt. Eine vollständige Auflistung der aktuellen Indikatoren würde den Umfang dieses Papers sprengen, weshalb exemplarisch jene Erwähnung finden, die besonders relevant sind oder einen hohen Innovationscharakter aufweisen, da sie in bisherigen Bewertungsschemata unbeachtet blieben.

3.2.1 Stadtstruktur und Stadtraum

Ein wesentliches Handlungsfeld sind die Stadtstruktur und der Stadtraum, sowohl aufgrund ihrer Wirkung als auch durch ihre Beeinflussbarkeit durch Maßnahmen im Einflussbereich der Stadt.

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Handlungsfeld 1	Stadtstruktur und Stadtraum
1.1	Dichte
1.2	Öffentlicher Raum (quantitativ)
1.3	Öffentlicher Raum (qualitativ)
1.4	Funktionen im öffentlichen Raum
1.5	Funktionale Durchmischung
1.6	Erdgeschoßzone
1.7	Flexibilität und Mehrfachnutzung
1.8	Grünraum und Parkanlagen
1.9	Durchwegung
1.10	Parzellierung

Die Dichte ist ein oft und unterschiedlich angewandtes Kriterium, weshalb mehrere Dichten in Betracht gezogen werden: die Bebauungsdichte und ergänzend der Bebauungsgrad, die Einwohnerdichte sowie die Nutzerdichte. Als Nutzer werden Bewohner, Beschäftigte und mit dem Faktor 0,5 die durchschnittliche Anzahl an Besuchern des Quartiers/Stadtteils definiert. Für die Bebauungsdichte ist außerdem der Unterschied zwischen der in den rechtlichen Planungsvorgaben (Bebauungsplan) vorgeschriebene Dichte sowie die tatsächlich errichtete Dichte ein interessanter Aspekt.

Der öffentliche Raum steht im Zentrum des Interesses, weswegen ihm viel Platz eingeräumt wird. In diesem Handlungsfeld findet die Arbeit des dänischen Stadtplaners Jan Gehl, die ein wesentlicher Ausgangspunkt der Forschung zum öffentlichen Raum am Institut für Städtebau ist, besonderen Niederschlag. Sowohl in der praktischen als auch der theoretischen Arbeit von Gehl[4] wird stets von der Perspektive des Menschen und seinen Aktivitäten ausgegangen, die unvermeidlich die Basis jedes nachhaltigen öffentlichen Raus darstellen.

Neben dem Anteil an der Gesamtfläche des Quartiers/Stadtteils und der zur Verfügung stehenden Fläche pro Nutzer werden der Flächenanteil unterschiedlicher Funktionen am öffentlichen Raum erhoben (Verkehrsfläche, Platzfläche, Grünraum), wie auch anhand einer Checkliste seine Attraktivität (Sitzgelegenheiten, Beschattung, Witterungstauglichkeit, Beleuchtung, Sicherheit, Soundscaping, Material- und Oberflächenqualität). Als öffentlicher Raum wird stets der öffentlich zugängliche Raum betrachtet, der schwerer zu messen ist als der Raum im öffentlichen Besitz (öffentliches Gut), aber der Realität deutlich näher kommt.

Ein Aspekt der bisher selten im Zusammenhang mit öffentlichem Raum beachtet wurde ist die Erdgeschoßzone der Bebauung, die jedoch wesentlichen Einfluss auf die Attraktivität und Nutzung des öffentlichen Raums hat. Relevante Indikatoren sind hier erst aus den Planungen oder der Bauaufnahme bestehender Gebäude zu erlangen: Der Anteil publikumsbezogener Nutzungen, die Dichte der Eingänge (Anzahl der Eingänge pro Fassadenlänge) und der Anteil der Flächen mit großer Raumhöhe (mehr als 4,5m lichte Höhe.

Grünraum wird sowohl im Handlungsfeld Gesellschaft als auch im Handlungsfeld Ökologie behandelt, wobei eine Unterscheidung zwischen sozial wirksamem Grünraum, der öffentlich zugänglich und nutzbar ist, und ökologisch wirksamem Grünraum (zu dem auch private Gärten zählen) getroffen wird.

Die Kleinteiligkeit der Bebauungs- und Erschließungsstruktur wird durch die Indikatoren Durchwegung (Maschenweite Fuß- und Radwege) und Parzellierung beschrieben, wobei hier zusätzlich zwischen der durchschnittlichen Grundstücksfläche und der durchschnittlichen Grundstücksfläche pro Eigentümer unterschieden wird.

3.2.2 Gesellschaft

Handlungsfeld 2	Gesellschaft
2.1	Wohnzufriedenheit
2.2	Soziale Durchmischung
2.3	Soziale Infrastruktur (Versorgungsgrad)
2.4	Barrierefreiheit
2.5	Flexibilität und Variabilität
2.6	Partizipation und Beteiligungsprozesse

Im Handlungsfeld Gesellschaft wird als ein zentrales Kriterium die soziale Durchmischung betrachtet und mittels mehrerer Indikatoren bewertet: dem Verhältnis von Eigentum und Miete, dem Anteil geförderten Wohnens, dem Anteil an Sonderwohnformen (z.B. betreutes Wohnen) und einer qualitativen Checkliste, die die Vielfalt von Grundrissgrößen und -gestaltung, Gemeinschaftsräume und -flächen, Sozialräume für Bewohner und für die Allgemeinheit beinhaltet.

[4] Jan Gehl: Cities for People. Washington, 2010

Neben dem Versorgungsgrad mit sozialer Infrastruktur sowie der Barrierefreiheit als weitere Standards wird auch Augenmerk auf die Flexibilität der Gebäude und Räume gelegt, um im Bedarfsfall mit relativ geringem Aufwand die Nutzungsmischung anpassen zu können (Gebäudestruktur, Raumhöhe, Erschließung).

Besondere Beachtung finden auch Beteiligungsprozesse vor und in der Planungsphase sowie die Möglichkeit zur Partizipation über Quartiersmanagement etc. Die Wohnzufriedenheit wird im Rahmen der Lebensqualitätsindikatoren seit 2005 in Vierjahresabstand durch die Stadt Graz erhoben.[5]

3.2.3 Ökonomie

Handlungsfeld 3	Ökonomie
3.1	Arbeitsplätze
3.2	Wirtschaftliche Dynamik
3.3	Nachhaltige und regionale Wirtschaft
3.4	Leerstand
3.5	Bodenwert

Neben der grundlegenden Erhebung der Anzahl der Arbeitsplätze wird die wirtschaftliche Dynamik anhand der Unternehmensgründungen und der Anzahl der Arbeitsplätze in innovativen Branchen bewertet.

Der durchschnittliche Kaufpreis sowie die Aufwertungsgewinne bilden im Punkt Bodenwert die monetäre Entwicklung eines Quartiers/Stadtteils ab.

Der Leerstand (sowohl gesamt als auch speziell in der Erdgeschoßzone) ist ein relevantes Kriterium im Handlungsfeld Ökonomie, jedoch ist dessen verlässliche Messung aufgrund ungenügender und uneinheitlicher Datenlage noch ein offener Aspekt.

3.2.4 Ökologie

Handlungsfeld 4	Ökologie
4.1	Versiegelung
4.2	Grünraum
4.3	Temperatur
4.4	Luftqualität
4.5	Wasser
4.6	Lärm
4.7	Nachhaltiges Bauen

Ein zentraler ökologischer Indikator in der Stadtentwicklung ist der Versiegelungsgrad, der gewichtet erhoben und um den Anteil an Wasserflächen erweitert wird.

Der Grünraum eines Quartiers/Stadtteils wird sowohl als Anteil an der Gesamtfläche erhoben, als auch bezogen auf die Nutzerzahl. Außerdem werden der Baumbestand (pro Nutzer), die relative Fläche begrünter Dächer sowie begrünte Fassaden einbezogen, die alle das Mikroklima positiv beeinflussen.

Unter dem Punkt Nachhaltiges Bauen werden die Berücksichtigung der Lebenszykluskosten, die Berücksichtigung der zur Errichtung eingesetzten grauen Energie sowie der Einsatz recycelter und kreislauffähiger Materialien bei der Errichtung von Gebäuden im Quartier/Stadtteil subsummiert.

3.2.5 Mobilität

Handlungsfeld 5	Mobilität
5.1	Modal Split
5.2	Nahmobilität / Stadt der kurzen Wege
5.3	Multimodalität
5.4	Fußgänger
5.5	Fahrradverkehr
5.6	Öffentlicher Verkehr
5.7	MIV und Parken
5.8	Anbindung an die Gesamtstadt

Im Themenfeld Mobilität wird ein klarer Fokus auf sanfte Mobilität gelegt. Das Kriterium Nahmobilität / Stadt der kurzen Wege beinhaltet als Indikatoren die für sanfte Mobilität nutzbare Fläche, die Maschenweite (Fuß- und Radwege) und die Erreichbarkeit/Chancengleichheit unterschiedlicher Mobilitätsträger (gemessen in der Entfernung zur Wohnungstüre).

Die Kriterien Fußgänger und Fahrradverkehr beinhalten als Indikatoren Frequenz, nutzbare Fläche, Netzlänge, Qualität, Sicherheit, Priorisierung sowie für den Fahrradverkehr mehrere Indikatoren zu der Verfügbarkeit und Qualität von Abstellplätzen.

[5] Stadt Graz/regionalis, SCAN, XENOS: LQI 2013 – Residenzielle Segregation. Vertiefende Analyse ausgewählter Teilräume, Graz 2014

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Multimodalität bewertet die Nähe zu multimodalen Knoten und deren Ausstattung sowie das Vorhandensein eines Mobilitätsträger-übergreifenden Informationssystems.

Das Kriterium Anbindung an die Gesamtstadt enthält qualitative Indikatoren zur Anbindung an das Stadtzentrum mit Fuß- und Radwegen bzw. den öffentlichen Verkehr sowie die Anbindung an die Mobilitätsnetze der Stadtregion.

3.2.6 Energie

Handlungsfeld 6	Energie
6.1	Energiebedarf
6.2	Energieerzeugung
6.3	Energieautarkie
6.4	Energiespeicherung
6.5	Energienetze
6.6	Gebäudegeometrie
6.7	Technischer Gebäudestandard
6.8	Bewusstseinsbildung

Im Handlungsfeld Energie wird neben dem Strom- und Wärmeverbrauch (Energiebedarf) auf quartier/stadtteilbezogene Indikatoren Wert gelegt: die lokale Erzeugung von Energie aus regenerierbaren Energieträgern, die Speicherkapazität im Quartier/Stadtteil und die Energienetze (Netzeffizienz: Anschlussdichte zu Gesamtnetzlänge). Die Energieautarkie des Stadtteils wird aus dem Verhältnis der lokal erzeugten und gespeicherten Energie zum Bedarf ermittelt.

Auf Gebäudeebene werden die Effizienz der Bebbauungsstruktur in Form des Oberflächen-Volumsverhältnisses, der Ausrichtung und thermischer Qualität der Grundrisse ebenso bewertet wie der technische Gebäudestandard.

3.2.7 Versorgung/Entsorgung

Handlungsfeld 7	Versorgung/Entsorgung
7.1	Wasserversorgung
7.2	Abfallmanagement
7.3	Nahrungsmittelproduktion
7.4	Netz- und Leitungsinfrastruktur
7.5	IT-Infrastruktur

Neben Standards wie der Wasserversorgung und dem Abfallmanagement (inklusive Recycling) werden innovative Indikatoren wie die großflächige und kleinteilige Nahrungsmittelproduktion im Quartier/Stadtteil und die IT-Infrastruktur berücksichtigt.

Das Indikatorenset für die Smart City Graz Indikatoren befindet sich aktuell in der Phase der Adaptierung und Optimierung in Abstimmung mit GIS-Experten bezüglich einer möglichst effektiven Nutzung der GIS-Schnittstelle und die Einarbeitung von Inputs internationaler Experten.

Neben dem vollständigen Indikatorenset für ein langfristiges Monitoring und die Evaluierung der Quartier/Stadtteilentwicklung wird ein geeignetes Subset an Indikatoren für den Zeitraum vor der baulichen Realisierung erstellt, mit dem die aktuelle Situation im Entwicklungsgebiet Smart City Graz Waagner Biro bis zum Ende des Projektes durchlaufenen Planungsphasen (Rahmenplan, Bebauungsplan, Planungen der einzelnen Projektbausteine) evaluiert werden können.

4 SCHLUSSFOLGERUNGEN UND AUSBLICK

Die inhaltlichen Zielsetzungen der Umsetzungsvereinbarungen sind zu einem guten Teil korrspondierend mit der Indikatorenentwicklung im Smart City Projekt. Es sind jedoch nicht alle bisher entwickelten Indikatoren in den zuvor angeführten städtebaulichen Verträgen manifestiert. Die Gründe liegen einerseits darin, dass sich einige Parameter noch in der Erkundungsphase befinden und es derzeit keine Möglichkeiten (Datenlage, etc.) gibt, diese sinnvoll zu integrieren und anwendbar zu machen. In den Bereichen Ökonomie (Wertschöpfungsabgabe, Mietfördermodell, etc.), Ökologie (Freiflächenausstattung, Maschenweite Parkanlagen, etc.), Mobilität (Fuß- und Radverkehr) und Energie sind einzelne Indikatoren bzw. Kennwerte integriert, die auch zukünftig einer Evaluierung unterzogen werden können. Gerade im Bereich der Indikatorensets Gesellschaft aber auch Stadtstruktur und Stadtraum sind viele erarbeitetet Indikatoren noch nicht ohne größeren Aufwand umsetzbar und messbar. Wichtige Kennwerte sind oftmals auch qualitativen Merkmalen ausgesetzt, die gerade im urbanen Raum einen gut überlegten Prozess im Vorfeld der Einsetzbarkeit benötigen.

Im Zuge der Entwicklung der Indiaktoren ist auch die Sinnhaftigkeit der Vergleichbarkeit mit anderen Städten oder Stadtteilteilen diskutiert worden. Einige Kennwerte können für den einen Stadtteil gut geeignet sein, für einen anderen Stadtteil (oftmals völlig unterschiedliche geographische, soziale oder kulturelle Vorraussetzungen) aber völlig ungeeignet sein. Die Ergebnisse von Indikatoren-basierten Bewertungen sind immer kontextsensitiv und Schlussfolgerungen, insbesondere auch der Vergleich von Stadtquartieren oder -teilen, immer im jeweiligen geografischen, räumlichen, ökonomischen, sozialen und kulturellen Zusammenhang zu betrachten.

Indikatoren zur Bewertung und Evaluierung von Quartier/Stadtteilentwicklungen sind ein langfristig angelegtes Instrument. Die Erhebung muss abhängig von der Größe des betrachteten Gebiets über mehrere Jahre erfolgen. Auch die Schwerpunktsetzung hat eine Auswirkung auf den erforderlichen Evaluierungszeitraum: Wird außschließlich auf bauliche Faktoren abgezielt, genügt eine kürzere Zeitspanne, wenn soziale Aspekte im Vordergrund stehen ist eine längere Beobachtung erforderlich. Eine aussagekräftige Überprüfung der Nutungsintensität des öffentlichen Raumes kann nur durch tatsächliche Evaluierung Vorort und in zeitlicher Abfolge innherhalb mehrer Jahre erfolgen.

Die Einbettung der Indikatoren in einen umfassenden Stadtenwicklungsprozess ist ein wesentlicher Faktor. Die eigenständige Entwicklung von Kriterien und Indikatoren führt zur Erlangung maßgeschneiderter Erkentnisse. Im Rahmen des Entwicklungsprozesses können Stadtentwicklungsprozesse nachweislich optimiert werden. Im Vordergrund sollte jedoch nicht die sture Anwendung der Meßergebnisse sondern die Optimierung des Stadtquartieres stehen. Im Fokus der Bemühungen muss die Steigerung der urbanen Lebensqualität der Menschen liegen.

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EmoCyclingConcept – Smart and Safe Mobility – Workshop

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1 ABSTRACT

Safety is one of the most important goods we have these days. When it comes to traffic in our cities and the interactions between the different traffic participants it is especially the everyday cyclist whose need for safety is crucial. How can you measure a good feeling or perceived safety? One possibility is to do a survey for some specific routes through the cities. To get more detailed results you invert the idea of safety. You measure unsafety by collecting negative emotional experiences while cycling. But how is this done?

The Department of Computer Aided Design in Urban Planning and Architecture (CPE) from the University of Kaiserslautern has dealt with this method for more than 5 years. Meanwhile we collected data in the context of accessibility of pedestrians (Bergner, et al. 2011) as well as cyclists (Buschlinger, et al. 2013) in different countries and with a variety of cooperations. Within the latest DFG-project "Urban Emotions", over 75 cyclists have been measured. For this method, three different instruments are used:

The main instrument is the "Smartband" (www.bodymonitor.de). It measures the galvanic skin response as well as the skin temperature to analyse the body signals. There is a special relation between psychological arousal and physiological reactions like the skin conductance and the temperature (Kreibig 2010). If you recognize this unique pattern, in which the level of skin conductance rises and the skin temperature decreases 3 seconds later, it can be interpreted as a "negative arousal" (Bergner et al. 2011). The body data is located with a GPS-tracker. For further analysis a GoPro records the trip. With the help of this setup, it is possible to identify severe problems (Rittel 1973), on which urban planners should react by trying to eliminate them.

The project should be understood as a work for progressing research, dealing with the optimization of the method by testing in use cases.

Keywords: Bicycle Traffic Planning, Human Sensing, Mobility and Safety, Urban Emotions, Workshop

2 STATE OF RESEARCH

The EmoCyclingConcept can be assigned to spatial sensing. We try to figure out how citizens respond to the environment. Therefore we use sensors and the people themselves also act as sensors. Spatial sensing therefore becomes human sensing. Similar experiments have already been done by Michael Goodchild with his "Citizens as Sensors" (Goodchild 2007) or Nolds' EmotionalCartography (Nold 2009). Compared to technical sensors the human being has some advantages. With the five senses of awareness (visual, aurally, olfactory, gustatory, haptic) and the context-intelligence, which enables to filter spatial phenomenons, makes the human being an optimal sensor for the environment (Zeile 2010; Exner 2013, 67 acc. to Sheth 2009, 89). Because of the focus on geo-located arousal or emotion we call it "EmoMapping". Measuring emotions with sensor devices, like it is done in the Urban Emotions approach (Zeile et al 2015, Resch et al. 2015, Dörrzapf et al. 2015) focuses on the following four basic emotions: anger, fear, sadness and joy. According to psychophysiological researchers and a review of different methods of detecting stress (Kreibig 2010), the EmoCyclingConcept focuses on "negative stress", which is described as a combination of anger and fear (Kreibig 2010).

Based on the experiences of former projects like "Ein emotionales Kiezportrait", "Emomap Mannheim" (Zeile 2010), "EmBaGIS" (Bergner 2010) or "EmoCycling" (Buschlinger, et al. 2013), the "EmoCyclingConcept" (Groß 2015) measured a higher amount of participants to get more reliable results. Furthermore it tried to represent the average society by recruiting people between the age of 15 and 85. In this latest work of research 75 cyclists were measured on a 2.4 km track. The circuit was predetermined and fixed. There was no opportunity of a free-ride, because all the test riders should be measured in comparable traffic situations. For this, different scenarios were developed: A variety of intersections (with or without traffic lights), roundabouts and cycling paths were chosen. This should build a database so that first statements could be deduced on how far environmental factors act together and lead to stress or how far the subjective safety coincide to objective safety.

Before measuring, the track was analysed for expectable critical spots and their possible reasons. In addition to that, every participant had to mark his own expected stress scenes before his ride. Everybody attended the track wearing the three instruments (cf. section "Workshop Setup"). Afterwards they had to repeat the survey, in regard to where they thought or felt that they were stressed. The results were three different evaluations of every cyclist:

- the subjective expectation
- the subjective awareness
- the measurement by instruments

These three steps enable the opportunity to gain some knowledge about the subjectively perceived safety and the objective safety. Further every single scenario with a measured arousal was analysed with the help of the videos.

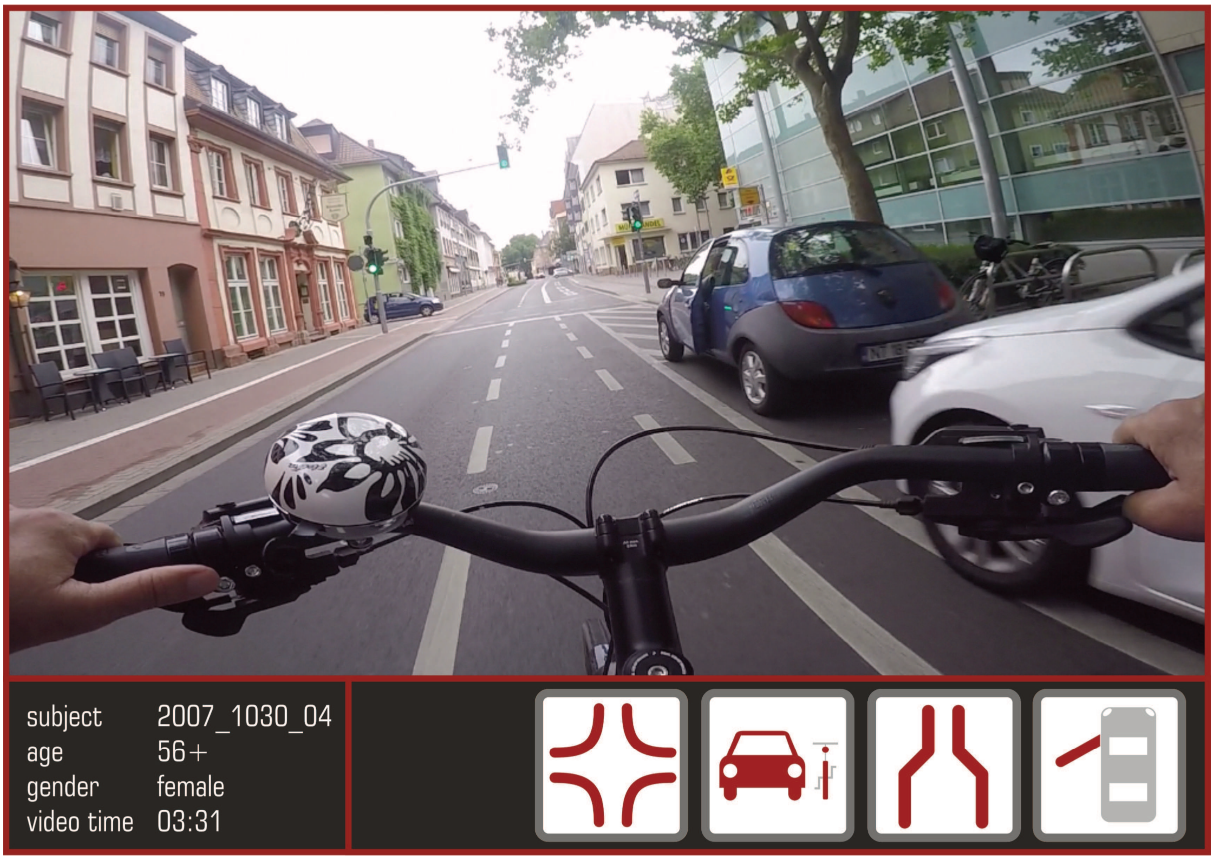

Fig. 1: Complex of triggers in a dooring-scene

This introduces the second aspect of this project. The planners have to understand the reasons of the citizens' emotions. Only when they know why people are afraid in specific situations, they can handle it with adequate measures. To get first hints of neuralgic points a first quantitative analysis is useful. For specific scenes a qualitative analysis is necessary. Therefore every spot, where the sensors showed an arousal was analysed with video (Fig. 1). The reasons were categorized based on the effects of stress. You can distinguish between three main categories with 13 triggers:

Horizontal effects (Fig. 2) occur in level. These triggers include intersections, threading, curves, surface (nature), obstacles and constrictions.

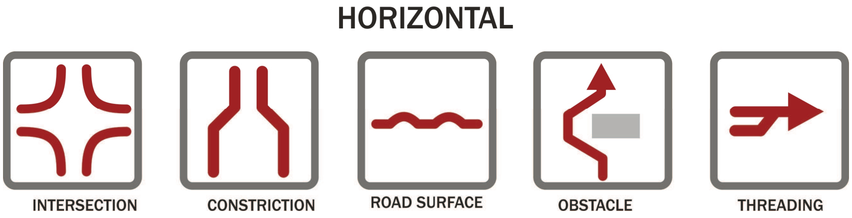

Fig. 2: Horizontal effects

Vertical effects (Fig. 3) describe all triggers which appear in the third dimension. These are negative or positive gradient as well as curb side.

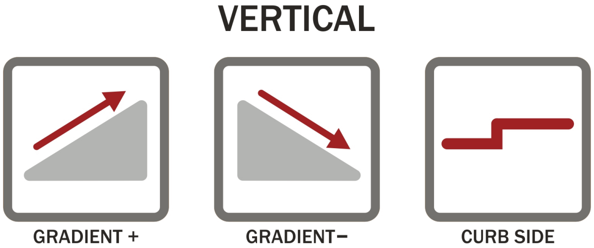

Fig. 3: Vertical effects

Anthropogenic effects (Fig. 4) do not have any three-dimensional aspect but anthropogenic causes like oncoming traffic, dooring, pedestrians or overtaking.

Fig. 4: Anthropogenic effects

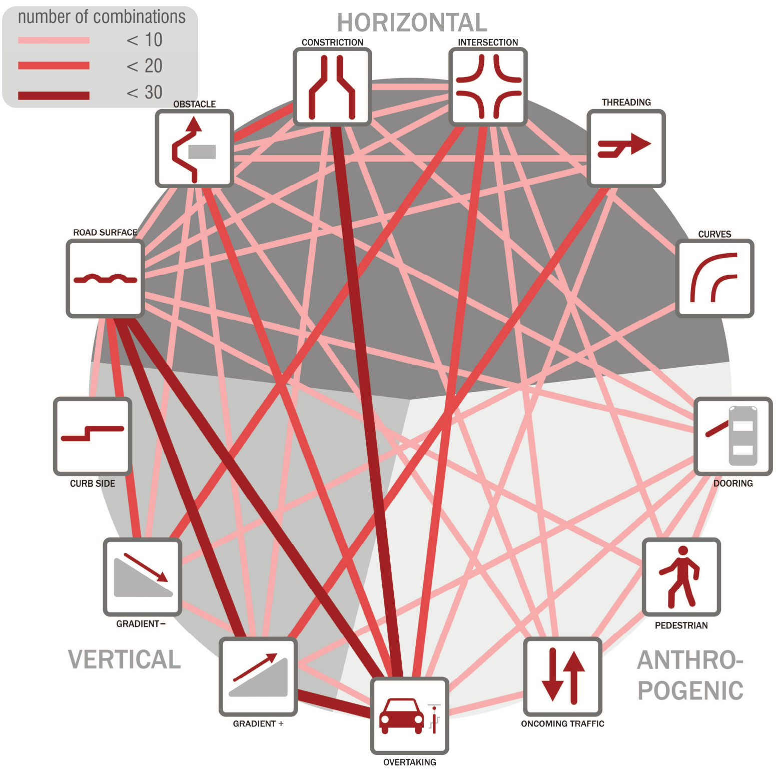

Fig. 5: Complexes of effects (dataset of Usecase “Worms”)

Especially the EmoCyclingConcept has to be understood as a part of new cycling concepts for cities. The analysis of the triggers builds the base of measures. The following graphic (Fig. 5) shows how often the triggers are connected to each other. They never appear alone. Only several trigger in combination lead to

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arousal. In the Usecase the following three were the most occurring triggers: positive gradient, bad road surface and overtaking traffic. Every third moment of stress contained at least one of these three triggers. There are some simple reasons why. A positive gradient and bad surface lead to a lower speed, which is a reason for instability and unsafety. Overtaking cars are too close in many cases, because other vehicles do not keep the prescribed distance of 1.50m. From those three triggers you can derive essential measures. When it comes to planning cycle-friendly routes, planners should avoid distinctive topography if possible. Bad road surfaces, especially at the edge of the roadway should be repaired. The number of close overtaking can be avoided by wider bike lanes or a reduction of the speed limit.

Beyond this some further hypotheses could be formulated:

- Participants under the age of 40 have less moments of stress than those over 40 years.
- There is no significant difference between male or female cyclists.
- The expectation of negative emotional happenings is higher than the real amount of experienced moments.
- The method identifies 95% of experienced moments.
- Even not experienced scenes can be identified with the help of video analysis.

The Usecase has shown that even without video analysis the quantitative analysis enables an adequate localisation of critical points (Fig. 6). By verifying with the help of the video and the qualitative analysis the triggers become clearly recognizable. Linked to the spatial context specific patterns appear. Due to the survey of expectation and experience compared to the measured results it could be proven in the approach that the subjective awareness can be recorded with physiological parameters like skin conductance and temperature.

3 WORKSHOP DESCRIPTION

In this workshop, participants will have the opportunity to measure their own stress while cycling through the streets of Hamburg with the equipment. The ride lasts about 20 minutes. After collecting the data on the first day, the datasets will be evaluated directly so that the results can be visualised (Fig. 6) and discussed the following days in a larger group of people. Each set will take about thirty minutes if everything goes as planned. If you are interested in how the datasets are analysed, we will explain it to you as well. Due to the manual effort to analyse the datasets the workshop is limited to 10 participants. Rental bikes are provided by the city of Hamburg.

Fig. 6: Density of stress from 48 bicyclists showing critical spots (Heatmap)

4 WORKSHOP SETUP

Every test person will wear the three mentioned instruments (Fig. 7), which are explained more detailed in the following:

The first one is the "Smartband" which is worn around the left wrist. The connection to the skin is guaranteed by two electrodes. Via skin the galvanic skin response and the temperature is measured. These two key parameters enable the later analysis of the psycho-physiological context. After knowing if there was stress for the bicyclist, it is important to know where it happened.

To be able to locate retrospectively where the stress occurred, everyone is equipped with a GPS-tracker. Therefore the person wears the "i Blue 747" by "Transsystems". The device records coordinates, acceleration and three-axial-movement every second.

As third instrument, a camera is fixed to the chest, helmet or bicycle. The videos can help in the following analysis to identify the trigger of stress. These occur in multiple ways and can be found in overtaking cars, doors being opened as well as a bad road surface or intersections.

Fig. 7: Used devices 1. GoPro, 2. i Blue 747, 3. Smartband

5 ESTIMATED RESULTS

This workshop should generate further knowledge of the emotional experience of people which are not familiar with the local situation. Because of the small sample statistical reliable results cannot be developed. It is a test run, to discover if the presented set-up is already suitable for an on-site experiment with a fast generated result. The downside of the presented approach in former times was the fact that the analysis of the collected data took too much time due to the need of manually post processing procedures. The results of the workshop, pictures and inside experiences from the experiment and also from the discussion during our live experience / experiment will be published on our Urban Emotion Blog under http://urban-emotions.ru.uni-kl.de/ .

We hope to get some results of the process. Not only of pathfinding in an unknown city, but also how the process of renting a bike with rental systems effects the choice in transportation system and we also hope to gain some insights of the test area, where potential danger spots could be located, areas of not feeling safe or, in a more positive view: where are the nice spots for a bike ride in Hamburg?

6 DISCUSSION

As already mentioned in former chapters the method of emotional mapping itself works. The main problems are technical aspects. For an autonomous use by citizens the processing and evaluation of data has to be optimized. At this state it is too time-consuming when it comes to the synchronization of the devices as well as the manual processing and correcting. The used GPS-trackers do not record with a reliable accuracy which leads to temporal deviations up to 50 meters. This also has to be corrected manually. The handling of the different devices is complicated and needs an admission to the test persons.

The handling can be optimized by merging the two devices: the Smartband and the GPS-tracker. An application which creates a single file collected i.e. by smartphone (GPS) and fitness-tracker (body data) would be another possibility. Furthermore algorithms should be able to correct occurring artefacts automatically. The accuracy of GPS-signals can be increased by methods of signal-filtering.

Beside the method of measuring the galvanic skin response for psycho-physiological reactions there is another method which is rather common in medical research. The cardio-vascular measuring can be an addition or verification. But both methods have to be researched.

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7 OUTLOOK

On the long run the "EmoCyclingConcept" should not just stay a temporal instrument for cycling concepts. It should be established as a subversive instrument for citizens in modern urban planning (Streich 2014). With new technologies like smartphones as well as fitness trackers people will be able to track their data autonomously. It offers the possibility to detect infrastructural grievance by bottom up process. The concept can raise awareness towards local politicians and planners concerning the importance of an adequate bike infrastructure. The more cyclists use this concept the larger the network of measured streets becomes to a coverage mapping at all times. The role of the planner will be to analyse the critical spots according to the contexts of environmental effects.

Latest projects are dealing with the automation of evaluation aiming for real time results. Technical developments of our modern society which make self-tracking possible and easier can support the progress of this method.

8 ACKNOWLEDGEMENT

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Enriching the 3D City Model for the Simulation of Urban Heat Demand

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1 ABSTRACT

In this paper we describe the process of enriching the Hamburg 3D City model (3D-Stadtmodell) with energy relevant attributes for the simulation of heat demand. The 3D data of the city provided by the Landesbetrieb Geoinformation und Vermessung (LGV) is a combination of Cadastre footprints and LiDAR data. This combination of data allows the LGV to produce CityGML data with a level of detail 1 (LOD1). We use this data as basis for the computation of urban heat demand.

This paper presents the enrichment process of the CityGML data. We make use of the energy application domain extension (ADE) to store the energy relevant data in a standardized format. For the enrichment process we classify the residential building stock into building types. And classify the non residential sector by use. From the building types we extract heat transmission coefficients of building components. With the enriched 3D city model we perform a monthly heat demand estimation of a selected neighbourhood in Hamburg.

The aim of this enrichment process is to create a robust but flexible method for the estimation of heat demand at a neighbourhood level with little energy relevant information. This paper presents a method for a quick estimation of the monthly heat demand of a neighbourhood without the need of any extra data input. This approach can be used by the energy and urban planning community for a first estimation of the heat demand used on a given neighbourhood or the entire city.

The results from this approach present an urban heat demand model for the city of Hamburg based on the freely available 3D city model data. Possible uses of this approach are: (1) identification of hot spots in the city, (2) creation of base data sets for the simulation of retrofit scenarios, and (3) creation of temporal heat density maps.

Keywords: 3D Cadastre, CityGML, Energy ADE, Heat Transmission, Urban Heat Demand

2 INTRODUCTION

On this paper we present a small program for the enriching of the 3D city model of the city of Hamburg. We develop a python command line interpreter that is able to:

(1) download CityGML data from different locations;

(2) process the data and retrieve relevant information;

(3) save the data as different data formats, including CityGML with Energy ADE relevant attributes; and

(4) compute heat demand for the residential and non residential sector

The main idea of the command line interpreter is to create a simple set of python scripts to process geo-spatial data for the computation of heat demand. This process is scripted on small text files for documentation purpose and for the processing of large data-sets.

The enrichment of process is a simple read and write procedure. In between the data input and data output we define a set of templates for the construction of CityGML files. The definition of templates for the storage of data is exclusive for the CityGML data files. Other common data formats do not need a predefined template to be used. The developed tool makes use of the fiona[1] python library for the read-write of spatial data. This library can read and write all OGR Vector Formats[2].

[1] https://pypi.python.org/pypi/Fiona/0.8
[2] http://www.gdal.org/ogr_formats.html

3 METHOD

In this section of the paper we briefly describe the underlying method of the presented tool. One of the most important methods used in the tool is the use of templates for the creation of CityGML files. This approach has the advantage of been very flexible because the files are created only based on the predefine templates. The disadvantage of this method is that the tool is not aware of errors implemented in the template. The tool provides a link to the xmllint[3] XML files validator.

Internally the tool will populate a template with predefine variables retrieved from either the downloaded data of from other sources joint to the data. For the example presented on this paper we define 3 templates:

(1) A header template, containing the header information of the xml file including all the namespace definitions;

(2) Some lines describing the generated file, including the bounding box of the geometry features; and

(3) A template describing a building element;

Both the header and the file definition template are used a single time. The building template is used for each processed building on the data-set. In order to start populating the xml file with the processes templates the tool needs to process the entire data set. This is required in order to compute the bounding box of the file. Within the developed tool all the information required to populate the xml file is stored on a GeoPandas[4] DataFrame.

One of the motivations to use a template system is its ability to adapt to new schemas without much effort. In this case we construct the templates based on the EnergyADE schema (Nouvel, Bahu, et al., 2015, Nouvel, Kaden, et al., 2015).

3.1 Defining CityGML Data Structures Through Templates

The use of templates for the construction of xml files is extremely straightforward. The first step is to create some pieces of xml code with pre define variables on them. These pieces of code can be arbitrarily defined decoupling so the development of the tool to any development of CityGML schema of any other xml schema.

Listing 1 shows an extract of the building template. On this template we define a singe variable: $sqm. The value of this variable will be populated by the computed heated floor area by the tool. In this case we leave the uom variable with our preset default m2. Each template can have as many variables defined as needed. In the case of Listing 2 we define five variables. In this case we populate this template with the computed heat demand of each building. Because the tool computes both monthly and yearly heat demands the unit of measure (uom) and the time interval unit have to be defined as variables as well.

```
<!-- Energy heated area -->
<energy:floorArea>
    <energy:FloorArea>
        <energy:type>EnergyReferenceArea</energy:type>
        <energy:value uom="m2">$sqm</energy:value>
    </energy:FloorArea>
</energy:floorArea>
```

Listing 1: Template for energy heated area.

3.2 Scripting the Enrichment Process

The tool is developed as a command line interpreter. This means that the tool can be used on the command line of we can run a script with it. We see a huge advantage of using a command line interpreter for this task rather than a GUI interface. The most important advantage is, developing time, without a GUI the tool is very light, easy to maintain and has a quick development cycle. But probably the mos important advantage of a command line interpreter is the ability to store the performed analysis on a script. Defining an analysis on a scrip can also be useful for the processing of large data sets.

[3] http://infohost.nmt.edu/tcc/help/xml/lint.html
[4] http://geopandas.org/

Listing 3 shows the script used to estimate the heat demand of the urban area presented on this paper. Available commands for the command line interpreter are still limited and many of the options are still embedded on the code as default values. The example presented on Listing 3 shows the simplest process to compute heat demand for an urban area using the default values of the tool.

Code line 2 defines the data set to use, if the data set is not available on disk, the tool will attempt to download it from a pre defined source. The information needed to perform this operation is stores a json file containing relevant information on available data sets. For now the tool has a limited understanding on how to access external data. The basic definition of data locations is for now just the download link and a list of default attributes available on this data set. We aim to expand this by defining more complex connections to external data sets like databases.

```
<!-- Computed energy demand -->
<energy:energyDemands>
    <energy:EnergyDemand>
        <energy:endUse>SpaceHeating</energy:endUse>
        <energy:energyAmount>
            <energy:RegularTimeSeries>
                <energy:id>$heatid</energy:id>
                <energy:temporalExtent>TMY</energy:temporalExtent>
                <energy:timeInterval unit="$timeintervalunit">
                    $timeinterval
                </energy:timeInterval>
                <energy:values uom="$uom">
                    $heatdemand
                </energy:values>
            </energy:RegularTimeSeries>
        </energy:energyAmount>
    </energy:EnergyDemand>
</energy:energyDemands>
```

Listing 2: Template for computed heat demand

Code line 4 deletes the attribute list retrieved from the configuration file. We delete this list because we do not want to keep all the attributes. On the next line we add three attributes to be used for the computation of heat demand. The data set define on code line 2 contains all the buildings for the city of Hamburg. We do not want to compute the heat demand for the entire building stock but just for a small urban area. We define this urban area as a bbox_clip. This bounding box can be define with an upper left and a lower right coordinates or with a spatial file. In this case we use a precomputed GeoJSON file to define the simulation area.

The tool has a small option to enrich the input data through the use of data store on csv files. In this case we input a csv file called bja.csv located on the path data relative to where the command line interpreted is run. The default options assumes that the file contains headers and use them to identify the variables store on the file. We make use of the headers name to filter them. In this case we join three attributes to the input data set. On code line 13 we can see that we enrich the dataset with construction years bja and building type baw. The join of both datasets is performed on the index. The index of the city 3D data is taken from the xml files and the index for the csv file is define on the first column. It is important to have the same index on both datasets, otherwise a join will fail.

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```
1 #download input data by name
2 download hamburg
3 #prepare the attributes to use
4 delete_attribute all
5 add_attribute function measuredHeight storeysAboveGround
6 #clip the geometry with a geo-json file
7 add_bbox_clip data/output/2016-02-16T04:26:22.145116-clip.json
8 #get the geometry of the buildings within the specified area
9 get_geometry all
10 #keep only objects within the simulation area
11 clip all
12 #join some data stored on a csv file by index
13 join data/bja.csv bja baw
14 #simplify the building geometry
15 simplify all
16 #compute yearly heat demand with a static method
17 #using climate from Hamburg
18 compute_heat Year static Hamburg
19 #save the result as different formats
20 save_geometry GeoJSON csv CityGML shp
21 #validate the generated CityGML file against a defined xsd schema
22 validate xsd/energy.xsd
```

Listing 3: Template for computed heat demand

The next command on the script: simplify all, code line 15, performs a geometrical simplification of the buildings, see next section. The computation of heat demand occurs on code line 18. On this line of the script we define a couple of parameters for the computation of heat demand. The first parameter defines de temporal aggregation of the simulation. The next parameter defines the type of simulation to perform, either a static steady state simulation using the heat (Muñoz H., 2015) library or a thermal simulation using EnergyPlus. The last parameter defines the climate data to use. This parameter can either be define as a path to a climate file or if using a climate one define on the heat library just as a string with the name of the climate zone.

3.3 Buildings

On the developed tool we have a small module for simplifying the geometry of buildings for the computation of heat demand. A simplification of the building geometry allows us to perform faster heat demand computations of individuals buildings and maintain a simpler data structure. An advantage of having a simple geometry definition for the individual buildings on our data set is the projection of the defined building stock into the future.

Kim, Plessis, Hubert, and Roux (2014) show that a simplification of the building geometry decreases the performance of the model by less than 1% of total annual heat demand but are able to perform the same simulation 700 times faster than taking a complex geometry into account. The implemented geometry simplification on the developed tool dos not take into account the neighbouring buildings. An algorithm considering the neighbouring buildings into account for a geometry simplification is described on (Muñoz Hidalgo, 2016 –in Press–).

The simplification algorithm does not take into account the overall orientation of the individual building components. In order to account for the building orientation of the individual building components we need to compute a weighted average of the orientations and define a general orientation for each building. The implemented algorithm defines a simple building geometry as length a with of the building, but keeping the building area to volume ratio.

3.4 Heat Transmission Coefficients

With the enriched data, through the csv file join, we classify the building stock into building typologies. The default building typology define in the tool is the IWU typology (Diefenbach, Cischinsky, Rodenfels, & Clausnitzer, 2010, Loga, Diefenbach, & Born, 2011). Table 1 shows the IWU building typology matrix. The classification of the building stock is performed based on the construction type baw and the construction year bja. These attributes are not part of the cityGML files provided by the city of Hamburg. This classification of the building stock does only work for the residential sector. We use this classification of the building stock into typologies in order to infer the value of the heat transmission coefficients of the building components and to estimate the percentage of gazing surface.

	< 1859	1860–1918	1919–1948	1949–1957	1958–1968	1969–1978	1979–1983	1984–1994	1995–2001	2002–2009
EFH[a]	183	180	164	181	146	155	118	132	110	88
RH		153	137	156	106	127	127	98	78	86
KMH	190	143	168	156	129	134	118	122	92	79
GMH		127	144	142	131	117				
HH					114	113				

Table 1: IWU-de building typology matrix for Germany. Source: (Loga, Diefenbach, & Born, 2011) Specific Heat demand (spez. Wärmebedarfskennzahl) [kWh/m2a]. (EFH) Single family house "Einfamilienhaus"; (RH) Terrace house "Reihenhaus"; (KMH) Apartment house "Mehrfamilienhaus"; (GMH) Large apartment house "Großes Mehrfamilienhaus"; (HH) High-rise "Hochhaus".

Currently the estimation of heat demand for the non residential sector has been only implemented for a yearly temporal resolution. The computation of the heat demand for the non residential sector is carried with help of the VDI-3807 (Verein Deutscher Ingenieure, 1994). In order to estimate specific heat demand coefficients for the non residential we aggregate the building functions listed on the input data to the functions describe on the VDI.

4 RESULTS

The computed results are depicted on Figure 1. On the figure we can see the simplified geometry of the individual buildings. The elements are colored by its specific heat demand. The pink line surrounding the computed elements is the geometry used to clip the input data set.

This particular part of the city contains many non residential buildings with a lower specific heat demand. On the figure we can identify some agglomerations of residential buildings with higher specific heat demand.

The implemented tool performs a geometry simplification that allows us to develop a quick prototype for the estimation of heat demand. We still need to quantify the loss in accuracy induced by the simplification of the building geometry. With these characteristics the simulation performance of the tool is very good.

The use of an application domain extension such as the Energy-ADE allows us to develop a tool that is potentially compatible with data generated by other developed also implemented this ADE. The gig advantage of using a template system as opposed to a hard coded data structure is its ability to cope with a rapid changing system. Through the templating system used in this tool we can populate a cityGML file with any type of data structure, even non valid data structures.

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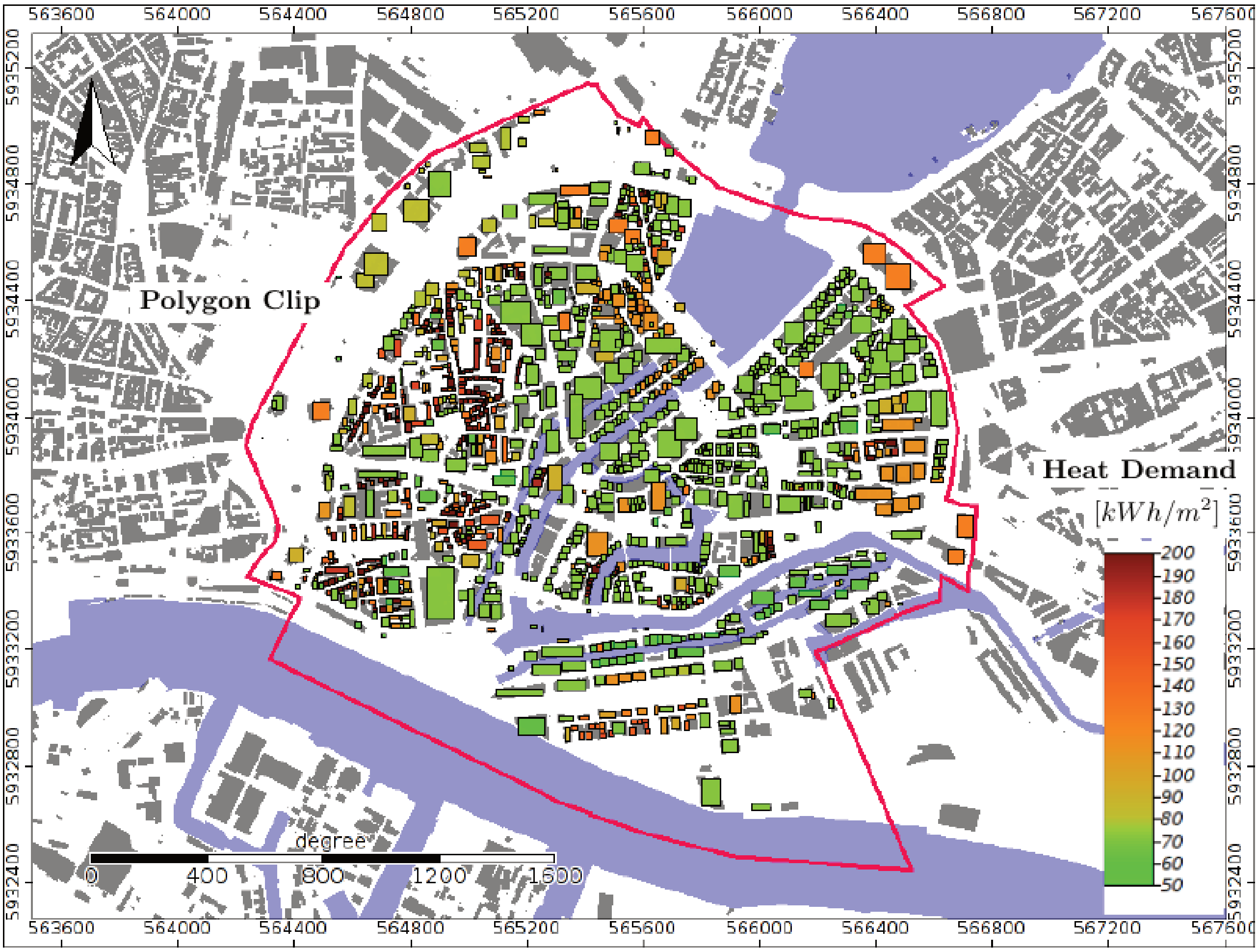

Fig. 1: Specific heat demand for selected urban area

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Environment and Social Audit for Smart City Planning Perspective in India

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1 ABSTRACT

In view of the fact that development is an ever growing process, its impact is also ever increasing, leading to rapid deterioration in environmental conditions and human health, auditing thus ensures that the potential problems are foreseen and addressed at an early stage in the projects and account the causes of detoriation during execution of as per requirement of smart city planning. Environmental auditing and social auditing are used to predict the consequences of any planning and execution of development phases; as such Auditing provides scientific approach to sustainable development for city plan. The auditing are thus a systematic process of identifying cause and consequences of phase development of planning practice in consultation with the individuals or society.

Environmental Site Assessment (ESA) tools have been applied internationally to ensure that proposed actions are economically viable, socially equitable and environmentally sustainable or not for planning stage. ESA is a process having the ultimate objective of providing decision-makers with an indication of the likely consequences of their actions. Environmental assessment enables us in carrying out environmental cost-benefit analysis of projects at an initial stage. It is thus a pre-cursor to detailed analysis of environmental impacts, which are taken up only if a need for the same is established. It gives a view of the actors involved in the development-environment linkages. This is required in view of the fact that the community at large is always at a loss in terms of deterioration of living environment that accompanies any development. Based on environmental assessment, the regulatory measures can be identified and the roles of concerned agencies defined for achieving more efficient environmental management. Further Environmental safeguard accounting including carbon foot print measuring can assesesmart accounting of any development plan.

Social Assessment (SA) is carried out to ascertain the impacts, which would occur due to implementation of the project. The exercise facilitates identifying types and extent of impacts and also identifying impacts that can be minimized by good planning practices. Efforts are made to mitigate impacts, which cannot be minimized during the planning stage. The assessment is thus a systematic process of identifying and mitigating impacts on individuals or society in consultation with the individuals or society affected. Further social auditing and pay back mechanism can assess the social viability of smart city planning.

The Supreme Audit Institution (SAI) in India is a constitutional authority, headed by the Comptroller and Auditor General (CAG) of India. The CAG of India derives his mandate from articles 148 to 151 of the Indian Constitution, examines various aspects financial, compliance and performance audit. Environmental and social audit by SAI India is conducted within the broad framework of compliance and performance audit.

This paper aims to integrate aspects of environmental audit and social audit for accounting smartness of city. Government of India (GoI) has decided on developing 100 “Smart Cities” in the country. It includes one satellite city of each of the cities with a population of 4 million people or more comprises of 9 cities, most of the cities in the population range of 1 to 4 million people about 35 out of 44 cities, all State/UT Capitals, even if they have a population of less than one million including 17 cities, cities of tourist, religious and economic importance not included 10 cities and cities in the 0.2 to 1.0 million population ranging 25 cities. This paper is framing out the parameter for accounting the environmental audit and social audit for smart city in India.

Keywords: Environmental Audit, Planning, SAI, Smart City, Social Audit

2 INTRODUCTION

In view of the fact that development is an ever growing process, its impact is also ever increasing, leading to rapid deterioration in environmental conditions and human health. Impact assessment thus ensures that the potential problems are foreseen and addressed at an early stage in the projects planning and design. Environmental audit and social audit are used to conduct the management process in any flow dynamic system. As such audits provide a rational approach to evaluations intended to identify compliance and effectiveness of management systems.

Environmental Auditis, is a general term that can reflect various types of evaluations intended to identify environmental compliance and management system implementation gaps, along with related corrective actions. In this way they perform an analogous function to other audits. There are generally two different types of environmental audits: compliance audits and management systems audits. Environmental compliance audits as their name implies are intended to review the site's/company's legal compliance status in an operational context. Compliance audits generally begin with determining the applicable compliance requirements against which the operations will be assessed. This tends to include federal regulations, state regulations, permits and local ordinances /codes. In some cases, it may also include requirements within legal settlements. Audits are also focused on operational aspects of a company/site, rather than the contamination status of the real property. Assessments, studies, etc. that involve property contamination/remediation are typically not considered for an environmental audit. ISO 14001 or ISO9001 etc are international standard for environmental management systems ("EMS"). ISO 14001:2004 provides the requirements for an EMS and ISO 14004 gives general EMS guidelines. An EMS meeting the requirements of ISO 14001:2004 is a management tool enabling an organization of any size or type to:

- Identify and control the environmental impact of its activities, products or services;
- Improve its environmental performance continually, and
- Implement a systematic approach to setting environmental objectives and targets, to achieving these and to demonstrating that they have been achieved.

Environmental audit can be defined as a basic management tool comprising a systematic, documented, periodic and objective evaluation of how well environmental organisations, management systems and equipment are performing. The aim of the audit is to facilitate management control on environmental practices and to enable the company to assess compliance with its policies including meeting regulatory requirements.

A social audit is a process of reviewing official records and determining whether state reported expenditures reflect the actual money spent on the ground. A social audit assists in verifying the social performance claims of the government schemes and revolves around the principles of equity, social responsibility, trust, accountability, transparency, inclusiveness and community benefit. As defined by the Grameen Bharat, a monthly newsletter by Ministry of Rural Development (MoRD) 'Social Audit' is "a public assembly where all the details of the project are scrutinized". It is "a way of measuring, understanding, reporting and ultimately improving an organization's social and ethical performance" as per the National Institute of Rural Development (NIRD). The concept of Corporate Social Responsibility (CSR) followed by corporations around the world lays the foundation of social audits. Social audit serves as an instrument for the measurement of social accountability of an organization. It is an in depth scrutiny and analysis of the working of an entity in which the public is involved vis a vis its social relevance. It provides critical inputs to correctly assess the impact of government activities on the social well being of citizens; determines the social cost and gauges the benefit to the society.

3 COINAGE OF ENVIRONMENT AND SOCIAL AUDIT IN INDIA

Environmental Audit in India: The Supreme Audit Institution (SAI) in India is headed by the Comptroller and Auditor General (CAG) of India who is a constitutional authority. The CAG of India derives his mandate from Articles 148 to 151 of the Indian Constitution. The CAG's (Duties, Powers and Conditions of Service) Act, 1971 prescribes functions, duties and powers of the CAG. While fulfilling his constitutional obligations, the CAG examines various aspects of government expenditure and revenues. The audit conducted by CAG is broadly classified into Financial, Compliance and Performance Audit. Environmental audit by SAI India is conducted within the broad framework of compliance and performance audit.

India is the first country in the world to make environmental audits compulsory. The government of India by its gazette notification [No.GSR 329 (E)] of March 13, 1992, made it mandatory for all industries to provide annual environmental audit reports of their operations, beginning with 1992-93. This required industries to provide details of water, raw materials and energy resources used, and the products and wastes generated by them. These audit reports were to be submitted to the concerned State Pollution Control Boards (SPCBs) or before September 30 every year.

This scheme was expected to promote proper monitoring of industrial activities, adoption of low cost technology and minimisation of resource consumption. But though it has been in force for more than two years it has not made much headway. Out of the lakhs of industries that exist in India, only 2,995 audit reports were filed by December 1993. It has also become obvious that the deadline of September 30 is not adhered to. Due to widespread non-compliance, this deadline has been extended a number of times. Champions of this regulation fee are that the government has adopted a proactive approach to the conservation of natural resources, instead of observing the usual command and control method. Its critics feel that this notification was hurriedly implemented without the prior creation of necessary infrastructure/experts which would enable its appropriate implementation.

This novel concept of environmental audit was distorted, surprisingly, by the government, when on April 22, 1993, by a revised notification [No. GSR.386 (E)] the term Audit Report was replaced by Environmental Statement. This change inevitably toned down the impact of the regulation.The industries were now to fill a form and submit it to the concerned Pollution Control Boards (PCBs). It made it easy for industries to make statements to the effect that they have taken the requisite steps in compliance with existing pollution control regulations. These statements might not be based on actual audit reports. If this becomes a rule, the whole purpose of the environmental audit regulation would be defeated. Industries have a list of grouses against environmental audits. They are opposed to environmental audits. They are opposed to the disclosure of their modus operandi to the public, who they feel are not mature enough to follow the importance of such data. They fear it would lead to legal wrangles and litigation and that the data would be used by PCBs for prosecution. Publishing details of raw materials used and processes might reveal their trade secrets. Even the PCBs have no follow up plans. The reports submitted are not double-checked to find out whether the forms hold the correct data. One report has been examined and acted upon till date. The industries do not get any feedback.

An environment audit programme, if designed and implemented conscientiously, can enhance environmental performance. If a programme sets up its own system in compliance with existing laws, then conducting audits would be a normal and considerably easier procedure. It will expose problems that require action. It improves the material and energy efficiency of production processes, conserves resources, minimises wastes, provides direct economic benefits to the society and stimulates growth as well as the national economy.

Environmental audits are vital not just for a clean environment but also because their use is the best way to correct different problems detected at their source and to minimize wastes and foresee conservation and maintenance measures needed to prevent major pollution, health problems.

Projects in developed countries conduct audits as part of their overall drive for quality assurance to establish a “green edge” over competitors in environmentally sensitive markets. Moreover, green audits are asked for by investment banks before they pour in money. With the Indian economy opening up, industries have no option but to go green if they want to remain in the race.

Social Audit in India: ‘Audit’ is a Latin word which is translated as ‘to hear’ in english. Audit is not a recent activity but is a practice that was adopted in the ancient time by emperors to analyse the public sentiment towards their rule and policies. The input of masses was then used to alter the policies. Thus encompassing the whole society in the decision making process of matters of governance.

The term social audits emerged in the United Kingdom and Europe in the mid 1970s. It was used to describe evaluations that focused on the likely impact on jobs, community and the environment. The term social audit was used in such evaluations in order to emphasize that these evaluations had a social angle to them and were not concerned with the economic function of government policies.

In India, the initiative of conducting social audits was taken by Tata Iron and Steel Company Limited (TISCO), Jamshedpur in the year 1979. Social audit gained significance after the 73rd amendment of the constitution relating to Panchayat Raj institutions i.e. bottom up approach in planning. The approach paper to the ninth five year plan (2002-07) emphasized upon social audit for effective functioning of Panchayat Raj institutions that empowered the gram sabhas to conduct Social Audits in addition to its other functions.

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In order to eliminate the loopholes in scheme implementation (contractors and middlemen), the Society for Social Audit, Accountability and Transparency, an autonomous body insulated from government interference, was set up first in state Andhra Pradesh (A.P.). The year 2006 marked the starting of social audits in the state of A.P. From the observations of the surveyors it could be concluded that out of 22 gram panchayats in which social audits were conducted, 17 reported mis-utilization of funds.

Social audits conducted afterwards revealed that after the initial set of audits, the discrepancies in procedures had reduced. A cross section of stakeholders including worksite beneficiaries was aware of the audit and its findings. Interaction with the laborers revealed that after the after the first social audit, wages were being paid on time. The only problem that still troubled the villagers was the weak follow up action in retrieving the swindled sums and poor enforcement of rules.

After the introduction the social audit scenario in A.P changed. Accountability and Transparency (SSAAT) concerns itself with the audits of Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS). As per the Act, social audits of MGNREGS have to be carried out every six months.

In the year 2009, social audits were conducted in the Bhilwara region of Rajasthan. The exercise in social audits not only brought to light the loopholes in scheme implementation but also served as a training ground in auditing for the local population. Practices such as not accepting any special food and hospitality from the sarpanch (elected person in village) ensured minimal contact with the sarpanch. Also, the villagers with whom the group ate proved a more balanced source of information.

In response to a public interest litigation (PIL) filed by sarpanches from 16 villages in which social audits were conducted, a division bench of the Rajasthan High Court stayed NREG social audits in sixteen villages. An informal ban was imposed on taking help from the NGOs with respect to social audits in Jhalawar and Bhilwara districts because of this dispute. It is the only state to have passed social audit rules in the year 2008, based on which the GoI issued rules in the year 2011.

Through the letter of the MGNREGA Director, to the Ministry of Rural Development dated 5th July 2012, an appraisal of the MGNREGS in the North Eastern states was presented along with suggestive measures to improve the implementation of the scheme, which are as under: i. selection of master trainers/ resource persons, ii. identification of blocks for pilot social audit, iii. training of master trainers at NIRD, iv. preparation of state specific manuals, v. setting up of social audit units. This hints at efforts being made in the north eastern states to improve social accountability through the means of social audits.

4 WAY TO SMART CITY PLANNING PERSPECTIVE UNDER ENVIRONMENT AND SOCIAL AUDIT

The indiscriminate utilisation of natural resources for meeting development demands, rapid unplanned developments are adversely impacting the environment. Dumping of wastes into our rivers and lakes, clearing forest land for cultivation and increased emission of harmful pollutants into the environment have all contributed to degrading our environment. Trends towards environmental degradation can, however, be slowed and even reversed by active governmental interventions. Over the last decade in India, there has been an increase in efforts in the area of conservation of the environment. Funds allocated for environmental programmes have also been increasing. In this context, first environmental audit report for the year ended 31st March 2009 for government projects (except industry) has been prepared for submission to the president under article 151(1) of the constitution. The environmental audit report is to create awareness and urgency about conservation and protection of the environment which need to be addressed by the government. Environmental audit contains audit findings relating to the themes of afforestation, biodiversity, pollution control and environmental aesthetic. It would serve as an aid to management in better governance of environment. This Audit helps in sensitising policy makers to look at environmental issues with a holistic approach and address the deficiencies in programmes/schemes/policies so that our environment is conserved more effectively. Now the question is how to prepare environmental audit for smart city planning in India. Should it become compliance audit or should it be a management audit.

The overall objective of the environmental audit for the smart city programme in India should be to improve environmental / economical / cultural / historical / heritage and tourism improvement and bring in visible results through implementation of identified environmental improvement projects in these towns and cities. The observation in audit should complt with the outflow of municipal contributions of matching funding.

However, works undertaken under this programme remained incomplete in all cities and towns. The cost benefit analysis of a project would be in compliance with the State Pollution Control Board (SPCB) for every year. Further carbon foot print can be advisable to suggest any scheme for further implementation.

The Minstry of Environmental and Forest (MoEF) would become theappellate authority where SPCB would become state level authority to mandate the programme in order to dovetail the environmental concerns with municipal functions and budget to ensure participative and pragmatic planning, as well as to take care of shortcomings in the implementation of the scheme. SPCB / MoEF may play to strengthen the project implementation mechanism and its control/monitoring mechanism before the programme is launched, so that it can effectively achieve the objectives set out for the smart city programme and improve facilities for stakeholders. The main key parameters for auditing are as follows:

Water supply and waste water treatment can be done by using recycled water and water harvesting method:

- Recycling of Waste Water:
- Rain water Harvesting:
    - energy supply, energy savings and renewable energy development:
    - waste management,
    - soil pollution and
    - air pollution;
    - cleaner industrial technologies and environmental management:
    - building construction and urban ecology management:
    - agriculture and food industries
- For these three hierarchcal set up the following issues are taken into consideration:
- Waste management system – optimal operation of collection, transportation, treatment and final disposal.
- Waste administration, organization and economic instruments.
- Reuse – recycling, energy recovery, etc.
- Environmental communication.
- Sustainable landfills.
- Capacity building – legislative and administrative capacity as to planning, monitoring and control.
- Training and education.
- Food industry and beverages help to susstain smart cities and
- Energy efficient buildings are inograted over this are to take way of sustainble developmennt:

Sky: day lighting and heat sink

Sun: heating, electricity generation and day lighting and solar chimneys

Air: ventilation and heat sink

Water: roof gardens and earth berms, for insulation

Earth: roof ponds, fountains for humidi fication and rain water harvesting

The first stage of smart houses is to incorporate solar passive design interventions and try to reduce the loads on conventional systems. Energy conservation is possible by judicious design of lighting and HVAC (heating, ventilation and air conditioning) systems, controls and operation strategies.

Urban traffic and transportation. Intra sector transportation is needed as well as restrictions of car movement of internal roads; pedestrianisation can be done and cycle patha are beneficiaries.

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As to date, in India, there is no blanket statutory mandate for social audits of various organizations / departments / welfare schemes for towns and city planning. The issue is being fervently pursued by the Minister of Rural Welfare, in regard of welfare schemes in year 2014.

Need for social audits, for the push for social audit is the huge disconnect between what people want and what people get. This is mainly because of the game of bribes and swindling of public fund for vested interest. Programmes are developed by the politicians and implemented under the guidance of the bureaucrats for development of the society. However, the play of margins, cuts, commissions and bribes deflect the public funds from the direction of the intended beneficiaries.

As soon as social audit kicks in, it exercises its control over the policy developers and implementers:

- It measures social benefit,
- Monitors social and ethical impact of an organisation's performance,
- Serves as the basis for framing the management's policies in a socially responsible and accountable manner,
- Boosts accountability,
- Increases transparency and
- Assesses social cost.

At the social audit public hearing forums information is read out publically and people are given an opportunity to question officials, seek and obtain information, verify financial expenditure, examine the provision of entitlements, discuss the priorities reflected in choices made and critically evaluate the quality of work, as well as the functioning of the programme staff.

Thus, the social audit public hearing proves to be a platform for in depth scrutiny of works that has been conducted in an area and gives the people an opportunity to review compliance with the requirements of transparency and accountability.

Here are some of the major parameters for social audits:

- While conducting a social audit, it is required that the purpose is clearly defined.
- The stakeholders should be properly identified.
- A note should be made of whether marginalized social groups, which are normally excluded, have a say on local development issues and activities and have their views on the actual performance of local elected bodies.
- The auditor must obtain information from reliable sources. After the introduction of Right to Information Act in 2005, the task of obtaining statistics and other information from the government departments had become a lot easier than before.
- The performance indicators adopted by the society at large should be taken as standards in order to judge the performance.
- Regular meetings and follow ups must take place in order to ensure the continuity and effectiveness of audits.
- Proper mechanisms must be set up in order to recover the swindled money from the corrupt officials.
- Substantive procedures are required to be devised instead of compliance procedures to gauge the performance.
- Hierarchy needs to be defined for conducting social audits and
- External Parties such as NGOs should be involved in conducting audits

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🏆 *reviewed paper*

Experiences from a Living Lab Trialling a Mobile Participation Platform

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1 ABSTRACT

The project b-Part adresses the currently low level of participation by introducing and evaluating a novel participation prototype utilizing contemporary mobile technology. As pervasive participation methods eliminate spatial and temporal barriers, it is anticipated that people are more inclined to engage in decision-making processes than with traditional forms (e.g. townhall meetings). Based on these considerations we developed a mobile participation platform that was evaluated in a real-world scenario over the duration of five months. This paper describes our methodology focusing on the conducted Living Lab and reports on experiences made during the runtime of the project. We hereby distinguish between experiences made by citizens and the authorites' view on the whole participatory process. Our findings show that there is a high acceptance of mobile participation methods among citizens and they want to have it developed even further. On the other hand, although city administration is often enthusiastic about novel participation formats, there are still challenges to meet regarding the definition of suitable topics for participation, a match between needs of citizens and city officials, the mapping of organisational responsibilities and long-term commitment to active participation.

Keywords: Digital Participation, Human-Computer Interaction, Living Lab, Mobile Participation, Pervasive Participation

2 INTRODUCTION

Governments around Europe are trying to improve methods how to integrate citizens in the public decision making processes (Michels, 2011). They aim to introduce new methods to broaden the scope of involved citizens as well as to encourage those previously less eager to participate, such as younger generations. Easy and attractive to use applications (user-friendly apps) making use of up-to-date technical devices can help to achieve these aims. In governing urban development, participation has been long encouraged and organised especially related to urban planning. In that field, the penetration of mobile devices (in EU, almost every adult citizen has a mobile phone, and in near future, majority of users will have a smartphone) provide new opportunities to collect citizen input directly from particular sites. The technology enables for instance location-based polls with maps, pictures and Augmented Reality (AR) applications to represent and visualise issues on portable devices for people to react and comment when they are momentarily on those sites.

Available applications (Desouza & Bhagwatwar, 2012) do not exploit this potential by far. The project presented in this work concerns the technical, social and democracy prerequisites of creating an advanced e-participation application, also addressing important aspects of developing functional prototypes in a user-centered design process and testing them in real-world situations such as a Living Lab.

In broader terms, the current state of mobile technology is supported by user-centred technologies that aggregate the contributions of individual users. As the 'open innovation' approach has proven effective in accelerating innovation processes, governments, too, have begun to seek ways to foster similar processes (for example Open Government or Government 2.0). Coupled with it is the wider social change brought about social media and user-generated content as well as the shift regarding political participation from traditional forms to more direct and individualized froms of expression (Dalton, 2005). Instead of an indirect involvement characterized through representation by others, the trend points towards a direct participation where citizen take personal action. In this context, the b-Part project aimed to create a manageable framework for pervasive citizen participation in urban surroundings. The project investigated novel concepts and solutions for citizen e-participation based on the pervasive computing paradigm utilizing latest mobile technology (smart devices) and appliances embedded in today's technically enriched urban environment. One goal in this context was to determine the requirements and explore the contributing factors for achieving an effective and sustainable dialogue between citizens and city officials (see Fig. 1). We applied the Living Lab methodology in order to test the framework in a real world environment and be able to draw representative conclusions regarding the impacts of the actions undertaken. In context of this field trial we engaged a multitude of stakeholders including civic organisations, citizens and urban planners in order to meet the requirements from all involved parties. In a highly interdisciplinary approach and pragmatic setting involving end-users through lab tests and urban field trials, the project combined user-centred pervasive interaction research with social studies (to explore the capability to engage citizens) while at the same time investigate democratic innovations (to ensure citizens' input integration into the overall political decision making process). The resulting tools, services and guidelines will help to promote and strengthen the involvement of citizens in urban governance by using contemporary technology.

Fig. 1: An important goal of the b-Part project is to create a sustainable and dialogue-like participation process between the public and city authorities [own graphic].

In this paper we report on the methodology the project employed to develop and test a novel mobile participation platform. We present insights gathered throughout the entire project runtime focusing on the experiences of the involved stakeholders, here citizens and city authorities. The focus of this paper is deliberately on an 'anecdotal' description of the actual experiences gathered throughout the participation process. These are seen as a useful input for various streams of further activities within the b-Part project, as well as future projects with the goal to better integrate citizen participation in the public policymaking process.

3 RELATED WORK

In response to the low level of public participation, governments around the world are experimenting with novel forms of engagement with the objective to integrate citizens in the public decision process. Particularly in the domain of urban development, participation has a long history where participatory processes have been encouraged and organized. Assuming that the main reasons for non-participation include people not having the time to attend location and time restricted physical events, a current trend is to develop web-based platforms that allow citizens to raise their voice. Recognizing the potential of emerging technologies (e.g. built-in sensors), such platforms recently have also been introduced to mobile devices allowing engagement at anytime from anywhere. In a short amount of time a large number of civic apps were developed by various cities across the world. Most of these apps serve information dissemination purposes or fall under the category of so-called reporting apps allowing citizens to notify authorities of issues in the city. The majority of current civic apps however do not exploit the potential of location-based input enriched with additional information (e.g. pictures). Especially mobile applications for urban planning only allow for a one-way channel with authorities (Ertiö, 2015), where citizens can report nuisances related to urban infrastructure. Only few examples provide a more substantiated feedback than a one-word response signalising a status change. When going into more detail, officials answer citizens' input by giving thorough comments explaining reasons behind a decision.

When talking about public participation methods and tools, it is important to be clear about the terminology. E-participation, an academic discipline investigating digital public participation methods, is highly interdisciplinary involving a variety of backgrounds. This resulted in a plethora of terms being used for the same concepts as well as misunderstandings when using the same terms but meaning different concepts. The list of related terms include citizen participation, civic engagement, political discourse or discoursive democracy, to name just a few. To avoid future confusions and facilitate distinctions, there is a need for a standardised terminology. In the context of this paper we understand public participation as the practice of inviting people to take a more active role in community relevant decision-making and thus public life by way of offering them solutions that are utilizing information and communication technologies (ICTs).

An effective approach to differentiate methods and tools with the objective to engage the public is to focus on the underlying objective that informed to participatory process. The goals often determine the possible and resulting level of engagement. A recent typology that provides a clear distinction between engagement methods and is also applicable for e-participation platforms, is based on four communication strategies: Telling, Asking, Discussing, and Deciding (Rucker, 2015).

In Telling approaches the objective is to merely inform the public about development plans or upcoming changes. Here the public is only in rare cases able to take an active part, classifying Telling approaches as uni-directional communication methods. Examples include traditional websites of for instance municipalties offering information about the size, population and important figures and people within that community. A concrete example is the website developed to provide citizen with informations about the redesign of a major shopping street in Vienna.[1] Althoug the name of the site suggests it to be an interactive or at least responsive platfom, the website merely summarized information and statistics about the progress of the construction.

Asking appraoches are basically crowd-sourcing strategies initiated by municipalities or other offical bodies in order to get insights about people’s opinions, viewpoints or even new ideas. Although enabling the public to take an active role in decision-making processes, most instances of Asking examples do not go beyond this limited one-way channel. Only few examples of Asking appraoches eventually feed the findings from such platforms back the (participating) public. One of the examples for Asking methods is the platform of the City of Dresden,[2] Germany, which has already been used for a list of purposes. The basic idea here is to employ the platform whenever the urban planning department requires input and feedback from the citizens regarding development plans.

While Telling and Asking strategies are more or less uni-directional approaches to engage citizens in decision-making, Discussing and Deciding strategies aim for an interactive and ongoing two-way communication between citizens and city authorities. The difference between the two strategies is that Discussing methods are a blend of crowdsourcing and debating with the objective to both inform and get relevant input (i.e. ideas, concerns) from citizens, Deciding approaches focus more on the actual decision-making instead of gathering options and alternatives. Participation methods following the Deciding strategy not only view citizens as consumers of solutions provided by authorities, but as partners with whom authorities collaborate to find those solutions. A good example for a Discussing platform is Betri Reykjavik[3] that is utilized by citizens of Iceland’s capital to engage in urban planning and urban life by proposing and discussing concerns and solutions. In fact, there are only very few platforms that meet these criteria, with participatory budgeting sites coming closest. Muncipalities involving citizens in budgeting do so by allocating certain amounts of money for this specific purpose, inviting citizens to propose changes or new ideas for which public funds should be used and then collaboratively decide on which ideas will actually be realized. An example for such a platform is the Bürgerhaushalt Lichtenberg which is used by a district of Berlin, Germany.[4] The mobile participation platform described in this paper can be characerized as Discussing platform as it mainly aims to engage people in discussions and gather insights from them, but also aims to give participants the opportunity to influence decisions.

4 METHOD AND DATA

In a highly interdisciplinary approach, the project explored the technical, social and democracy prerequisites of creating e-participation apps that encourage an effective and sustainable participation. As such b-Part combined user-centred pervasive interaction research with social studies to explore engagement and activation, and research on democratic innovations to ensure integration into the overall political decision making process.

[1] http://www.dialog-mariahilferstrasse.at/
[2] http://dresdner-debatte.de/
[3] https://www.betrireykjavik.is/
[4] http://www.buergerhaushalt-lichtenberg.de/

The project itself can be broken into three main parts, which are described in the following section. The first step was to gather requirements for pervasive participation systems. Insights from this analysis were then fed into the development of the prototype, which was iteratively improved based on findings from smaller user studies. In a second step, the resulting mobile participation platform was trialled in a longitudinal field study. The last phase of the project is characterized by the evaluation of the data gathered throughout the project.

4.1 User-centred design process

In the beginning of the development process for our mobile participation prototype but also of the entire project, a requirements analysis was necessary to determine barriers and contributing factors in public participation processes. We started with a broad review of existing systems. We then moved on to assessing requirements in the field by conducting small scale user studies. For these studies we employed functional prototypes, where we initially focused on the system itself by testing variations of input modalities for interacting with the system. With our overall goal being to explore novel concepts for pervasive participation methods, we conducted these exploratory studies using a public screen. These first studies explored novel interaction techniques (e.g. display pointing) as well as compared people’s preferences for more private or more public (= visible) means of casting a vote (e.g scanning a QR code, clicking buttons). We found that if provided, direct voting opportunities are clearly preferred while providing mobile voting opportunities do not significantly increase the overall participation rate (Baldauf et al, 2013). Due to limited availability of large public screens at our trial site, we utilized mobile devices as participation medium for the main trial as well as smaller side field trials.

Based on findings from both our exploratory studies and review of existing works, we developed a first prototype for the mobile participation platform. The concept of this prototype was then evaluated in a small-scale field trial (Thiel et al, 2015). For this study our analysis focused on the acceptance and actual usage of specific features of the prototype (e.g. being able to post a picture). After incorporating findings from the field study and minor bug fixing, the second iteration of the prototype was tested in another field study by a group of participants that used the prototype while walking around a pre-defined route in a city district (Thiel & Lehner, 2015). Participants commented positively on the concept, highlighting the benetfits of being able to participate on the spot. Again, comments and suggestions from participants were integrated into the design of the prototype. This third version was then presented to officials and urban planners of our Living Lab site. During discussions about the actual integration of this tool into their processes, it was decided to develop a web-based dashboard for the authorities to reply to input coming through the app in order to facilitate the process of replying to citizens’ input. Apart from the idea to integrate social network sharing buttons into the prototype, both urban planners and city officials seemed to be content with the features and concept of the mobile participation platform.

4.2 The prototype

In a user-centred research and design process, a novel m-participation concept which enriches in-situ/mobile participation with pervasive gaming features (mobile location-based games combining digital objects and tasks with real-world locations) was developed. The concept features several novel opportunities which go beyond traditional reporting apps. For example, social interaction among the citizens as well as teamwork is encouraged and rewarded. Aiming to encourage co-creation and open innovations through bottom-up initiatives, citizens may not only report issues but are enabled to create polls on topical issues for their neighbourhood to uncover so far unknown or neglected concerns and citizen views.

Based on the participatory sourcing approach, the basic idea of the m-participation prototype is to allow citizens to pro-actively raise their voice proposing own ideas or bringing issues to the attention of authorities but also answer to official inquiries providing authorities with relevant feedback (e.g. on development plans). A central element in the application are so-called contributions, which are automatically geo-referenced pieces of content that can be augmented with relevant pictures of the area. Contributions are displayed on a map view and are openly visible to all users. These posts can further be commented and voted upon allowing citizens to discuss topics. Authorities were encouraged to join those discussions by contributing relevant facts, forwarding ideas and issues to responsible departments as well as communicating decisions. The current status of a contributions was further visible in the detail view of that post, giving users a quick indication of whether it had already been considered. City officials and citizens have the same user rights within the application, merely an icon next to the username of city officials allows to differentiate between the two user groups. Discussions are not restricted to a specific topic enabling users to talk about almost any topic of their interest. Missions, which are in-app tasks on the other hand ask for input to specific topics. As urban planning lends itself very well to participatory processes, most of the missions created by city officials (official missions) addressed themes related to urban planning. One of such missions in the Living Lab for instance asked citizens whether they would favour a bridge connecting a near peninsula and if yes, whether a restaurant should be built next to that bridge.

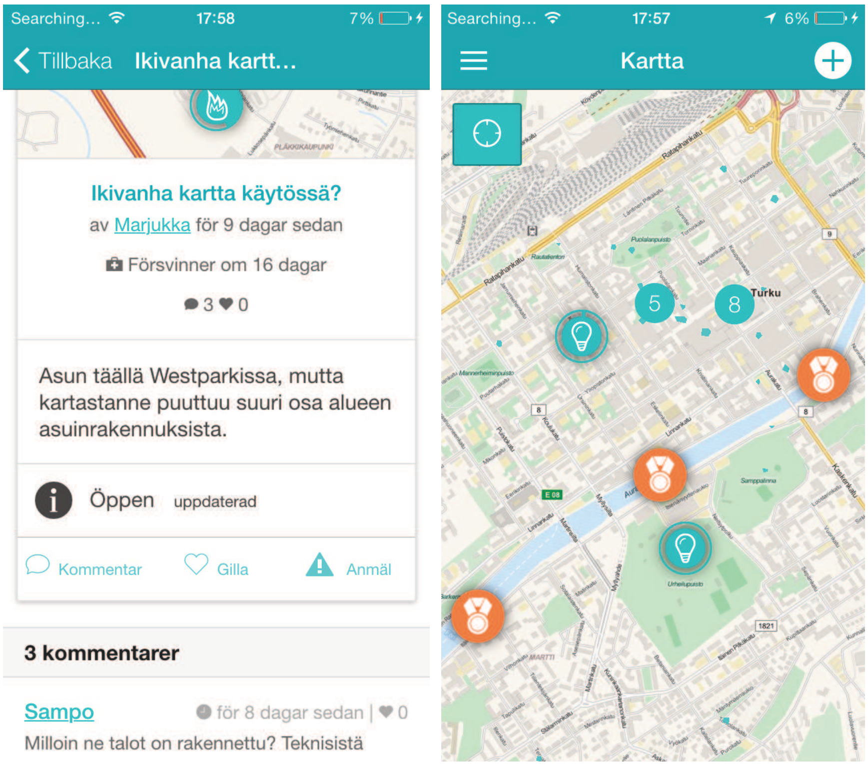

Fig. 2: Screenshots of the mobile participation platform.

4.3 Living Lab

The novel m-participation was evaluated in a longitudinal field study in a city in Finland. Fundamental for achieving an effective participation process is the involvement of local authorities as they respond to citizens' input. Receiving feedback in turn is the key aspect for making engagement relevant for citizens. Hence we employed a Living Lab methodology that involved both local authorities (i.e. city officials and urban planners) as well as residents.

Having been introduced into urban research in the mid-2000s, the method of so-called Living Labs has quickly gained popularity among researchers. The main advantages of Living Labs is that they involve a multitude of stakeholders in processes, thus allowing to connect research to public and private stakeholders with citizens. While projects applying the Living Lab methodology come from various disciplines with differing interests, the core objective of Living Labs is to co-create and co-design products and services that help improve the living quality in cities (Edwards-Schachter et al., 2012). As such Living Labs are particularly prevalent in product-based laboratories, where new products or services are evaluated by users in artificial living environments. Connecting research and therefore also innovation development with the actual living envronment is another objective of Living Labs. In their real-life environments potential future users help shape and create new products and services making them more competitive and hence more likely to succeed. Through this close involvement in development processes users become co-creators. It has been argued that this practice will eventually transform our product-based economy into an innovative service economy where users are placed in the centre (e.g. Pascu & Van Lieshout, 2009; Mulder, 2012).

With public participation becoming increasingly important, existing definitions of co-creation were extended not only to characterize products and services as an outcome of the partnership of two or more stakeholders (Tanev et al., 2013; Allen et al., 2009), but also the collaboartive process in itself. The latter is applicable in particular for social-centred Living Labs that largely revolve around the idea of co-developing cities and

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improving living spaces (Franz, 2014). Here outcomes do not necessarily have to be tangible but are labelled as "social innovation" (Franz, 2014). Given this framework, the b-Part Living Lab can be characterized as being both socially-centred and technology-centred. Technology-centred because through participants using and commenting on the employed participation platform, the research team received valuable input that informed improvements to the service. The social innovation focus arises from the discussions and ideas that will evantually be realized.

The Living Lab lasted from June to October 2015. During those five months the application served as official channel for soliciting citizen input of the City of Turku. Being a characteristic of Living Labs, we did not recruit any participants for this trial. In order to spread the word about the existence of the new engagement method, we relied on common marketing strategies such as posting articles in established newspapers of the city and contacting community groups. During the first month of the Living Lab we furtther operated a small booth near the city centre in a relatively busy shopping centre staffed with two researchers, who would explain the mobile application or provide background information about the trial. Approximately halfway through the trial we further set up tangible signs (about A4 size) in locations of missions in order to catch people's attention on the spot. Due to this lack of a structured recruitment phase and the participation platform featurering a light-weight registration process, we did not know for sure who (in terms of socio-demographics) were using the prototype at any given time. To compensate for this, we integrated a survey into the mobile application that opened upon registering and asked about socio-demographics as well as other project related statistics such as attitudes towards urban planning or experience with mobile devices. We logged activties within the applications (e.g. posted contributions and comments) in the backend. At the end of the trial we distributed another questionnaire among participants asking about their experience with the participation platform, the in-app discussions as well as the trial itself. As we had a large amount of so-called non-active users (participants who never became active in terms of generating content), we conducted interviews with some of these participants to gain insights into the reasons of their behaviour.

5 EXPERIENCES

To the best of our knowledge the b-Part Living Lab is the most profound longitudinal field study in the domain of mobile public participation. During the five months period but also prior to the launch of the trial and afterwards, we were able to collect rich data and experiences that help a) understand the potential of mobile participation, b) inform future mobile participation prototypes but also c) design Living Labs that enable both a throrough evaluation of a product as well as enable social innovation. In the following section we summarize the experiences we made in the course of the project, structured by involved stakeholders.

5.1 User aka citizens perspective

During the actual Living Lab the research team had only very limited personal contact with participants. As we only had their e-mail addresses (which to some extent were fake addresses or contained typos), reaching out to them would have been problematic. In order to still receive feedback during the trial from actual users, the research team organized and participated in a series of events all relating to the broader theme of improving city life and technologies. Personal communication with attendees, which were citizens, city officials and local business owners, we gained insights about citizens' experiences with the application.

Our first finding relates to people's expectations when being offered the chance to trial a novel technology. A disclaimer that was displayed after opening the app for the first time, informed users about the background of this application telling them that it would serve as an official channel for communicating with the City of Turku for only a limited period of time in which the system would be evaluated in terms of fitness for public engagement. The disclaimer further highlighted that the mobile app had been developed in the context of an EU-research project. The text was intended to both be honest with citizens about the context of this trial entailing that findings from it would be used for research purposes (i.e. publications, presentations) but also to keep expectations in check.

Despite our attempted expectations management, citizens viewed the mobile participation prototype the same way they would any other app they downloaded from the app stores. Hence, citizens showed hardly any tolerance for slowness, shortcomings or crashes of the system. For them the prototype was a product. In the field of Human-Computer-Interaction (HCI) it is common practice to evaluate prototypes, which are varying degrees from being ready for market, in small user studies. Introducing a system in Living Lab settings and hence deploying the system to a broad audience, requires a different starting point. Here participants expect no less than a fully functional and stable product.

Overall, citizens seemed to accept mobile technology as a means to engage in public life and communicate with authorities. Findings from our two surveys confirm that citizens perceive participation with mobile technology as promising and worth developing. Especially the advantage of participating on-site was considered highly valuable. Despite these attitudes that encourage to further develop mobile participation, citizens also wished for a complementary web-based participation service. Confirming Korn's (2013) presumptions, citizens expressed the need for having the opportunity to sometimes reflect more on their contributions or discuss matters more deeply than they would when being restricted to typing on a small touch-based keyboard.

Related to the aspect of in-situ participation are our findings regarding the so-called NIMBY (not in my backyard) effect. The theory behind this effect is that citizens would be especially motivated to participate in situations where something is planned to happen or be constructed in the vicinity of their home that they oppose to. According to the theory, the desire to prevent something in one's community, citizens who normally do not engage would become active. Findings from our study contradict the theory behind the NIMBY effect to the extent that we found that people not only want to participate in discussions regarding the place where they live, but also in those parts of the city they are interested in. In fact, citizens are as interested in developments and general mattes concerning the city centre as they are in their own residential districts. Topics that gained most interest and thus were the most discussed were traffic planning and public spaces. This high interest beyond the fictive borders of one's centre of living implies that the concept of a community in the context of urban planning needs to be revisited.

The majority of our participants were highly educated and displayed an above average interest in both urban planning and politics. While we succeeded to both include the elderly and the younger generation in the trial, the socio-demographics of participants of the Living Lab show that there is still work to be done to include other society groups (e.g. with low levels of education). With the nowadays high distribution of mobile devices, ownership of and access to the necessary technology was replaced by something else as the main barrier to participation. Involving these so-called hard-to-reach groups and hence promoting social equality should be the focus of future work aiming to encourage more political engagement.

Another experience we made regarding citizens' attitudes towards public participation echoes the viewpoint of many others. Even though some participation methods are more effective in terms of engaging the public and mitigating traditional barriers to participation, the critical aspect within public participation determining the success or failure of the participatory process is not the method that is employed to gather opinions and viewpoints from people, but the position of authorities towards public participation. This position comprises factors such as the readiness, skills and willingness of official institutions to make a sustainable and effective participation process possible.

5.2 Authorities perspective

As argued in the previous section detailing citizens' experiences with mobile participation, the exact method (e.g. using traditional means or digital technologies) is not the key to effective participation, but the mind-set of the governing body. Following this train of thought, the project presented in this article made an effort to integrate relevant authorities of the trial site, a larger city in Finland, early on in the design and development process of the participation platform. This was done through regular meetings and workshops with both city officials and urban planners. In this meeting we assessed their requirements for the participation platform in terms of data needed and interest in specific topics but also their general attitudes towards participatory processes and their commitment to take an active role in them.

Throughout the whole project and during all events members of the municipality presented themselves as very enthusiastic towards the concept of public participation and were eager to be part of a trial exploring new participation methods. In fact, being among the first European cities to have a mobile public participation service that went beyond uni-directional issue-reporting was a major motivation for them.

The mission feature mainly served the purpose of increasing the relevance of the trial for authorities by asking citizens targeted questions regarding urban topics. Missions have an optional time limit during which

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input and feedback would be collected. After this time limit missions would disappear from the app. In order to encourage browsing the mobile app on a regular basis, new missions were introduced approximately every four weeks. In preparation for the launch of the Living Lab, we aimed to create a preliminary plan as to when to launch what mission. As the vast majority of the missions would be coined by the municipality and the urban planners, we invited those two groups to a workshop. The objective was to have them brainstorm potential use cases to be addressed in the participation platform. Both groups actively engaged in this exercise proposed a plethora of ideas, questions and topics. When going through the list after the brainstorming session in a joint discussion round, we noticed that a great amount of the listed topics concerned were what we call quick-fixes. A quick-fix concerns a topic that requires little to no effort from the responsible city department to solve the matter. For instance one department responsible for youth and social services was planning a sports festival for the summer and wanted to know whether citizens would prefer the festival taking place in location a) or b). Another large group consisted of topics where citizens would indicate locations on a map for various purposes (e.g. where more bike racks are needed). When the research team specifically asked for topics where citizens would be invited to propose own ideas or indicate problematic areas or situations in the city, city officials reacted rather hesitantly to our request. They argued that regarding more complex problems and issues within the city they were already aware of opinions and viewpoints as people would already notify them of these issues through other means (e.g. telephone, personal visits). They further told us that people contacting them were always the same persons talking about the same problems and concerns. They assumed that those being active in the mobile participation platform would again be the same people or at least voice the same concerns, which would make the whole participatory process rather meaningless for them as they as the city authority would not gain any further relevant insights into the topics. Regarding particularly controversial topics, city officials feared heated debates and even shitstorms that would worsen the situation and definitely not lead to a solution. The participation platform would in this scenario serve as an outlet for disappointment, anger and dissatisfaction, bringing together sceptical and disenchanted citizens. This collection of negative feelings and resentments might even lead initially optimistical citizens to become doubtful. In short, city authorities and urban planners embraced the concept of public participation in a sense that they could claim they as city they were active in that respect and even a trailblazer for innovative participation methods – as long as the input gathered through these participatory processes was in line with their current strategies and did not feed controversial discussions.

Our presumption regarding this divergent mind-set towards public participation was confirmed during the Living Lab itself. Particularly in the last two meetings before the launch of the field trial but also in other meetings, we stressed the importance of the city allocating an adequate amount of resources for responding to citizens' input. We further highlighted that this responsibility would require substantial effort and commitment from their side. Representatives of the municipality acknowledged this and seemed to be prepared as well as willing to contribute the necessary resources. To facilitate coordination and communication within the municipality and across departments, a person was chosen to be responsible for the central management of the provision of feedback to citizens' input. Both city officials and urban planners seemed to be aware and clear on the amount of effort the trial and their active participation it would require from them. Yet, they appeared confident that they would be able to handle it.

To make responding to citizens' input easier and therefore less time-consuming, we implemented a web-based dashboard to which only authorities had access. This dashboard followed the same principles as the mobile version and also contained the same features, but had the advantage of being accessible from a desktop computer hence facilitating text-based input. The dashboard further allowed to search all input based on keywords. We anticipated that city officials and urban planners would benefit from this tool by being able to respond to citizens' input in a more efficient manner.

During the first few weeks of the Living Lab authorities were quite active in responding and providing feedback. Halfway through the trial the majority of these responses became short "thank you for your input" notes in which they assured citizens that their concern or idea would be forwarded to the responsible entity. Because these entities were rarely part of the municipality and therefore were either not obliged (and thus motivated) to update the status of an original request in the mobile participation platform or simply did not know of the origin of the request, the process of handling that input often stalled or stopped at this point altogether. Authors of the respective posts and other users interested in the matter reacted upset to this lack of status update and started doubting the meaning of contributing to the participation platform. In these cases, the research team intervened by asking the municipality for the status of the particular posts. In the majority of cases, officials replied that the matter was out of their hands and they were waiting for feedback themselves. An example of such a case was repairing bumps or cracks in streets. An external company hired by the city was responsible for fixing those issues. Whenever someone notified the city via the application of such a street related issues, city officials would contact that company instructing them to take care of the issue. After notifying the author of the post that the issue had been forwarded, according to the city officials their responsibility had been fulfilled. In most instances the commissioned company never reported back. After the first half of the Living Lab responses from city officials and urban planners had become so fragmented that the research team decided to install counter measures. As such, we started to compile all contributions that awaited feedback form authorities into one document that would be send to the municipality on a regular basis asking them to respond to the listed topics. Towards the end of the trial such a document was send to officials almost every week, reminding them of their commitment to provide feedback.

Interviews with a selection of city officials that were either directly or not at all involved in the Living Lab revealed two main reasons for this decline in feedback. These discussions revealed for one that only a very small number of city officials was actually aware of the trial and the existence of the mobile participation platform. This would explain why some departments never responded to posts they would have been responsible for. On the other hand, officials reported that a great amount of input coming from citizens through the mobile application was either not relevant for them (i.e. were not authorized to reply) or was not constructive in a sense that the post would contribute to any city-related conversation. Again other posts suggested ideas that were too bulky requiring the involvement of many stakeholders and complex considerations of factors. For the latter, city officials expressed the wish for a better informed public that would be aware of necessary processes and eventually lead to more substantiated and hence relevant input.

Interestingly enough, a large number of users of the mobile participation platform were city officials and urban planners that used the system as citizens suggesting ideas for improving quality of life and reporting issues themselves. This type of engagement accounted for more activity within the participation platform than replying to other citizens' input.

6 SUMMARY AND CONCLUSION

The presented project investigated novel concepts and solutions for citizen e-participation utilizing latest mobile device technology and appliances embedded in today's urban environments. Instead of merely informing citizens, the developed pervasive participation approach considered each level of e-participation by enabling, engaging, and empowering citizens with the ultimate aim of encouraging a continuous dialogue between a city and citizens by using contemporary technology. We described our methodological approach and experiences of the longitudinal field trial from the perspective of both citizens and authorities consisting of city officials and urban planners. Our insights of trialing a novel form of public involvement, in our case a mobile application, hold implications for practitioners such as municipalities but also commercial institutions that are aiming to increase the overall level of participation in their communities.

The reported observations show that both citizens and officials see great potential in the use of mobile devices to facilitate public participation and would like to see it further developed and applied on a broader scale (i.e. longer timeframe, different purposes). At the same time, there is also a great percentage of users who never actively became invovled with the system. While it underpins assumptions that some people are content with merely being informed about ongoing discussions, it also raised questions as to why these people chose not to become active. One explanation could be that some people are uncomfortable with generating text-based replies and would have liked other opportunities to contribute. Yet again, these people could have expressed their opinions through votes. Hence, it is important to provide a multitude of opportunities for people to engage.

Referring to the perspective of the authorities, the continous provision of feedback to citizens is of immense importance as this signalises citizens that they are being heard, listened to and that their participation causes impact. In a best case scenario, suggestions from citizens will eventually be implemented. Our trial showed that even though a municipality might be in favour of introducing novel forms of participation, actually implementing these is still a challenge. Succesful participation solutions are dependent on a continuous interplay between citizens, who are transparently informed about the status of their contributions and discussion topics. Also, there should be support by future systems to define suitable topics for discussion (beyond quick-fixes). Summarizing, we argue that it is crucial to integrate participatory processes and associated tools into exisiting (policy) processes and structures. Opportunities and alternatives are currently being analyzed within the b-Part project consortium.

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Fernerkundungsgestütze Wärmeverlustdetektion von Dachflächen als Beitrag zur Energieeffizienzsteigerung von Stadträumen – Ergebnisse einer Fallstudie in Graz/Österreich

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1 ABSTRACT

Der Beitrag dokumentiert die Ergebnisse eines Forschungsprojektes, das zum Ziel hat, die komplexen Zusammenhänge von Sensor, Atmosphäre, Dachbedeckung, Dachkonstruktion und Nutzung am Fallbeispiel der Gebäude des Campus der Karl-Franzens-Universität näher zu untersuchen. Die Vielzahl an unterschiedlichen Dacheindeckungen, die heterogene Altersstruktur der Bausubstanz sowie die Erfassung der Nutzung des Dachraumes geben einen differenzierten Blick auf den Aussagewert der Thermaldaten und dienen somit als ideale Testbasis zur Methodenentwicklung bzw. -verbesserung. Über eine kritische Betrachtung der Datenakquisition und des Zusammenhangs von Emissivität und Oberflächentemperatur sowie über die Erfassung der unterschiedlichen Dachbedeckungen bzw. –konstruktionen und der darunter liegenden Nutzungen kann schließlich eine qualitative Erfassung der Wärmeabgabe und der baulichen Defizitgebiete an den Dächern erfolgen.

Keywords: Effizienz, Dachflächen, Fernerkundung, Urbane Räume, Wärmeverlust

2 RELEVANZ DER THEMATIK

Die zunehmende Breitenwirkung des Klimawandeldiskurses (v. a. im Fokus der Reduktion von CO_2-Emissionen) der letzten Jahre bewirkte eine deutliche ökologische Bewusstseinssteigerung in der Bevölkerung. Durch eine Verbesserung der Energieeffizienz von Gebäuden ließe sich der Gesamtenergiebedarf der Europäischen Union um 5 bis 6% und die CO_2-Emissionen um circa 5% verringern. Hier spielen vor allem thermisch-energetische Sanierungsmaßnahmen eine bedeutende Rolle (EUROPÄISCHE KOMMISSION 2015). Sowohl bei Neubauten als auch bei der Sanierung von Gebäuden wird das Thema Energieeffizienz immer bedeutender (NICOL und HUMPHREYS 2002, KROMP-KOLB und JAROS 2009, BERGER und PUNDY 2009). Bei nicht gedämmten Gebäuden wird, je nach Bauart und Baualter, von einem Wärmeverlust von durchschnittlich 10–15 % (LILLESAND et al. 2008), 15–20% (FEDDECK 2003) bzw. von bis zu 30% (HEMACHANDRAN 2013) der gesamten Raumwärme über das Dach ausgegangen. Aufgrund des nach wie vor hohen Bestandes an Gebäuden mit thermisch-energetisch deutlich verbesserbarem Zustand besteht in Österreich jedoch noch immer erhebliches Reduktionspotenzial, denn derzeit liegt die jährliche Rate umfassender thermisch-energetischer Gebäudesanierungen mit 1% deutlich unter den in der Klimastrategie 2007 angestrebten 3% (UMWELTBUNDESAMT 2014).

Als Mittel zur Visualisierung von Wärmebrücken an Gebäudehüllen kommen häufig Wärmebildkameras zum Einsatz. Diese Technik ist mittlerweile gut ausgreift und wird von der Bevölkerung gut angenommen. Der Wärmestrom nach oben, und somit der Energieverlust über das Dach, ist im Bewusstsein der Bevölkerung aber bei weitem nicht so stark verankert. Ein Grund dafür liegt in Tatsache, dass dieser bisher schwierig zu erfassen bzw. zu visualisieren war. Durch den Einsatz von neuartigen, hochauflösenden flugzeuggetragenen Thermalsensoren ist es nun aber möglich den potenziellen Wärmeverlust über Dachflächen zu detektieren. Die Analyseergebnisse der Befliegungsdaten können in einem weiteren Schritt als Zusatzinformation in die Maßnahmen zur Dachsanierung integriert werden und liefern dadurch einen wertvollen Beitrag zur Minimierung des Energieverbrauches und von CO2-Emission. Die Untersuchung des Wärmeverlustes von Gebäuden insgesamt kann nur mit sehr großem Messaufwand gemessen werden (PARKER et al. 2000, SANTAMOURIS et al. 2001, HARTZ et al. 2006). Die flugzeuggetragene Thermografie wird seit den 1970er-Jahren für die flächendeckende Erfassung von Wärmeverlusten über Dachflächen in Städten und Gemeinden eingesetzt. Durchgeführt werden die Kampagnen zu einem

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überwiegenden Teil im Rahmen von Bewusstseinsbildungs- und Energiesparprogrammen. Die Ergebnisse der ersten noch rein qualitativ ausgerichteten Untersuchungen wurden bereits in den ausgehenden 1970er-Jahren methodisch kritisch hinterfragt. So zeigten erste wissenschaftliche Untersuchungen, dass die aus dem Flugzeug erfassten Thermaldaten durch eine Vielzahl von Einflussfaktoren bestimmt werden. Daraufhin wurde versucht, neue Modelle zu entwickeln, mit deren Hilfe die Wärmeverluste auch quantitativ erfasst werden können. Viele der für die Berechnung der Oberflächentemperatur notwendigen Einflussparameter sind aber nur schwer zu berücksichtigen bzw. ist dazu eine Menge, nur aufwändig zu ermittelnder, zusätzlicher Daten notwendig, sodass hier meist nur vereinfachte Annahmen getroffen werden (KERN 2015).

Mit dem Rückgang der Energiepreise Mitte der 1980er-Jahre geht auch die Zahl der Anwendungen und Publikationen stark zurück. Erst mit dem Aufkommen des Klimawandeldiskurses und dem zunehmenden Bewusstsein über den Zusammenhang zwischen der Emission von Treibhausgasen und der globalen Erwärmung sowie einem neuerlichen Anstieg der Energiepreise wird die Energieeffizienz von Gebäuden in den 1990er-Jahren wieder zum Thema. Die gegenwärtigen Projekte (Tab. 1), die vorwiegend von Städten und Gemeinden (in einigen Fällen, wie z. B. in den Projekten der RWE Deutschland, auch heute noch in Kooperation mit lokalen Energieversorgern) in Auftrag gegeben werden, werden in erster Linie von kommerziellen Interessen geleitet. Die zu erzielenden Projektergebnisse sind dadurch klar vorgegeben und die Projektfinanzierung an die Zielerreichung gekoppelt. Eine intensive, kritische, wissenschaftliche Auseinandersetzung mit der Thematik erfolgt heute, im Gegensatz zur Beginnzeit der Anwendung, meist nur mehr randlich (KERN, 2015). Die Probleme, die die Anwendung mit sich bringt, sind aber trotz neuer technischer Möglichkeiten sowohl im Bereich der Sensoren als auch der Auswertetechniken vielfach immer noch dieselben. Thermalbefliegungen werden auch heute noch als eine im Vergleich zu terrestrischen Methoden günstige und schnelle Alternative zur flächenmäßigen Erfassung von Wärmeverlustinformationen eines großen Gebietes angeboten. Da mit Thermalprojekten nach wie vor ein hoher Grad an Aufmerksamkeit in der Bevölkerung erzielt werden kann, werden derartige Projekte auch gerne zu PR-Zwecken eingesetzt. Dass es sich bei den im Rahmen der Projekte zur Verfügung gestellten Thermaldaten in der Regel um qualitative Anwendungen handelt, deren Aussagekraft vielfach anzuzweifeln ist, wird meist nicht weiter kommentiert und die Ergebnisse werden einer breiten Öffentlichkeit großteils ungefiltert, z. B. über WebGIS-Portale zugänglich gemacht.

Projekt	Zeitraum	Sensor	Geometr. Auflösung	Zusätzliche Daten / Informationen	Methode	Kommunikations -medium
Heat	Phase I (2008–2011)	TABI-320 (LW)	1,0 m	Dacheindeckungs-material über die Webseite durch Freiwillige	Quantitativ	Webseite (öffentlich) Öffentlichkeit
	Phase II (2011/2013)	TABI-1800(MW)	0,5 m			
EnergyCity	2010/2013	TS9260 (LW)	~0,5 m	Referenzmessungen (T, ε), Dachein-deckungsmaterial über Klassifikation	Quantitativ	Webseite (nicht öffentlich) lokale Entscheidungs-träger
RWE Flug-thermografie	seit 2012	Silver 660M (MW)	0,6[1] m	Fragebogen bzw. über Interpretations-schlüssel für die Bevölkerung	Qualitativ	Webseite (nicht öffentlich) Gebäudeeigen-tümer
TIR4U	2013/2014	TABI-1800 (MW)	0,6m (0,75 m)[2]	Dacheindeckungs-material über Klassifikation, ε unterschiedlicher Materialien, T/LF im Dachraum	Qualitativ/ Quantitativ	Bericht, Posterausstellung ,Auftraggeber, Stadtverwaltung

LW = Langwelliges Infrarot, MW = Mittelwelliges Infrarot; T = Temperatur, LF = Luftfeuchte, ε = Emissionsgrad

[1] Angabe gültig für Arnsberg (STADT ARNSBERG 2015) und Sonsbeck (GEMEINDE SONSBECK 2015).

[2] Die Daten wurden mit 0,75 m aufgenommen und auf 0,6 m entzerrt (MOSKOPP und LEGAT 2013).

Tab. 1: Übersicht über ausgewählte aktuelle Thermalprojekte (KERN 2015).

3 FALLSTUDIE: TIR4U - THERMAL INFRARED DETECTION OF ROOF HEAT LOSS FOR UNIVERSITY OF GRAZ

Auf Initiative der Stadt Graz ist das Institut für Geographie und Raumforschung der Karl-Franzens-Universität Graz seit 1986 in regelmäßigen Abständen (1996, 2004 und 2011) mit der Datenauswertung von flächendeckenden Thermalbefliegungen beauftragt worden. Die daraus gewonnen Expertise dient als wesentliche Grundlage für die Analyse des Stadtklimas in den Jahren 1986 bis 1992, 2004 bis 2006 und 2011/12 (LAZAR et al. 1993 und 1994, LAZAR und PODESSER 1999, LAZAR und SULZER 2013 und 2014). Die Schwerpunkte liegen dabei in der Verteilung städtischer Wärmeinsel („urban heat island“) und der Analyse der Frisch- und Kaltluftproduktion aus den Seitentälern (SULZER et al. 2009). Daraus abgeleitete Klimatopkarten und Planungskarten stellen in Graz seit 1986 wichtige Entscheidungsgrundlagen in der städtischen Raumplanung bzw. Stadtentwicklung dar. Die Änderung stadtklimatischer Elemente ist vor allem im Fokus der lokalen Modifikationen durch die Verbauungstätigkeit und der globalen bzw. daraus resultierenden regionalen Klimaänderungen von hohem Interesse. Der hohe Stellenwert von Fernerkundungsmethoden in der Stadtklimaforschung (u. a. VOOGT und OKE 2003, QUATTROCHI and LUVALL 2004, XU et al. 2008) und die Erfahrungen des Instituts für Geographie und Raumforschung soll in dieser Studie um den Einsatz von Thermaldaten in der thermischen Sanierung erweitert werden. Die erstmalig im Winter (20. Dezember 2011) durchgeführte Thermalbefliegung der Stadt Graz ermöglicht auch Aussagen über die besonderen klimatischen Verhältnisse in der Heizperiode. Bei der stadt- und geländeklimatologischen Analyse zeigte sich, dass durch die hohe Auflösung detaillierte Analysen der thermalen Strukturen der Stadt Graz und somit auch Aussagen über den Wärmehaushalt von Hausdächern durchführen lassen. Die spezielle klimatische Situation (kein Schnee, Windarmut, niedrige Lufttemperaturen) während der Befliegung im Dezember eignet sich sehr gut für die Erfassung der Wärmeabgabe der städtischen Strukturen an die Atmosphäre. Somit kann die Wärmeabgabe künstlicher Oberflächen analysiert und visualisiert werden.

3.1 Projektziele

Hauptziel des Projektes ist es anhand eines Fallbeispiels (die öffentlichen Gebäude der Karl-Franzens-Universität Graz) Methoden zur Analyse und Visualisierung thermaler Infrarot-Fernerkundungsdaten zu entwickeln und ein Bewusstsein für eine eventuell notwendige thermische Sanierung von Dächern anderen öffentlichen Gebäuden (z. B. des Magistrats, des Amtes für die Steiermärkische Landeregierung) und schließlich auch von Firmengebäuden und privaten Häusern zu wecken. Die öffentliche Verwaltung (entsprechende Abteilungen des Magistrats Graz, Landesregierung Steiermark) ist von Beginn an in die Projektentwicklung eingebunden und tritt somit zugleich auch als Bauträger und finanzieller Förderer von Gebäudesanierungen auf. Die Analysemethodik und Visualisierung der Thermaldaten, die beispielhaft an der Universität Graz durchgeführt wird, soll die Grundlage für eine flächendeckende Umsetzung in Graz sein.

Ein weiteres Ziel des Projektes ist eine differenzierte Methodenentwicklung für die Datenanalyse der Thermalaufnahmen unter Einbindung der klimatischen und baulichen Rahmenbedingungen im Bereich des Universitätsstandortes. Der Campus der Karl-Franzens-Universität besteht aus vielen unterschiedlichen Bauepochen. Neben der alten gründerzeitlichen Kernsubstanz (engerer Campus mit dem Hauptgebäude) gibt es auch barocke Bauten (z. B. Meerscheinschloss), Gebäude aus den 1960er Jahren (z. B. Erdwissenschaften), aus den 1990er Jahren (Mathematik-/Geographie-/Anglistikgebäude) und Gebäude aus dem beginnenden 21. Jahrhundert (Zentrum für Molekulare Biologie). Somit wird mit diesem Projekt ein breites Spektrum an verschiedenen Dachkonstruktionen (Bedeckung und Nutzung) erfasst. Durch die vergleichende Darstellung verschiedener Dachtypen werden Informationen in qualitativer und auch quantitativer Form ermittelt, die zur Berechnung des tatsächlichen Energieverlustes einbezogen werden können um eine ökologisch nachhaltige und ökonomisch effiziente Sanierung von Dachflächen zu unterstützen.

3.2 Datenakquisition

Die Informationsbasis für die Erfassung von potentiellen Wärmeverlusten über Dachflächen stellen thermale Infrarot-Fernerkundungsdaten dar, die im Zuge einer Befliegung am 20. Dezember 2011 (ca. 20.00 bis 21.30 Uhr) erhoben wurden. Dabei kam der Thermalsensor TABI-1800 (Thermal Airborne Broadband Imager) von ITRES Research Limited (2012), der im einem Wellenlängenbereich von 3,7 bis 4,8 µm Daten aufnimmt, zum Einsatz. Dieser lieferte bei einer Flughöhe von ca. 1850 m über Grund Daten mit einer geometrischen

Auflösung von 75 cm und einer thermalen Auflösung von 0,05° K. Eine erste Prozessierung der Rohdaten erfolgte bei der Sensorherstellerfirma ITRES in Calgary (Kanada). Die nachfolgende Orthorektifizierung wurde von der Vermessung AVT ZT GmbH durchgeführt. Dabei wurde eine geometrische Auflösung von 60cm festgelegt. Zur Abdeckung des TIR4U Untersuchungsgebietes wurde lediglich einer der insgesamt zwanzig Flugstreifen benötigt. Dadurch konnten für das gesamte Untersuchungsgebiet einheitliche Aufnahmebedingungen während der Datenakquise sichergestellt werden und es mussten keine radiometrischen Anpassungen der Befliegungsstreifen durchgeführt werden.

Um die kleinräumigen Strukturen von Baublöcken und Gebäuden mit unterschiedlichen Dacheindeckungsmaterialen für die geplante nachfolgende Korrektur der Emissionsgrade erfassen zu können, sind Fernerkundungsdaten mit einer entsprechend hohen geometrischen Auflösung erforderlich. Zur Erfassung der Dacheindeckungsmaterialien wurden multispektrale Bilddaten in Form von UltraCam Daten verwendet (Fig. 1).

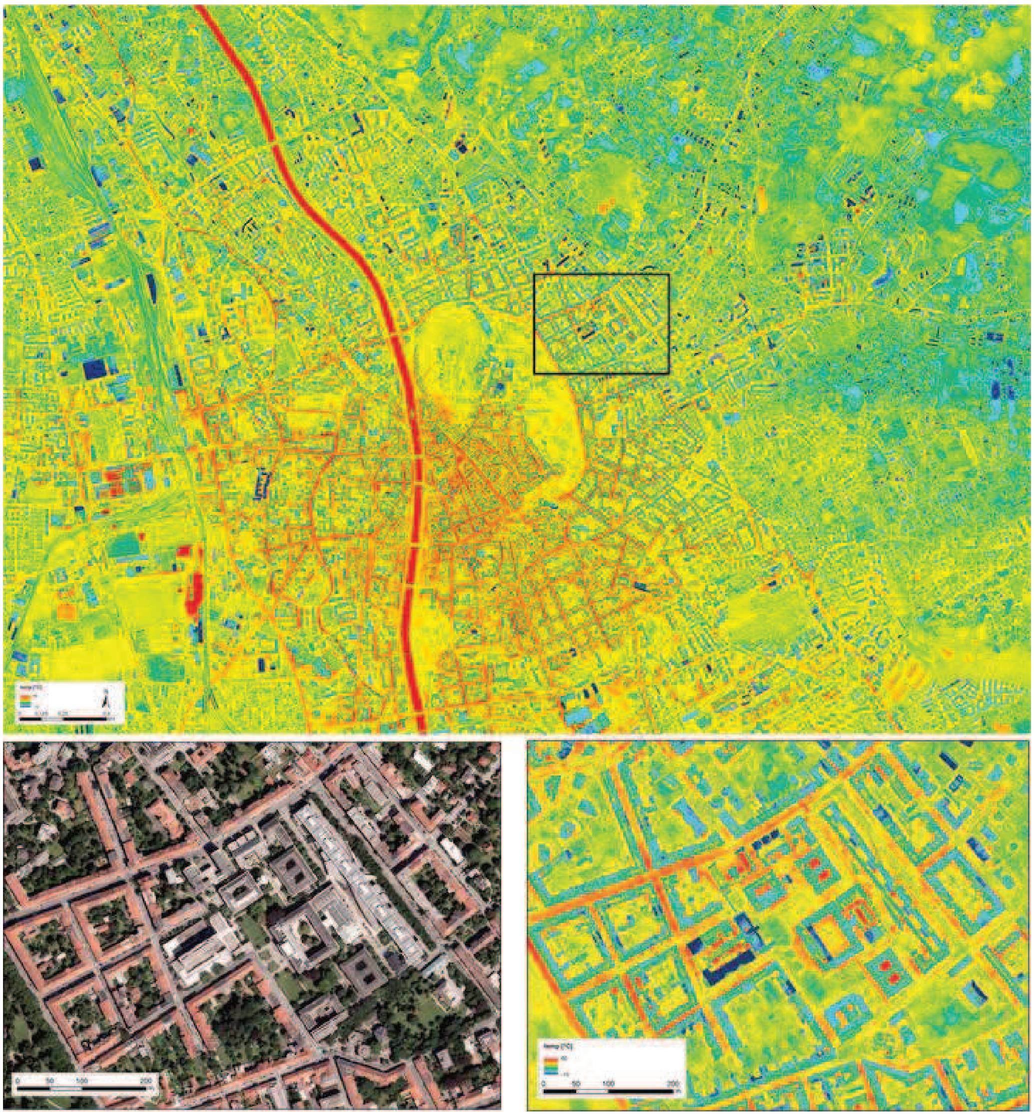

Fig. 1: Untersuchungsgebiet. Links unten: Detailausschnitt Campus Universität Graz UltraCam (Stadt Graz 2012); Rechts unten: Detailausschnitt Campus Universität Graz TABI-1800 (Stadt Graz, 2011)

3.3 Erstellung eines Dachflächenkatasters

Da reale Körper keine perfekten Emitter sind, ist die Temperatur der Dachfläche die von Sensor aufgenommen wird, stets kleiner als die wahre Temperatur der Fläche. Um für quantitative Untersuchungen die annähernd wahre Temperatur einer Dachfläche berechnen zu können, muss daher auch ihr Emissionsgrad bekannt sein. Da sich die Baustruktur und somit auch die Dachlandschaft im Untersuchungsgebiet als sehr heterogen darstellt, greifen herkömmliche Ansätze aus der Literatur, die meist den Gesamtdatensatz mit nur einem Korrekturwert anpassen, hier zu kurz. Da die Information über die Dacheindeckung in amtlicher Form nicht verfügbar ist, müssen alle Gebäude im Untersuchungsgebiet räumlich erfasst und nach Dacheindeckungsmaterialien klassifiziert werden. Zusätzlich wurden die Emissionsgrade ausgewählter Dacheindeckungsmaterialien in-situ erhoben.

Zur Abgrenzung der Gebäude in thermalen Infrarotdaten werden bei kleineren Untersuchungsgebieten oft eigens erstellte Vektordaten in Form von Gebäude-Shapefiles verwendet. In größeren Gebieten kommt häufig die Gebäudeinformation des amtlichen Katasters zum Einsatz (u. a. ALLINSON 2007, HEMACHANDRAN 2013). Bei der Verwendung der Gebäudegrenzen aus dem Kataster tritt das Problem auf, dass die beiden Datensätze, Gebäude-Shapefile und thermale Infrarotdaten, auch bei präziser Ko-Registrierung nicht immer deckungsgleich übereinander passen bzw. Gebäude(-teile) noch nicht oder noch immer eingetragen sind und es dadurch bei der Verschneidung der beiden Datensätze in den Thermaldaten im Randbereich der Gebäude zu Informationsverlusten kommt. Daher wurde im Zuge des Projektes ein objektbasierter Ansatz zur automatischen Erfassung der Gebäudeaußengrenzen entwickelt. Mit Hilfe der Software eCognition konnte durch den kombinierten Einsatz eines Digitalen Oberflächenmodells mit Mulitspektraldaten, in Form der Verfügung stehenden UltraCam Daten, alle Gebäude im Untersuchungsgebiet erfasst werden.

Die wichtigste Datenbasis zur Ermittlung der Gebäudegrenzen liefert das Digitale Oberflächenmodell. Damit wurden die Gebäude und andere erhabene Objekte in einem ersten Schritt über Höhendifferenzen und Neigungsinformationen grob abgeleitet. Zur exakten Abgrenzung der Gebäude und zur Differenzierung zwischen Gebäuden und anderen erhabenen Objekten, wie etwa Bäumen, wurde die spektrale Information aus den UltraCam Daten hinzugezogen. Die vegetationsbedecken Flächen wurden im Zuge eines iterativen Prozesses über den Vegetationsindex NDVI von den Gebäudeflächen unterschieden. Die wichtigsten Schritte des Vorgangs der Gebäudeabgrenzung sind in Fig. 2 beispielhaft dargestellt.

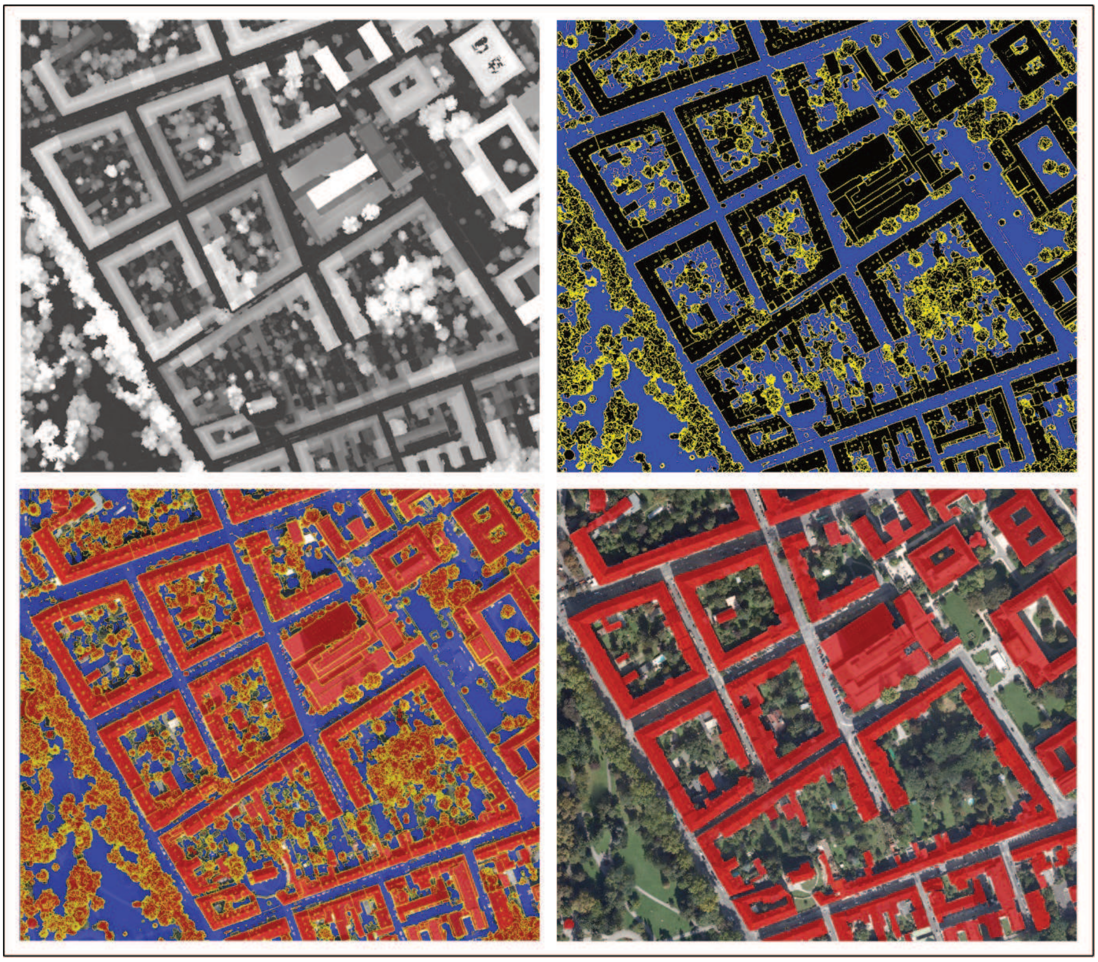

Fig. 2: Überblick über den Ablauf der Ableitung der Gebäudegrenzen. DOM (links-oben), Klassifikation der Geländegrundfläche (rechts-oben), Erfassung der erhabenen Objekte im DOM (links-unten) und die Gebäudegrundflächen nach der Trennung von den Vegetationsflächen (rechts-unten).

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Für die nachfolgende Klassifikation der Dacheindeckungsmaterialien wurde ebenfalls ein objektbasierter Auswertevorgang gewählt. Aufgrund der bereits vorliegenden Ergebnisse aus der Gebäudeerfassung konnten für die Erfassung der Dacheindeckungsmaterialien alle Nicht-Gebäudeflächen vorab automatisch ausgeschlossen werden und die nachfolgende Klassifikation wurde nur mehr innerhalb der Gebäudeflächen durchgeführt. Um auch die unterschiedlichen Dacheindeckungsmaterialen innerhalb eines Gebäudes oder Baublockes ableiten zu können, wurden die Gebäudeflächen auf Basis der spektralen Information aus den UltraCam-Daten mit Hilfe eines Segmentierungsalgorithmuses in kleine Einheiten unterteilt. Dafür wurde eine „minimum mapping unit“ (MMU) von 9m2 mit einer Objektmindestbreite von 2m (8 Pixel in den UltraCam-Daten) bestimmt. Diese Mindestgröße war auf Grund der geometrischen Auflösung der Thermaldaten von 0,6m und den in den Thermaldaten vorhanden Mischpixeln notwendig. Dacheinspengelungen und anderen kleineren Dacheindeckungseinheiten wie Dachflächenfenstern konnten dadurch nicht als eigenständige Bildobjekte erfasst und klassifiziert werden. Die im Zuge des Segmentierungsvorganges entstandenen Einheiten wurden nun im Rahmen des Klassifikationsvorganges den Dacheindeckungsmaterialklassen: Ziegel, Faserzement / Schiefer, Metall, Beton, Schotter, Beton / Schotter, Glas und Sonstiges zugewiesen. Da bei Baublöcken mit einheitlicher Dachbedeckung aneinandergrenzende Gebäude nicht automatisch als Einzelgebäude erfasst werden konnten, wurden diese nachfolgend manuell voneinander getrennt. Auf Grund der geringen spektralen Unterschiede von Faserzement und Schiefer in den UltraCam-Daten konnten diese beiden Klassen nicht automatisch getrennt voneinander klassifiziert werden. Die am Universitätscampus vorhanden Schieferdächer mussten daher in-situ erhoben und manuell eingezeichnet werden. Sonderflächen wurden auf Basis einer visuellen Klassifikation ebenfalls manuell eingezeichnet. Fig. 3 zeigt die Ergebnisse der Dacheindeckungsklassifikation.

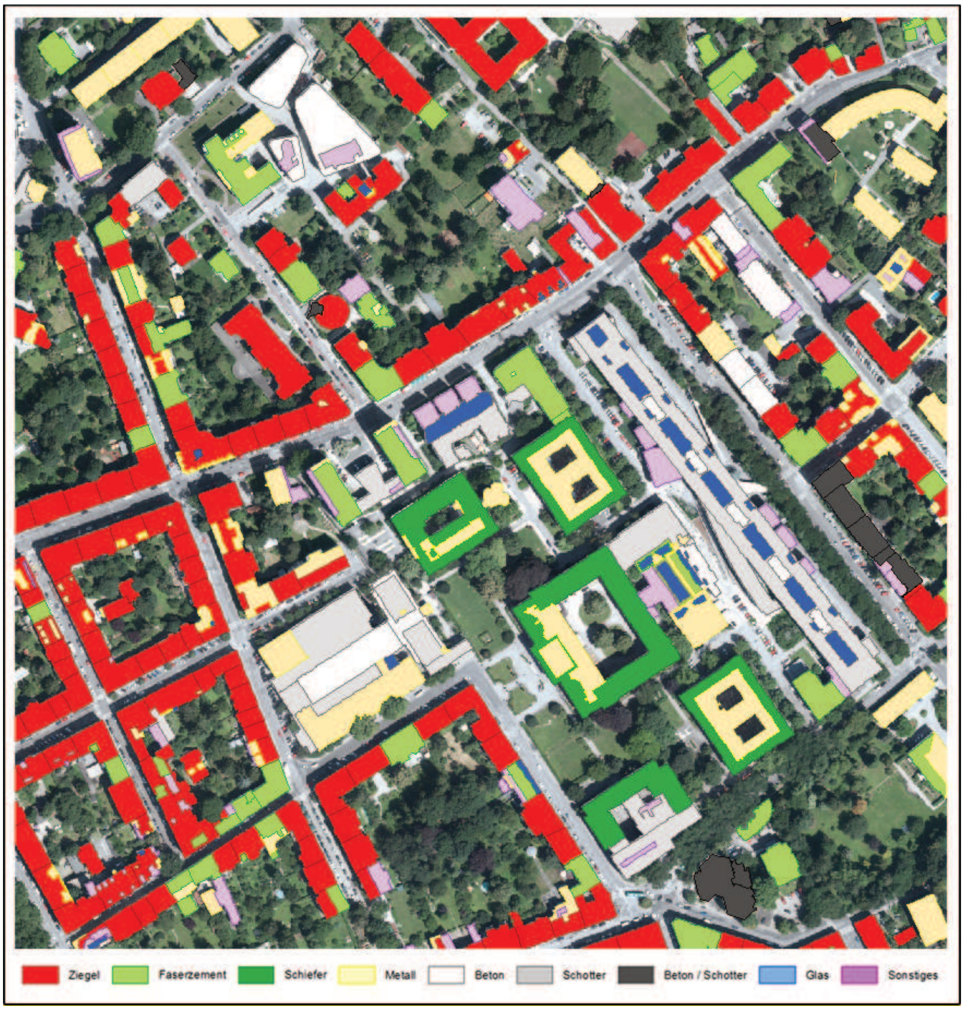

Fig. 3: Ergebnis der Dacheindeckungsklassifikation.

Studien, wie beispielsweise jene von HEIDEN und HELDENS (2010), zeigen, dass mit dem Einsatz von hyperspektralen Fernerkundungsdaten einen höherer Differenzierungsgrad bei der automatischen Klassifikation der Dacheindeckungsmaterialien erzielt werden kann.

3.4 In-situ-Erhebung der Emissionsgrade und Umrechnung der Emissivität auf reale Oberflächentemperaturen

Neben der Art des Dacheindeckungsmaterials muss auch der jeweilige materialspezifische Emissionsgrad bekannt sein. Der Emissionsgrad gibt an, wie viel Strahlung ein realer Körper im Vergleich zu einem idealen schwarzen Körper abgibt. Der Wert kann zwischen 0 und 1 liegen. Die Fähigkeit eines Körpers Strahlung abzugeben und somit der Emissionsgrad, ist abhängig von der materiellen Zusammensetzung des Körpers, seiner Oberflächenstruktur, der Wellenlänge sowie seiner Temperatur (Fig. 4, FOUAD und RICHTER 2012). Das bedeutet, dass die Temperatur, die ein Körper abgibt und die von einem Sensor aufgenommen wird, immer kleiner ist als die wahre Temperatur des Körpers. Um für quantitative Untersuchungen die annähernd wahre Temperatur eines Körpers berechnen zu können, muss daher auch sein Emissionsgrad bekannt sein.

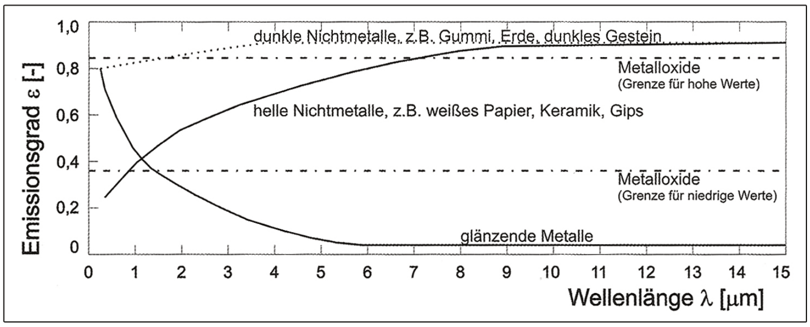

Fig. 4: Emissionsgrade verschiedener Materialien bei Raumtemperatur in Abhängigkeit von der Wellenlänge (FOUAD und RICHTER, 2012).

Zur Abschätzung der Emissionsgrade werden üblicherweise Werte aus gängigen Tabellenwerten verwendet. Doch hier tritt häufig das Problem auf, dass meist nur Werte für den Wellenlängenbereich von 8 bis 14 µm verfügbar sind, die angegebenen Werte eine sehr große Streuung aufweisen und diese in der Regel unter Laborbedingungen erhoben wurden. Doch schon kleine Abweichungen von angenommen zum tatsächlichen Emissionsgrad einer Oberfläche können zu deutlichen Fehlern bei der berechneten Temperatur führen.

Da für den Wellenlängenbereich von 3 bis 5 µm keine allgemein verfügbaren Tabellenwerte zur Verfügung stehen und auf Grund der großen Unsicherheiten bei der Verwendung von Emissionsgradangaben aus Tabellenwerken und der signifikanten Fehler, die daraus bei der Berechnung der Oberflächentemperaturen entstehen können, empfiehlt es sich die Emissionsgrade für die im Untersuchungsgebiet vorhandenen Materialien im Labor oder in-situ zu erheben. Da in der Gebäudethermographie heute keine Mittelwellenkameras (mehr) verwendet werden, mussten für die Untersuchungen auf ein Langwellengerät zurückgegriffen werden. Die Problematik der gängigen Verwendung von Tabellenwerken kann aber auch damit gut aufgezeigt werden.

Im Zuge des Projektes wurden die Emissionsgrade unterschiedlicher Dacheindeckungsmaterialein (Betonplatten, Glas, Faserzementschindel, Metall, Schiefer, Schotter und Tonziegel) an fünf Gebäuden des Campus der Universität Graz in-situ erhoben. Zu Erhebung wurde eine Infrarotkamera der Typs FLIR T 640, die in einem Spektralbereich von 7,5 bis 14 µm aufnimmt, verwendet. Eine Infrarotkamera, die im selben Spektralbereich wie der für die Befliegung verwendete TABI-1800, nämlich 3,7 bis 4,8 µm, aufnimmt stand für die Untersuchungen nicht zur Verfügung. Die Aufnahmen erfolgten ca. 1 bis 3 Stunden nach Sonnenuntergang bei einer Lufttemperatur von ca. 3° C und einer relative Luftfeuchte von 60%.

Zur Erhebung der Emissionsgrade wurden jeweils drei Referenzemitter, in Form von Klebepunkten, deren Emissionsgrad bereits bekannt war, auf die zu untersuchende Fläche aufgebracht. Die Ermittlung der Strahlungstemperatur des Hintergrundes erfolgte mit Hilfe eines Reflektors aus Aluminiumfolie. Darüber hinaus wurde bei jeder Messung mit einem Temperaturfühler auch die Umgebungstemperatur erhoben. Messsetting, Thermogramm sowie die Ergebnisse der Emissionsgraderhebung für das Hauptgebäude der Universität Graz sind in Fig. 5 dargestellt.

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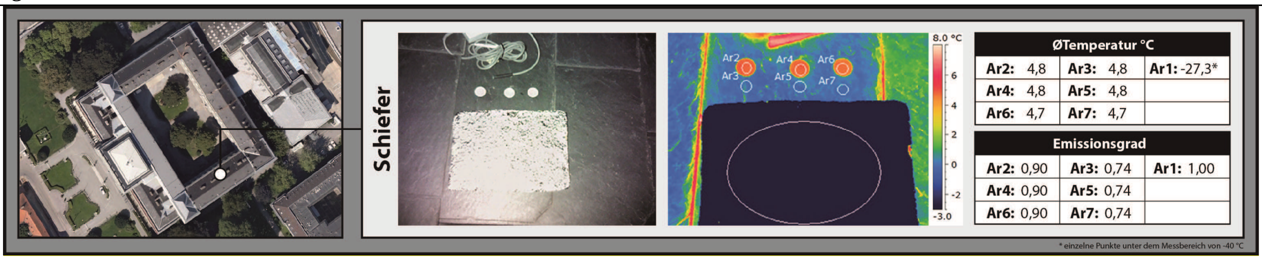

Fig. 5: Erhebung der Emissionsgrade am Dach des Hauptgebäudes der Universität Graz. Dachfläche im Luftbild (links), Messsetting, Thermogramm sowie Temperaturwerte und ermittelte Emissionsgrade (rechts; MUDRI, 2014).

Tab. 2 zeigt die Ergebnisse der in-situ-Erhebung für alle untersuchten Dacheindeckungsmaterialien. Mit Ausnahme der Werte für Tonziegel, wurden im Zuge der in-situ Erhebung für die jeweiligen Messpunkte der Materialien einheitliche Emissionsgrade ermittelt. Der Emissionsgrad bei Tonziegeln variiert in Abhängigkeit des Verwitterungszustandes zwischen ε = 0,88 und ε = 0,95. Hier ist ein deutlicher Anstieg des Emissionsgrad mit zunehmender Verwitterung des Material zu erkennen ist. Neben den in-situ ermittelten Emissionsgraden sind in Tabelle 1 auch Vergleichswerte aus gängigen Tabellenwerten aus der Literatur angeführt. Die erhobenen Werte liegen, außer bei Schiefer, alle innerhalb der angegeben Schwankungsbreiten. Die großen Schwankungsbreiten der Literaturwerte zeigen aber auch deutlich die Problematik der Verwendung von Werten aus der Literatur auf.

Material	ε in-situ	ε Tabellen	Material	ε	ε Tabellen
Betonplatten	0,94	0,88-0,951	Schiefer	0,74	0,972
Metallumfassung	0,86	0,02-0,972	Faserzement I	0,93	0,88-0,951
Schotter	0,93	-	Faserzement II	0,93	0,88-0,951
Glas	0,83	0,76-0,942	Tonziegel	0,88 - 0,95	0,91-0,932

[1] Beton/Zementbeton (PARKER et al. 2000, 2 OMEGA 2014)

Tab. 2: Vergleich der in-situ erhobenen Emissionsgrade mit Tabellenwerten aus der Literatur.

Die Emissionsgrade der Materialien im Untersuchungsgebiet können im Zuge einer in-situ Erhebung sehr genau erhoben werden, doch auf Grund der Heterogenität der Dachlandschaft am und um den Campus ist es mit verträglichem Zeit- und Kostenaufwand kaum möglich die Emissionsgrade für alle vorkommenden Materialien inkl. ihrer Verwitterungszustände (z.B.: Ziegel) zu erheben. Daher muss eine vereinfachte Herangehensweise getroffen werden, die aber große Unsicherheiten bei der Ermittlung der realen Oberflächentemperatur mit sich bringt. Schon kleine Abweichungen des Emissionsgrades können in Abhängigkeit von der Umgebungstemperatur zu großen Fehlern bei der berechneten Temperatur führen. Diese Unsicherheit ist in Fig. 6 grafisch dargestellt. So erscheint beispielsweise eine Oberfläche mit einem Emissionsgrad von 0,7 (wie Schiefer) die real eine Temperatur von -3° C aufweist bei einer Hintergrundtemperatur von -30° C in der thermalen Infrarotaufnahme mit 6,3° C. Die Hintergrundtemperatur wurde während der Befliegung aber nicht erfasst und die Emissionsgrade der Oberflächen für den Wellenlängenbereich von 3 bis 5 µm sind nicht verfügbar.

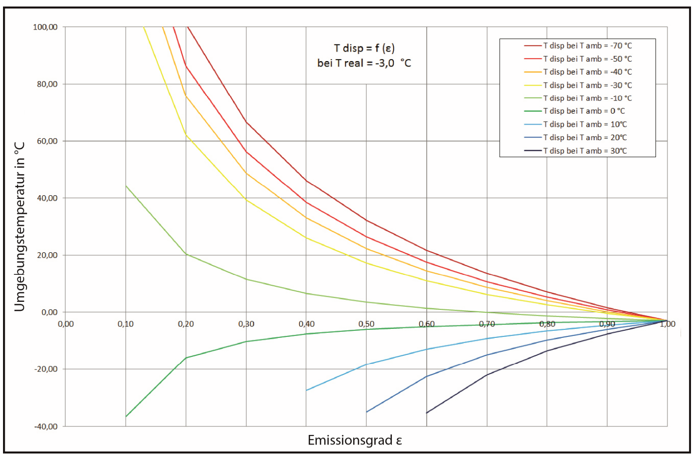

Fig. 6: Angezeigte Temperatur (T disp) in Abhängigkeit von der Umgebungstemperatur (T amb) bei unterschiedlichen Emissionsgraden ε (MUDRI, 2014b).

Hinzu kommen noch die Unsicherheiten bzw. die Einschränkungen durch die räumliche Auflösung sowohl der thermalen Infrarotdaten als auch der UltraCam Daten bei der automatischen Erfassung der Dacheindeckungsmaterialien. Eine quantitative Auswertung ist daher nur für homogene Untersuchungsgebiete zu empfehlen. Aus diesen Gründen wurde im Rahmen des Projektes von einer Umrechnung der scheinbaren Temperaturen in berechnete Oberflächentemperaturen Abstand genommen.

3.5 Ausarbeitung eines Parameterkataloges

Ein großes Ziel des Forschungsprojektes war es, Einschränkungen dieser Fernerkundungsmethode im Kontext der vorhandenen Daten aber auch im Vergleich mit bisherigen Studien aufzuzeigen und gegebenenfalls Lösungsansätze bereitzustellen. Einige der Einschränkungen lassen sich in einer, speziell für diesen Verwendungszweck der Thermaldaten abgestimmten, Datenakquise aufheben. Teilweise sind Einschränkungen sehr stark abhängig an begleitenden in-situ Messkampagnen, sodass eine quantifizierbare Auswertung der Thermaldaten nur mit höherem Personalaufwand, und damit einhergehend Kostenaufwand möglich ist. Hier gilt es präzise den weiteren Verwendungszweck (quantifizierbare / qualifizierbare Aussagen) mit dem zu betreibenden Aufwand abzustimmen.

3.5.1 Befliegungszeitpunkt

Die Angaben in der Literatur weisen für thermale Infrarotaufnahmen bezüglich des frühesten möglichen Aufnahmezeitpunktes nach Sonnenuntergang Schwankungen von 4 bis 12 Stunden auf (u. a. ÖNORM 1999, ALLINSON 2007; MEIER et al. 2010, LAGOUARDE et al. 2012). Bei den Aufnahmen der Stadt Graz konnte aber nur eine maximale Auskühlungszeit von 3-5 Stunden erreicht werden. Bedingt durch den frühen Befliegungszeitpunkt sind thermische Einflüsse durch Sonneneinstrahlung in den Daten nicht ganz auszuschließen (Fig. 7). Die Ergebnisse der Modellierung der Sonneneinstrahlung auf Basis eines digitalen Oberflächenmodelles der Stadt zeigen, dass in den Daten für alle süd- bis westlich exponierten Dachflächen zum Befliegungszeitpunkt noch Effekte der im Laufe der 6 Stunden eingegangenen Sonneneinstrahlung zu erwarten sind.

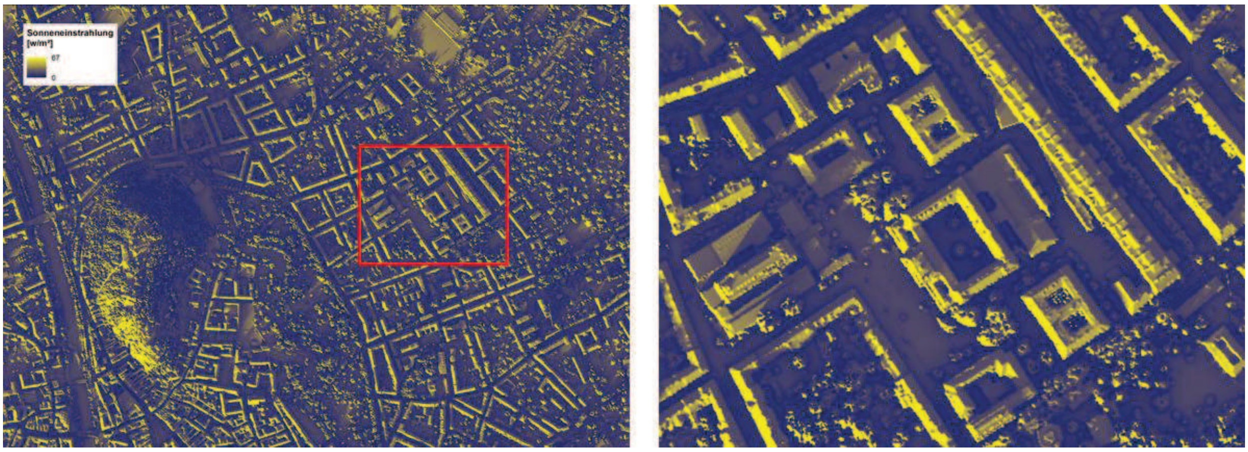

Fig. 7: Summe der direkten und diffusen Sonneneinstrahlung in W/m² im Stadtgebiet berechnet sechs Stunden vor dem Zeitpunkt der Aufnahme. Teile des Bezirks Innere Stadt mit Schlossberg, sowie Geidorf und St. Leonhard (links), Detailansicht Campus Uni Graz (rechts).

3.5.2 Wellenlängenbereich des Sensors

Der verwendete Sensor TABI -1800 operiert in einem Wellenlängenbereich von 3,7 – 4,8 µm, also im mittleren Infrarot. Dieser Wellenlängenbereich eignet sich besonders gut zur Detektion von sehr hohen Temperaturen. Für Fragestellungen rund um das Thema Wärmeverlust von Gebäuden wären aber Sensoren, die im Wellenlängenbereich von 8 bis 13 µm, dem langwelligen Infrarot, aufnehmen, besser geeignet. Zudem sind heute Thermalkameras, die im mittleren Infrarot aufnehmen und für Referenzmessungen am Boden benötigt werden, nur mehr schwer verfügbar.

3.5.3 Geometrische Auflösung

Die im Projekt verwendeten Thermaldaten verfügen über eine geometrische Auflösung von 60 cm. Auf Grund der großen Heterogenität der Dachlandschaften im Untersuchungsgebiet ist eine detailgenaue Erfassung von kleineren Einheiten wie metallische Einfassungen, Dachrinnen, Schneefänger, kleinere

Dachflächenfenster oder Lüftungen nicht möglich. Häufig bestehen diese kleineren Einheiten aus Metallen, also Materialien mit einem sehr niedrigen Emissionsgrad. Diese führt zu einem hohen Anteil an Mischpixeln und somit Mischtemperaturen in der Thermalaufnahme, die dadurch in diesen Bereichen nur mehr schwer bzw. nur mit großen Einschränkungen interpretierbar ist.

3.5.4 Partizipative Beteiligung der Bürger

Das Projekt TIR4U hat wichtige Erkenntnisse für die methodische Umsetzung einer Thermalbefliegung zum Zwecke der Dachanalysen gebracht. Neben der forschungsorientierten Betreuung der Flugkampagne hinsichtlich der klimatischen Rahmenbedingungen (Wetter / Aufnahmezeitpunkt / Jahreszeit / zusätzliche Messkampagnen im Gelände) hat sich die Notwendigkeit einer Einbindung der Bevölkerung herausgestellt. Hier wurde mit dem Magistrat Graz schon eine entsprechende Vorgehensweise eingeleitet. Die Bevölkerung soll als wichtige Grundlage für die Analyse der Daten, unter anderem Informationen über die Gestaltung, Eindeckung, Dämmung und Nutzung liefern. Dafür bekommt der Hausbesitzer / die Hausbesitzerin Informationen über das thermische Verhalten der Dächer. Dieser Informationsaustausch erfolgt über ein WEBGIS gestütztes Online Formular.

3.6 Dachflächenemissivitätsanalyse anhand von Beispielgebäuden

Als Testgebiet wurde das 1895 errrichtet Hauptgebäude der Karl-Franzens Universität mit der angrenzenden Universitätsbibliothek gewählt. Der angrenzende Gebäudeteil der Universitätsbibliothek ist von einer sehr komplexen Dachlandschaft gekennzeichnet.

Um einen Überblick betreffend der wärmsten Bereiche (potenzielle Leckagen) zu bekommen, wurde eine Hot Spot Analyse durchgeführt. Die Detektion der Hot Spots funktioniert in zwei Schritten. In einem ersten Schritt erfolgt die Ausweisung von Rasterzellen als potenzielle Hot Spots. Also solche werden Rasterzellen bezeichnet deren Wert höher ist als jener der acht Nachbarzellen. In einem zweiten Schritt erfolgt mittels einer Nachbarschaftsanalyse eine detaillierte Untersuchung der zuvor erfassten potenziellen Hot Spots. Der verwendete Algorithmus greift dabei jede Zelle im Raster auf und berechnet ein definiertes statistisches Kriterium mit einer identifizierten Nachbarschaft.

Als statistisches Kriterium wurde die Überschreitung einer Temperaturspanne (range) gesetzt. Die Nachbarschaftsanalyse funktioniert überlappend, daher werden Zellen mehrmals in die Kalkulation einbezogen. Erfüllt eine Rasterzelle beide Kriterien, erfolgt die Zuweisung als Hot Spot. Diese Berechnung wird für alle im Zuge der Dacheindeckungsklassifikation ermittelnden Flächen durchgeführt. Dadurch ist der Algorithmus auch für Thermaldaten anwendbar, die nicht hinsichtlich der Emissivität korrigiert worden sind. Das limitierende Kriterium stellt die Segmentierung der Dacheindeckung dar.

Die Kalibrierung des Algorithmus erfolgte für zwei Gebäudetypen. Erstens für den Typus „Einzelgebäude“, mit einer relativ homogene Dachlandschaft und einer geringen Anzahl an Kaminen und Entlüftungen. Zweitens für den Typus „komplexe Gebäude“, mit sehr heterogener Dachlandschaft, einer hohen Anzahl an Kaminen und Entlüftungen bzw. komplexe Installationen (Klimaanlagen). Beispielhaft für die erzielten Ergebnisse ist in Fig. 8 das Hauptgbäude sowie die Universitätsbibliotek dargestellt.

Die bisherigen Anwendungen von Fernerkundungstechniken im Kontext der thermischen Sanierung integrieren thermische Einflussfaktoren des obersten Dachraumes nur ansatzweise. Ziel des Projektes war es, durch die Berücksichtigung der Verhältnisse des obersten Dachraumes, den Grund der thermalen Emissivität eines Gebäudes zu analysieren und damit einen Beitrag zur Methodenverbesserung dieser Fernerkundungsmethode zu liefern. Zu diesem Zweck wurden in 8 Gebäuden 19 Temperaturdatenlogger installiert (Fig. 9), die in einem 10-Minuten-Intervall Temperatur und Luftfeuchte aufzeichnen.

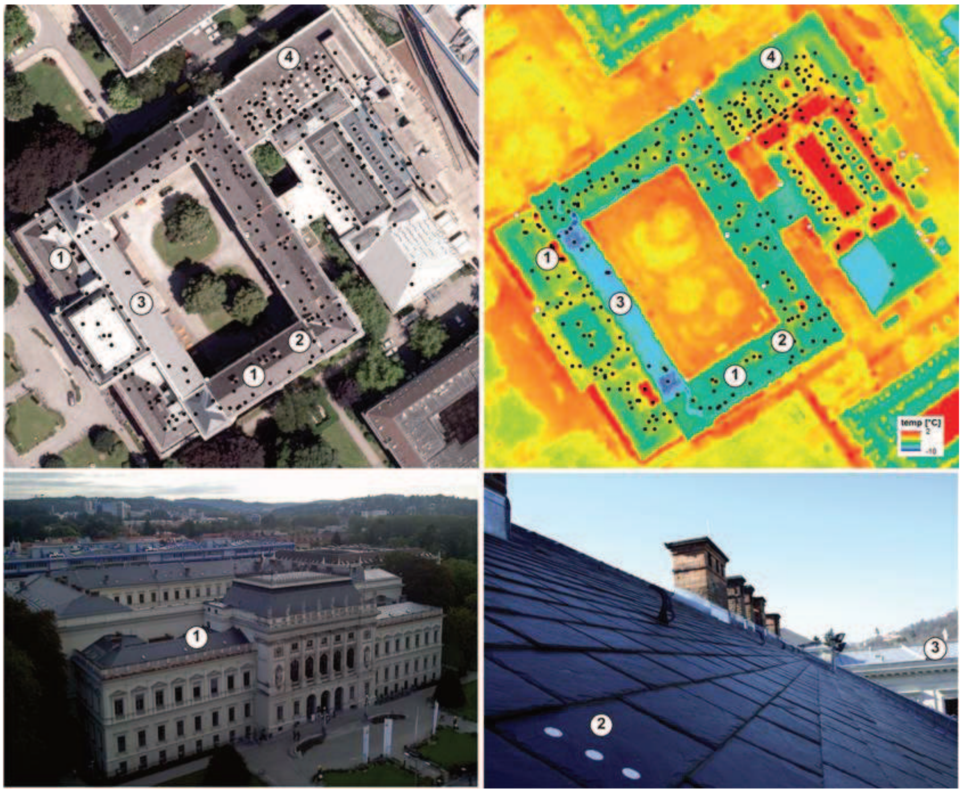

Fig. 8: Ergebnis der Hot-Spot-Detektion am Beispiel des Hauptgebäudes der Karl-Franzens-Universität Graz (Universitätsplatz 3) und angrenzender Universitätsbibliothek. (1) Position der Datenlogger; (2) Position der In-situ-Emissivitätsmessung für die Dacheindeckung Schiefer; (3) Metalldach; (4) Ventilationsinstallationen.

Fig. 9: Position der Datenlogger. (1) Elisabethstraße 27; (2) Holteigasse 6; (3) Mozartgasse 3; (4) Mozartgasse 8; (5) Mozartgasse 14; (6): Schubertstraße 51; (7/8) Universitätsplatz 3.

Die Aufzeichnung der Datenlogger (Fig 10) dienen als Zusatzinformation über den obersten Dachraum betreffend Durchlüftung oder Temperaturstau.

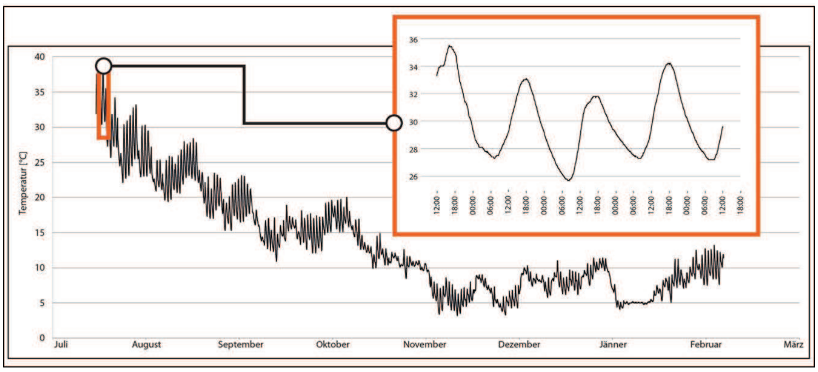

Fig. 10: Beispiel Temperaturdatenlogger Hauptgebäude der Karl-Franzens-Universität Graz (Universitätsplatz 3). Der nicht gedämmte oberste Dachraum zeigt einen ausgeprägten Tagesgang der Temperatur.

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4 ZUSAMMENFASSUNG UND AUSBLICK

Das Projekt TIR4U hat wichtige Erkenntnisse für die methodische Umsetzung einer Thermalbefliegung zum Zwecke der Dachanalysen gebracht. Die Ergebnisse der Arbeit zeigen, dass quantifizierbare Aussagen mit den derzeitigen technischen Möglichkeiten nur unter einem großen zusätzlichen, zeitlichen und finanziellen Aufwand erzielt werden können. Neben der forschungsorientierten Betreuung der Flugkampagne hinsichtlich der klimatischen Rahmenbedingungen (Wetter / Aufnahmezeitpunkt / Jahreszeit / zusätzliche Messkampagnen im Gelände /…; weitere Details können aus KERN 2015 entnommen werden) hat sich die Notwendigkeit einer Einbindung der Bevölkerung herausgestellt. Hier wurde mit dem Magistrat Graz schon eine Vorgehensweise eingehend diskutiert. Die Bevölkerung soll als wichtige Grundlage für die Analyse der Daten, unter anderem Informationen über die Gestaltung, Eindeckung, Dämmung und Nutzung des Gebäudes zum Befliegungszeitraum, liefern. Dafür bekommt der Hausbesitzer / die Hausbesitzerin Informationen über das thermische Verhalten des Daches. Dieser Informationsaustausch soll über ein WEBGIS gestütztes Online Formular erfolgen. Die Umsetzung ist ab Herbst 2016 geplant.

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reviewed paper

Floating Architecture and Structures – an Answer to the Global Changes

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1 ABSTRACT

Currently a contradictory global situation takes place. The climate and social changes are progressing. The sea level is rising by the smelting of ice and the extension of ocean owing to the temperature rise. This means: the building ground reduces above all things in costal and river districts. On the other hand the mankind and its claims with regard to living room is growing and more building sites are necessary. A smart solution for the conflict situation is the floating architecture. This means floating settlements and cities. In the consideration should be taken also so-called amphibious and floatable houses as a solution in case of floods in river destrics. Technical and social questions must be investigated. Some examples for the problems are demonstrated in the paper.

Keywords: alternative energies, floating architecture, floating settlements, Schwimmende Bauten, self sufficiency

2 INTRODUCTION

Smart me up! In case of sea level rise and increasing frequency of destroying floods the floating houses are an innovative idea for coastlines and river districts in times of global climate change (Strangfeld, 2014). The idea of floating settlements should be transfered ino the praxis. Then a lot of problems refering technique, administration and social behaviour of the user of floating equipments are to operate.

For the moving building ground there must be investigated for instance the following main points:

- Investigation and development of materials and constructions
- Selfsufficency with regard to supply and disposal
- Safety of users and construction, pontoons should be investigated with regard to fire protection, waterwaves, water chemistry and ice formation,
- Adaptation of architecture and design to the regional and national conditions
- Environmental protection
- Economic aspects

3 GLOBAL CHANGE

The statement of the last report of the IPCC is clear: sea-level rise is expected to continue both faster and more intense than previous forecast. Even with a drastic reduction of greenhouse actions of the world community, the process of sea level rise will continue for many decades and infrastructure threaten. In this process is between the cause and its effects a phase shift of up to more than a hundred years (IPCC, 2013). Regardless of the loss of human settlements owing to desert wandering and sea level rise (fig.1 and 2), the demand for land increases due to global population growth (fig. 3) and the increasing demands of the people with respect to living space and leisure culture.

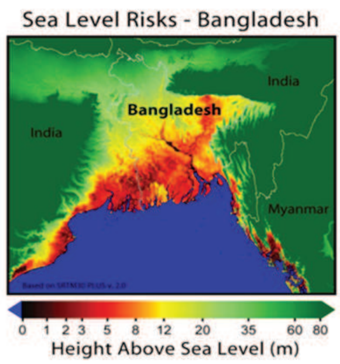

Fig.1: Examples of threaten of land by rising sea level, Fig.2: The Netherlands and Bangladesh

Even in the industrialized nations with declining birth rate several 100ha areas are additionally sealed daily. On the other hand are available unused industrial ports, channels and newly created mining lakes for floating structures. More than 70% of the earth's surface is covered by water and this area is growing.

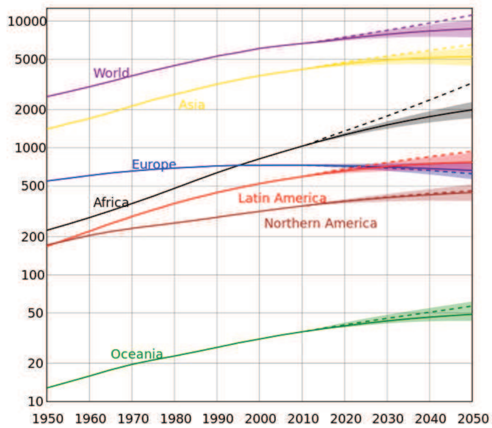

Fig. 3: Course oft the world population acc.U.N. (Bundeszentrale für politische Bildung, 2010)

According to recent research (Klingholz, 2016), the number of children per woman is clearly correlated with the educational level of a country. With education initiatives in developing countries, the absolute number of the world's population could therefore fall back even again. How teaches the situation in the industrialized nations the requirements for building ground, including the infrastructure will continue in spite of everything to grow. This means in context with the climate change, a settlement from water surfaces is expected to continue

4 FLOATING ARCHITECTURE

4.1 History

The global history of floating houses is very complex and widespread almost all continents (Stopp, 2012). The technique and architecture of these buildings all over the world depend on the climate boundary conditions, the culture and the raw materials, which were available at the different local places, e.g. (fig 4). The historical situation in Europe is relatively simple: at the beginning there were houseboats, which were in many cases originally used as barges before. Asia has much longer history of floating architecture. Yet owing to the Asian mentality the documentation is very meagre and the records are only rarely available.

Fig. 4:"Life on the water in Asia", photography: Gerold Noack

4.2 Current situation

All over the world there are efforts underway the image of districts to impove by means of the floating architecture. Modern floating buildings are constructed with accordance to all sanitary requirements and are made with the newest technologies and materials, compared with floating houses-boats, fishmarkets and other traditionall floating constructions (Völker, 2015).

Following figures represent views of the most extraordinar and functional contemporar residential and non-residential products (e.g. congress centre Rotterdam, fig. 5) of floating architecture. A very interesting idea could be a floating stadium, fig.6. After the use of the world cup it is possible to transfer to anorher place in order to use for the next event. Unlike many other sport facilities by this the utilization is increased. Another one unique object is a floating research station. It is situated nearby river Rhine- the first “plus energy house on waterr”, which aims to win energy only from environmental sources (fig. 7). The floating church in figure 8 was erected at the ground before the water was coming. It was fixed by means of long steel chains on concrete cubes. With the flooding the object was rising. Touristic examples, shown in the figures 9 and 10, demonstrate the situation of the Lusatian Lakeland in the eastern part of Germany.

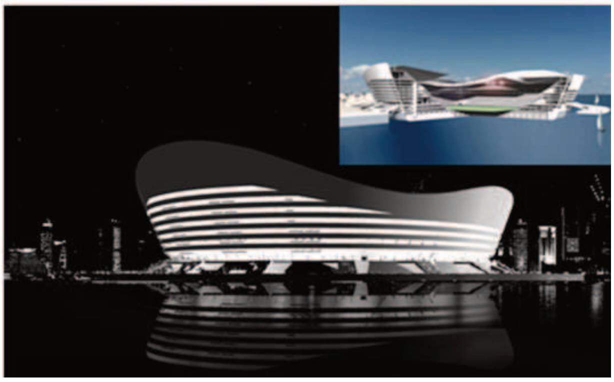

Fig. 5: Floating Pavillon, Rotterdam J.W. Roel, FlexBase, Fig. 6: Floating soccer stadium, world Cup 2022 in Quatar, designed by Peter Knoebel, Düsseldorf

Fig. 7: Floating research station on a former opencast gravel mining, nearby Kleve/ Rhine, Fig. 8: Floating church installed in area of “Neu-seenland” nearby Leipzig

Fig. 9: Lusatian landscape, the largest artificial created Lakeland in Europe, Fig. 10: Floating house typ „Ar-che”, Lusatian landscape, marina Geierswalder Lake

Being the world leader in producing of floating constructions and accepting floating objects by laws The Netherlands has not only world famous “boat- houses”, appeared at the end of 19th century, but also a lot of modern communities on the water and non-residential floating objects with annual constant production of

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300 nowadays. “IJburg neighborhood” is a community on water in the capital of the country for more than 45000 residents.

5 SCIENTIFIC TASKS

As shown in the chapter before up to now the floating architecture is erected and designed with a hightech style. In most cases the supply and disposal is carried out by means of the infrastructure of landside. But if we look for settlements with thousands of people we have to develope a self-sufficient community. This means new ideas of construction, new materials and above all things inexpensive products including infrastructure.Having unusual boundary conditions floating architecture causes new problems to be investigated and solved. Among of them there are themes of balance on the water, fire protection, energy supply and smart implementation of environmental sources, ice formation protection and utilisation. The scientific group of the Institute for floating buildings IfSB of the BTU Cottbus carries out experiments and scientific studies to improve conditions in floating constructions and its safety.

5.1 Safety of users and construction

The building ground, partly strong moving and sometimes covered by ice, must be considered by the people. It is most important for children, old humans and also guests. The techniques for this demands must be developed and installed. On the other hand the picture in the fig. 11 symbolizes the possibilities of the adaptation of the man to his environment. It is demonstrated the two-handed activity and at the same time the locomation across the lake by an active leg. The adaptation is also necessary with regard to the waste in context with a very sensitive natural environment.

Fig. 11: Inle Lake in Myanmar, so-called one-leg angler when fishing. Photography Andrea Staar

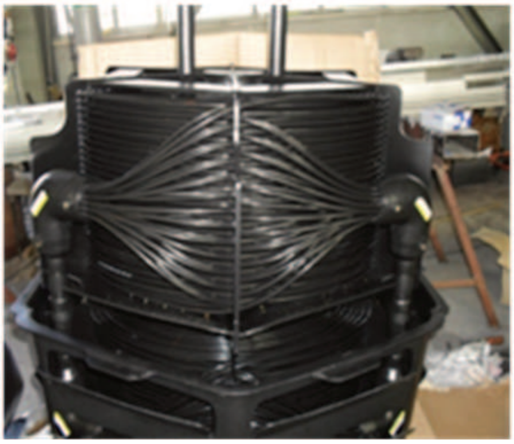
5.2 Selfsufficency with regard to supply and disposal

One of the undeniable advantages of floating objects is their location direct on water – a huge energy source under the floor. By having high comfort requirements modern floating houses should be supplied with energies of different types and levels. The investigations of the IfSB are aimed at optimizing the heat- and mass transfer processes of underwater heat exchangers to improve the energy efficiency of the whole heat-supplying system. Two types of heat exchangers have been examined, (Malakhova, 2016).

“Compact” heat exchanger can be described as a coil of thin plastic pipes in figure 12 with a whole length of about 1040m, constructed in plastic envelope and installed in different depths under water.

“Spiral” heat exchanger is a spiral- formed pipe with a diameter of pipe, diameter of spiral and whole length of 30mm, 0,65m and 44 m correspondly. Two spirals of this heat exchanger are constructed directly between three parts of the pontoon in figure 14 of the floating house represented in figure 10.

Experiments on heat exchangers are assisted by theoretical investigations and simulation of thermodynamic processes, which helps to optimize form, materials, mass flow rate and heat-storage medium in underwater applications and to minimize the measurements and experimental investigations.



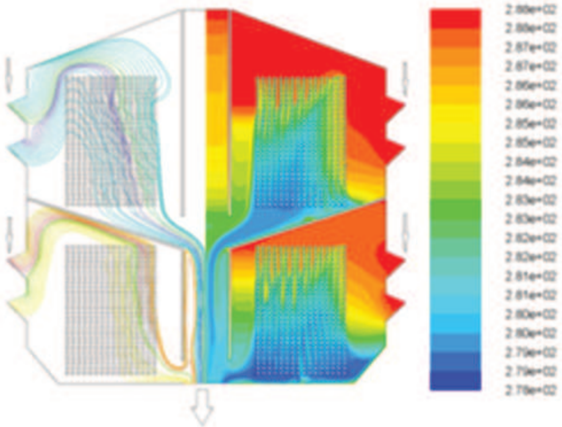


Fig. 12: “Compact” heat exchanger without envelope, Fig. 13: Approximate two- dimensional numerical simulation of the temperature distribution

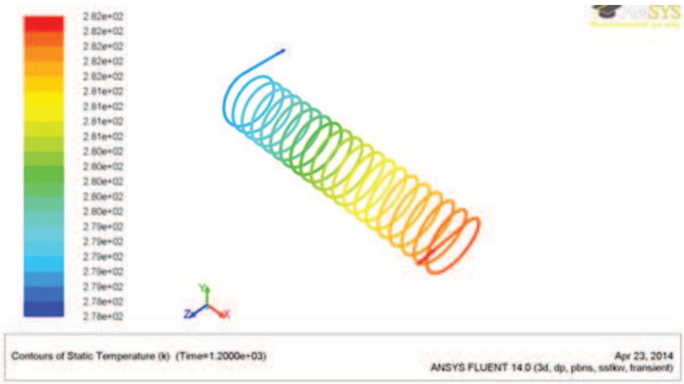
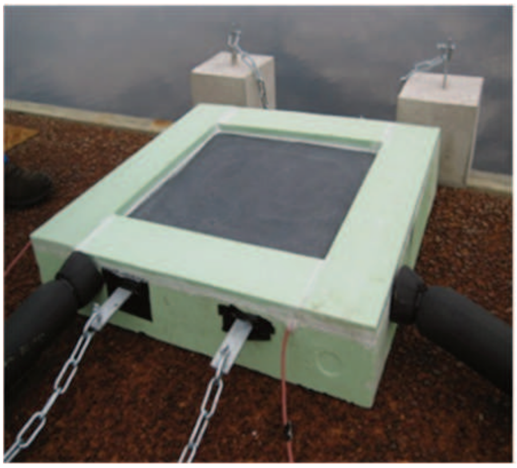


Fig. 14: Process of constructing of two spirals- heat exchanger between of three parts of pontoons, Fig. 15: Simulation of heat- mass transfer processes in spiral underwater heat exchangers in software ANSYS FLUENT 13.0

Another scientific study in the field of sustainable energy supply of floating houses is a plate heat exchanger with concrete elements which is integrated in underwater envelope of house or in underwater part of pontoon to win energy from lake water as an innovation for floating houses (Kiesche, 2016).



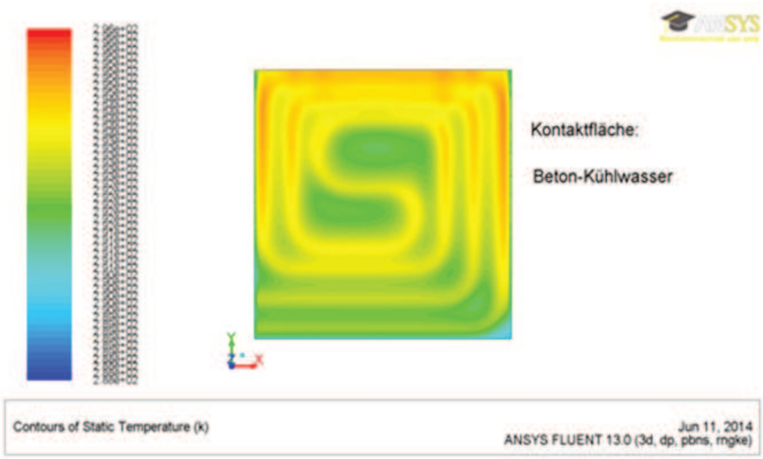


Fig. 16: Plate-shaped underwater heat exchanger with anchor and thermally insulated flow and return pipe, Fig.17: Simulation of heat and mass transfer processes in plate-shaped underwater heatexchangers in software ANSYS FLUENT 13.0

5.3 Ice protection

Pontoons of floating houses on the Geierswalder Lake (fig.10) are attached at vertical metallic beams in the water, which are making it possible for pontoons to move vertically up and down. This need is caused by changing of water level in lake. Ice formation on water surface in winter can be dangerous and problematic

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for free moving of pontoons and their connections. As a solution to predict and escape ice formation, it is proposed a solution by means of the heat pipe method, fig. 18, 19. This application is based on thermodynamic properties of a special water- alcohol mix, which is holding on the temperature of the water around of beams on non-freezing level.

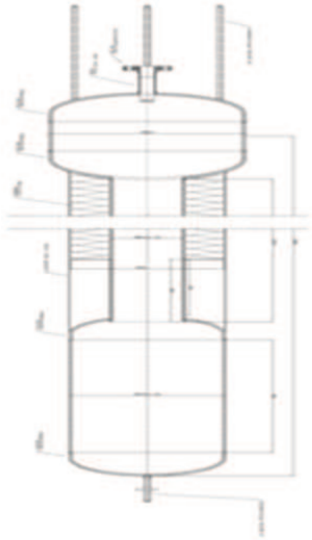
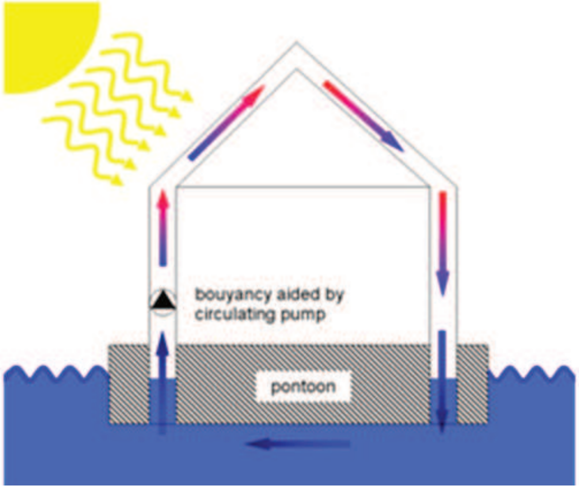


Fig. 18: Heat pipe of vertical beam for predicting of water freezing, Fig. 19: Scheme of heat pipe

5.4 Thermal activation of construction's elements

Lake water can be used for heating during the cold season and cooling of buildings in summer time. The system consists of pipes with lake water inside, integrated in elements of outside constructions. Solar radiation power on pitched roofs is not symmetrical with respect to both sides, what causes difference of temperature and, therefore, difference of water density in different parts of outside envelope. Low density of water on heated side and high density in another one activate moving in cooling circle, which is supported by additional pumps. In this way the process of circulating of water in elements of outside construction is going.



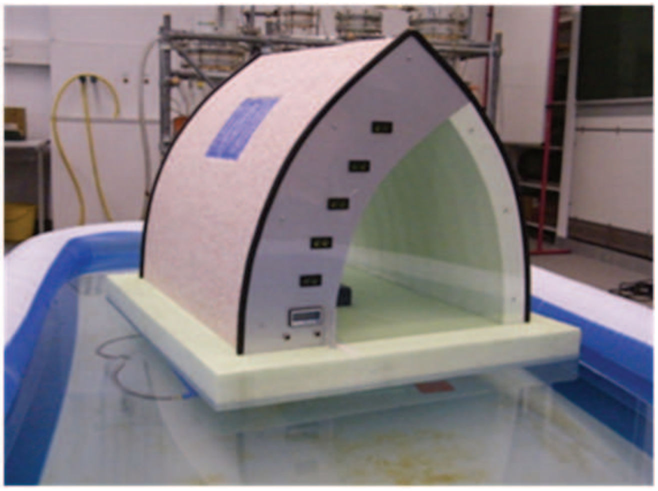


Fig. 20: Schedule of water circulation in cooling system, Fig. 21: Mini- model of floating building with active thermal components

5.5 Underwater part: investigation and development of materials and constructions

The most important but also the most sensitive element of construction is the pontoon of a floating house. This part of building should not only hold the balance on the water in case of water waves, but also be protected from aggressive lake water of former open cast minings or other industrial waters. The contact by water can be dramatically. The figure 22 shows results of permanently mounted floating concrete elements. So the water-air changing zone is independent from the water level of the lake.

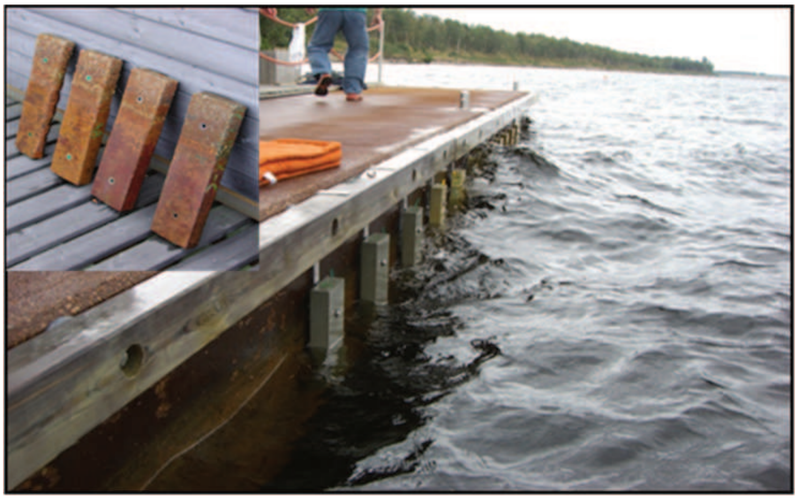


Fig. 22: Concrete samples produced by different concrete formulation after two years contact with water in lake of the former opencast mind

Experiments (figure 23) and simulations of mechanical behavior of pontoons regarding to water waves, carried out by Institute of floating constructions at the institution IfSB, BTU Cottbus- Senftenberg allow its scientifical group to optimize underwater parts of constructions and to predict dangerous influence of water.

Fig. 23: Experimental investigations of water wave's imitation and pontoons moving. IfSB, BTU Cottbus-Senftenberg

6 OUTLOOK + CONCLUSION

Owing to sea level rising, growing of total population of the world and its claims with regard to living space the settlement of water surfaces take place. In opposite to the need in most cases there are designed and built expensive buildings of floating architecture.

In a current project "Autartec" a new typ of floating house for the Lusatian Lakeland is developed and installed 2017. It is designed in a modern styl and represents the possibilities for a self-sufficient supply and disposal with regard to energy and water. More than 15 collaborating partners of the local industry and sientific institutions of the southern Brandenburg and eastern Saxony of Germany are looking for a sustainable solution.

Besides of residential building on water, demonstration floating nuclear power plant based on China National Nuclear Corporation's (CNNC's) with small reactor ACP100S will be built by 2019, according “World nuclear news” (World Nuclear News, 2016).

But how to become a smart city in a lot of districts of the world for the future? Above all things there must be developed and installed simple and payable floating buildings. They should be adapted to the environment with corresponding materials of the surrounding landscape. In addition the floating cities should use the

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alternative energies of the water and generate a cycle of water consumption in order to respond to the global changes properly and in time.

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Fühl die Stadt – Methoden zur Erfassung subjektiver Wahrnehmung

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1 ABSTRACT

Wie der Mensch urbane Räume wahrnimmt, ist vor allem im Hinblick auf die Akzeptanz der gebauten Umwelt durch Bewohnerinnen und Bewohner eine grundlegende Forschungsfrage der Stadtplanung. Im Zeitalter digitaler Technologien, welche eine Vielzahl an Möglichkeiten zur Erfassung unterschiedlichster Messgrößen bieten, können nun die subjektiven Wahrnehmungen bzw. Emotionen von Menschen erfasst werden. Die Verschneidung der Disziplinen Raumplanung, Geoinformatik und Computerlinguistik forciert ein besseres Verständnis, wie Menschen den (urbanen) Raum wahrnehmen und auf Umwelteinflüsse reagieren. „Multi-Methoden-Ansätze" gewinnen in diesem Zusammenhang an Relevanz; insbesondere dann, wenn im Sinne der Methodentriangulation sowohl technische Sensoren als objektive Methoden mit subjektiven Befragungen kombiniert werden.

Im Rahmen von studentischen Projektarbeiten wurden die verschiedenen Methoden zur Erhebung der subjektiven Wahrnehmung mit Hilfe von Sensoren bzw. Wearables angewandt, getestet und anschließend analysiert sowie bezüglich ihrer Anwendbarkeit verglichen. Zielstellung dieser Arbeiten war es, geeignete Methodensets zu entwickeln. Das Hauptaugenmerk lag auf der Analyse, welches Methodenset geeignet ist und wie die erhobenen Daten anschließend in eine (virtuelle) Karte übertragen werden können. Darüber hinaus wurde auch die Frage behandelt, wie diese Methoden in Planungsprozesse miteinbezogen werden können.

Ein Fallbeispiel betrachtete die gefühlte Sicherheit im Radverkehr in Abhängigkeit unterschiedlicher radinfrastrukturellen Gegebenheiten mittels verschiedener Sensoren. Zum anderen untersuchten die Studierenden, wie der Wiener Donaukanals von den Nutzerinnen und Nutzern wahrgenommen wird, der in den letzten Jahren sowohl zum kommerzfreien Erholungsraum avancierte als auch kommerziell durch Gastronomie genutzt wird und unterschiedliche Teilräume mit verschiedenen stadträumlichen Qualitäten aufweist.

Keywords: Emotion, Humansensorik, Methoden, Raumplanung, Stadtwahrnehmung

2 EINLEITUNG

Welche Auswirkung hat die bauliche Umgebung des Donaukanals auf das Wohlempfinden eines Passanten beziehungsweise einer Passantin? Warum meidet diese(r) manche Straßen, Plätze oder sogar Bezirke? Welche infrastrukturellen Gegebenheiten lösen Stress bei Radfahrerinnen und Radfahrern aus? So schnell sich diese Fragen auch aufdrängen mögen, so komplex sind diese in ihrer Beantwortung: Alleine der Begriff des Raumes, der früher mit einem Container gleichgesetzt wurde, ist nicht nur als geschlossenes System, sondern in seiner Mehrdimensionalität zu betrachten. Für den spatial turn wird nicht der territoriale Raum als Container oder Behälter maßgeblich, sondern Raum als gesellschaftlicher Produktionsprozess der Wahrnehmung, Nutzung und Aneignung, eng verknüpft mit der symbolischen Ebene der Raumpräsentation (etwas durch Codes, Zeichen, Karten)" (Löw 2001). Zudem ist das Verständnis der subjektiven Wahrnehmung eine große Herausforderung in der Stadt- und Verkehrsplanung und die Forschung stößt in diesem Themenfeld nach wie vor an ihre Grenzen.

Die Wahrnehmung des Raumes beziehungsweise die Wahrnehmungsgeographie als subjektspezifische Raumperspektive avancierte in den 1960er Jahren zum Untersuchungsobjekt – als „Bild der Stadt" (Lynch 1960), die kognitive Repräsentation des Raumes (Downs und Stea 1982) oder mit dem Einsatz kognitiver Karten als psychologische Methode durch Duncan und Milgram (1977). Ein halbes Jahrhundert später wird die Forschung zur subjektiven Wahrnehmung des Raumes durch die digitale Entwicklung angereichert.

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Unter dem Titel „Humensensorik“ (Dörrzapf et al. 2015, Zeile et al. 2013, Sagl et al. 2012, Exner et al. 2012) beschäftigt sich die aktuelle Forschung mit dem Einsatz neuster Technologien und Hardware, wie das Smartphone und ergänzende Gadget (Smartbänder, Eyetracker, Smartwatches etc.), um mehr über den Menschen und seine subjektive Wahrnehmung im Kontext seiner Umwelt zu erfahren. Humansensorik im städtischen Kontext, wiederzufinden in den Projekten „Urban Sensing“, „People as Sensors“ (Resch 2013) oder „Citizens as Sensors“ (Goodchild 2007), spielt verschiedene Szenarien von Fußgängermobilität, über Radfahren bis hin zu Barrierefreiheit durch, um eine geeignete Vorgehensweise und darüber hinaus Ergebnisse zu ermitteln, die im Planungsprozess einbezogen werden können. Zusätzlich treten Fragen hinsichtlich der geeigneten Methodik auf. Welche Methodensets sind für die Erfassung der subjektiven Wahrnehmung beziehungsweise Emotion geeignet? Wie lassen sich Planungsprozesse mit der Erfassung der subjektiven Wahrnehmung räumlicher Gegebenheiten miteinander vereinbaren oder auch verknüpfen? Diese Fragestellungen behandelten die Studierenden im Rahmen eines Projektes an der TU Wien.

3 ERFASSUNG SUBJEKTIVER WAHRNEHMUNG IN DER STADT

In der Stadtplanung wird die These verfolgt, dass durch die Berücksichtigung der menschlichen Wahrnehmung in der Planungspraxis eine höhere Akzeptanz und Identifikation durch die Bewohnerinnen und Bewohner mit der gebauten Umgebung herbeigeführt werden kann. Die subjektive Wahrnehmung hängt von der menschlichen Interaktion mit der Umgebung ab. „In their daily lives people exercise a permanent acknowledge of the environmental conditions, and they do so by using their perceptive processes” (Caves 2005). Der Fokus auf den Menschen und seine subjektive Wahrnehmung führte zur Akzentverschiebung in der Planung und rückt damit die Frage wie eine Stadt aussehen soll in den Mittelpunkt. Generell ist die Abkehr von dem reinen „Was ist Stadt?“ zu bemerken. Viel mehr, wie auch Anne Brandl feststellt, sollte die Frage nach dem Wie (zum Beispiel „Wie wird die Stadt wahrgenommen?“) in den Fokus urbanen Handelns rücken (Brandl 2013).

Nach wie vor zieht die Stadt- und Verkehrsplanung Wahrnehmungskonzepte heran, die auf Theorien und Leitbilder der 1960er zurückgreifen, auch wenn diese nicht mehr der täglichen Planungspraxis entsprechen. Die städtebauliche Umgebung bzw. die Gestaltungsqualität lässt sich durch die Wahrnehmung (meist visuell) bewerten, wie es Kevin Lynch in den 1960er Jahren formulierte. Er spricht von „Image of the City“, also das Bild der Stadt und von “imageability: that quality in a physical object which gives it a high probability of evoking a strong image in a given observer” (Lynch 1960). Eine Methode bei der Erfassung von Wahrnehmung sind „mental maps“ oder „cognitive maps“ in Form von katographischen Darstellungen. Diese geben die subjektive Wahrnehmung einer Person zu einem (städtischen) Raumausschnittes wieder und sind „complex, highly selective, abstract, generalised representations in various forms“ (Downs & Stea 2011). Es ist festzuhalten, dass es sich dabei nicht um eine (geographische) Karte im eigentlichen Sinn handelt, welche die topographische, physische Umwelt repräsentiert, sondern diese „spiegelt die Welt so wieder, wie ein Mensch glaubt, dass sie ist […]“ (Downs & Stea 1982). Auch Duncan und Milgram befassten sich mit den kognitiven Karten einer Stadt, betonten allerdings, dass es dabei mehr um eine psychologische Sichtweise, also um die wahrnehmbare Struktur der Stadt, als um geographische oder administrative Grenzen geht. Sie untersuchten die kognitive Wahrnehmung von Paris indem sie Probandinnen und Probanden Zeichnungen erstellen und verschiedene Gebiete mit Attributen (z. B. gefährlich, wohlhabend) versehen ließen (Duncan & Milgram 1977).

Mit den neuen digitalen Möglichkeiten erlebt dieses Forschungsfeld Jahre später eine Renaissance und wird durch Goodchild mit „People as Sensors“ (2007) oder Christian Nold mit seiner Forschung zu „Emotional Cartography“ (2009) wieder aufgegriffen. In diesem Kontext ist auch die „Real-Time-City“ zu sehen, welche durch das SENSEable City Lab des MIT geprägt wurde, wo unter anderem bei LIVE Singapore! mittels Daten von ubiquitären Sensoren (z. B. Smartphones und Mobilfunkdaten) menschliche Aktivitäts- und Mobilitätsmuster abgeleitet wurden (Kloeckl et al. 2011). Auch das Forschungsprojekt „Urban Emotion“ greift die subjektive Wahrnehmung der Stadt auf und versucht sie in die Stadtplanungsprozesse rückzuführen. Dabei wird die Humansensorik vor dem Hintergrund des „Bottom-up“ betrachtet, indem das Methodenrepertoire durch die Verwendung von Sensoren erweitert und traditionelle „top-down“ Planungsansätze durch Crowdsourcing-Prozesse sozusagen „von unten“ ergänzt werden (Zeile et al. 2015).

Emotionale Empfindung sowie die subjektive Wahrnehmung für die Stadtplanung werden schon lange berücksichtigt, eine umfassende Integration der Humansensorik in der räumlichen Planung konnte allerdings noch nicht erreicht werden.

4 INNOVATIVE METHODEN UND WERKZEUGE DES SENSINGS

Trotz der fehlenden Methodenintegration in Planungsprozesse existiert bereits eine Vielzahl an innovativen Methoden zur Erfassung der menschlichen Wahrnehmung. Die Tendenz bei empirischen Untersuchungen geht eindeutig zum „Multi-Methoden-Ansatz“, wodurch gewährleistet wird, dass nicht nur ein Werkzeug isoliert Einsatz findet.

Es existieren verschiedene Hauptgruppen an Sensing-Methoden, die Kanjo et al. (2015) wie folgt kategorisiert:

- Selbstreport: Probandinnen und Probanden werden gebeten, ihre Empfindungen selbst zu erfassen. Beispiele dieser subjektiven Befragung sind die verbale Rating-Skala, die Fotographie markanter Gegebenheiten oder auch Visual Mapping (gleichbedeutend mit Lynchs „Mental Mapping“).
- Psycho-physiologische Signale: Emotionale Reaktionen gehen mit Veränderungen in der Aktivität des autonomen Nervensystems einher, welche in Form von beispielsweise Hautleitfähigkeit, Hauttemperatur oder Bewegung der Augen (eye-tracking) messbar sind. Dieses psycho-physiologisches Monitoring, unterstützt durch Wearables (z.B. Smartbänder), ermöglicht die Erhebung der personenbezogenen Vitaldaten sozusagen in Echtzeit. Smartbänder sind bereits weit verbreitet und zählen zu weit verbreiteten Anwendungen im Leistungssport (Sport-Tracker). Von Forscherinnen und Forscher des „Urban Emotions“ wird zur Zeit vor allem der „Zephyr BioHarness 3“ für die physio-psychologische Erfassung als einsatzfähig bewertet (Resch et al. 2015).
- Smartphone-Nutzung: Verfügbarkeit von GPS, Beschleunigungssensoren, RFID, Mikrophon, Kamera, Gyroskop, etc. (Yan & Chakraborty 2014) eignen sich für die Erfassung subjektiver, ortsbezogener Informationen – und das ebenfalls in Echtzeit. Durch Apps kann eine große Zahl von Nutzerinnen und Nutzern erreicht und Daten gesammelt werden. Dies erlaubt die Datenerhebung im Raum in hoher Granularität und die Verknüpfung mit der physischen Umwelt (Klettner, Huang, Schmidt, & Gartner 2013).
- Soziale Netzwerke: Diese ermöglichen die Auswertung räumlicher, zeitlicher und semantischer Information. Vor allem Twitter, Flickr und Instagram eignen sich hier speziell, da die Daten für Forschungszwecke frei verfügbar sind (Graham, Stephens, & Hale 2013).
- Gesichtsausdrücke: Die Erfassung von Gesichtsausdrücken ermöglicht ebenfalls eine emotionale Zuordnung, allerdings ist diese Methode in der raumbezogenen Forschung noch nicht intensiv erprobt. Darüber hinaus sind Gesichtsausdrücke schwierig auszuwerten und leicht manipulierbar (Kanjo et al. 2015).

Das Forschungsprojekt „Urban Emotions“ bedient sich beispielsweise des „Multi-Methoden-Ansatzes“ und strebt eine Kombination aus Sensorentechnik (Smartband), einer App zur subjektiven Abfrage der Probanden sowie dem Herausfiltern von Informationen aus Social-Media-Data (z.B. Twitter) an (Resch et al. 2015).

Die Messung von Emotionen unter Einsatz von psycho-physiologischen Sensoren ist nach wie vor eine Herausforderung. Die Gründe für die zögerliche Verwendung der Methoden zur Erfassung subjektiver Wahrnehmung sind vielfältig: Zum einem wird eine große Stichprobengröße benötigt, um valide Aussagen treffen zu können. Darüber hinaus sind die Feldtests äußerst zeitaufwändig, nicht nur in Durchführung, sondern auch in der Vorbereitung und Auswertung. Viele verschiedene Parameter (z.B. Wetter, persönliche Stimmungslage, situationsbedingte Einflüsse) müssen zusätzlich betrachtet werden und die Daten können nicht auf die Allgemeinheit übertragen werden (Kanjo et al. 2015). Und zum anderen ist die Technik (z.B. das Smartband) noch nicht ausgereift genug, um verlässliche Daten zu eruieren. Hinzu kommen noch Datenschutzbedenken und die teils fehlende Bereitschaft der Bevölkerung an solchen Sensing-Experimenten teilzunehmen (Dörrzapf et al. 2015).

Urbane Sensing Methoden stellen keinen unmittelbaren Lösungsansatz für Planungsfragen der Stadt- und Verkehrsplanung dar, aber „[i]t can be seen as a novel anthropocentric approach for understanding the complex spatio-temporal dynamics and interactions in the human-space framework“ (Zeile et al. 2015).

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5 FALLANALYSEN

Im Folgenden werden zwei studentische Projekte vorgestellt, die sich mit qualitativen und quantitativen Methoden zur Messung der Raumwahrnehmung und den damit verbundenen Empfindungen sowie der Visualisierung dieser Ergebnisse beschäftigt haben. Beide Projekte wurden im Zuge des Masterprojekts „Fühl die Stadtregion“ im Sommersemester 2015 bearbeitet, welches die Auswirkungen der gebauten Umwelt und des sozialen Raums auf die subjektiven Wahrnehmungen und Emotionen messbar machen sollte.

5.1 Bike Emotions

Zentralen Schwerpunkt des Projektes Bike Emotions bildet die gefühlte Sicherheit im Radverkehr. Ziel war es einen Ansatz zur Erhebung von (subjektiven) Gefahrenstellen und deren Entschärfung im Untersuchungsgebiet aufzuzeigen. Dies könnte einen Beitrag zur Wiener Verkehrsplanung leisten, um künftig den Radverkehr zu attraktiveren.

5.1.1 Ziele von Bike Emotions

Mithilfe unterschiedlicher Messmethoden und deren Verschneidung sollen Hotspots für Radfahererinnen und Radfaherer im Straßenverkehr und in der baulichen Umgebung entdeckt, im Kontext zueinander analysiert und veranschaulicht werden. Hotspots sind Stellen, Elemente oder Situationen, die sowohl physiologisch messbare als auch subjektiv erlebte Änderungen des persönlichen Befindens hervorrufen. Durch die gewonnenen Daten können identifizierte Hotspots verbessert, entschärft bzw. zukünftig anders organisiert werden.

5.1.2 Angewandtes Methodenset

Die Anwendung mehrerer verschiedener quantitativer, physiologischer Messmethoden erfolgte mit dem Ziel, diese hinsichtlich Einfluss auf die Erhebung, Anwendbarkeit und Ergebnisse zu vergleichen und potenzielle Überschneidungen zu identifizieren. Im Rahmen eines Multi-Methoden-Ansatz wurden vier verschiedene Sensoren von den Probandinnen und Probanden gleichzeitig verwendet. Das Untersuchungsgebiet in Wien Ottakring (Bereich Lerchenfelder Gürtel, Thaliastraße, Hasnerstraße) wurde deshalb ausgewählt, da es vier unterschiedliche Radinfrastrukturtypen aufweist, unter anderem Wiens erste Fahrradstraße (siehe Tabelle 1).

Quantitative Methoden	Eyetracker (Tobii Glasses) für Blickrichtung und Fixation; EEG (MindCap XL von NeuroSky) zur Messung von Gehirnströmen, Hautleitfähigkeit (eSense Skin Response von Mindfield) als Indikator für Stress, GPS-Tracking (Endomondo App) zur geographischen Verortung und Erfassung des exakten Routenverlaufs, der Durchschnitts- und Maximalgeschwindigkeit zum Vergleich der einzelnen Probandinnen und Probanden
Qualitative Methoden	Fragebogen mittels Multiple Choice und offenen Fragen, sowie subjektive Kartierung von Hotspots auf einer Karte
Untersuchungsgebiet	Wien, Ottakring (Lerchenfelder Gürtel, Thaliastraße, Hasnerstraße), Blockrandbebauung Vier unterschiedliche Radinfrastrukturtypen: Lerchenfelder Gürtel: gemischter Fuß- und Radweg, hohes Fußgängeraufkommen im Bereich der U-Bahn- und Straßenbahnstation Thaliastraße Thaliastraße: Mischverkehr Straßenbahngleise (Tempolimit 50 km/h), hohes MIV-Aufkommen Brunnengasse: Einbahn mit Radfahrstreifen in Gegenrichtung (Tempolimit 30 km/h) Hasnerstraße: Fahrradstraße (Tempolimit 30 km/h) Strecke: 0,7 km, gefahren wurde gegen den Uhrzeigersinn (mehrere Linksabbiegevorgänge)
Probandinnen und Probanden	Alter von 20 bis 31 Jahren Vier männlich, vier weiblich sechs geübte, zwei ungeübte Radfahrerinnen und Radfahrer

Tabelle 1: Eckpunkte zu "Bike Emotions"

Neben den rein quantitativen Messmethoden wurde auch eine qualitative Methode eingebettet, um eine subjektive Rückkopplung des Gemessenen zu erhalten. Hierfür wurden die Probandinnen und Probanden im

Anschluss an ihre Fahrt einerseits mittels Leitfadeninterview befragt, andererseits sollten sie mittels subjektiver Kartierung die Stellen verorten, welche sie als angenehm/unangenehm im Straßenverkehr empfunden haben. Somit fand auch eine Überprüfung statt, ob sich die Aussagen dieser subjektiven Kartierung und Befragung mit den der quantitativ gemessenen Ergebnisse decken.

Die Messung selbst wurde wochentags an einem Vormittag durchgeführt. Aufgabe der Probandinnen und Probanden war es eine vordefinierte Strecke mit dem Fahrrad zu absolvieren. Die Probandinnen und Probanden wurden vor der Fahrt mit allen Messgeräten ausgestattet und sollten die Strecke in einer selbstgewählten Geschwindigkeit zurücklegen, die dem persönlichen Sicherheitsbedürfnis entspricht.

5.1.3 Auswertung und Ergebnisse

Bei der Auswertung der Messergebnisse konnte festgestellt werden, dass die Daten zur Hautleitfähigkeit, die Veränderungen des Befindens bezogen auf Straßenelemente bzw. Situationen (durch Peaks = auffällige Ausschläge eines Wertes) gut markierten. Kombiniert mit den Daten des Eyetrackings konnten Hotspots identifiziert und verortet werden. Des Weiteren ermöglichte Eyetracking einen Einblick in die Perspektive der einzelnen Probandinnen und Probanden zu gewinnen, indem der Blickfokus durch sogenannte „Heatmaps“ wiedergegeben wurde. Die daraus abgeleiteten Erkenntnisse wurden durch die subjektive Einschätzung der Probandinnen und Probanden, die mittels Fragebogen und Kartierung erhoben wurden, gestützt. Lediglich die Daten des EEG lieferten kaum einen Beitrag zu den Ergebnissen, da es bei den Befahrungen durch die Probandinnen und Probanden oftmals zu Unterbrechungen bedingt durch Empfangsstörungen des Bluetooth kam.

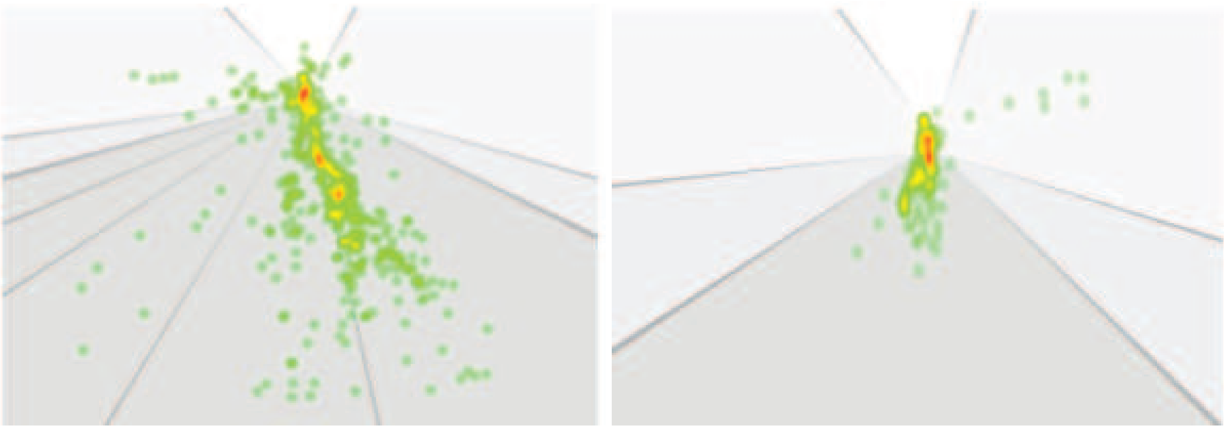

Abbildung 1: Eytracker Visualisierung: Heating Map Thaliastraße (links), Heatmap Hasnerstraße (rechts)

Zusammenfassend zeigen die Ergebnisse nicht nur infrastrukturelle Merkmale im Straßenraum auf, die Auswirkungen auf das Wohlbefinden hatten, sondern auch Situationen, die durch das Zusammenspiel des Verhaltens unterschiedlicher Verkehrsteilnehmerinnen und Verkehrsteilnehmer entstanden sind, waren im Messergebnis ersichtlich.

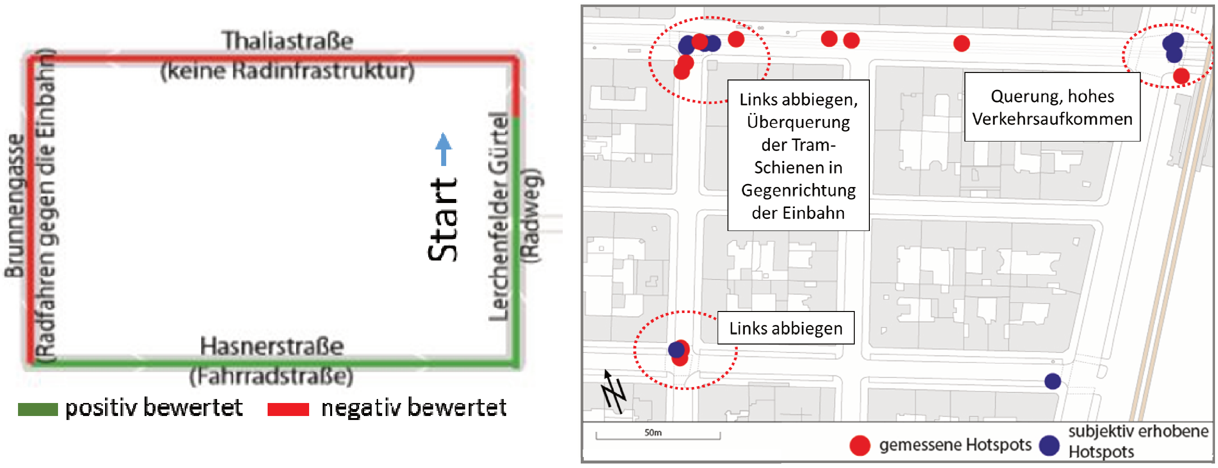

Abbildung 2: Kartierung und Route mit den vier Teilabschnitten, Darstellung gemessener Hotspots und subjektiv erhobenen Hotspots

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Die physiologisch gemessenen, als auch die subjektiv kartierten Hotspots aller Probandinnen und Probanden wurden in einer Karte verortet. Folgende Ergebnisse lassen sich feststellen:

- Die Kreuzungsbereiche Thaliastraße/Lerchenfelder Gürtel und Thaliastraße/Brunnengasse verursachten unter den Probandinnen und Probanden Stress. Dies ist u. a. auf infrastrukturelle Mängel (z. B. fehlende Aufstellflächen) zurückzuführen.
- Beim Queren der Straßenbahngleise in der Thaliastraße war eine Erhöhung des Stresspegels messbar. Im Zuge der Blickfokusanalyse konnte eine starke Orientierung der Blicke der Probandinnen und Probanden während der Fahrt auf den Schienen festgestellt werden (vgl. Abbildung 1, links). Auf der Hasnerstraße hingegen, einer Fahrradstraße ohne Schieneninfrastruktur, war der Blick fokussierter in Fahrtrichtung nach vorne gerichtet (vgl. Abbildung 1, rechts).
- Generell lässt sich festhalten, dass das Queren der Straßen vor allem beim Linksabbiegen oder bei stark befahrenen Straßen als unangenehm empfunden wurde und sich negativ auf das Sicherheitsgefühl auswirkt.

Aufgrund der identifizierten Hotspots lassen sich als Handlungsempfehlung beispielhaft eine Gummibefüllung der Straßenbahnschienen oder die Schaffung geeigneter Aufstellflächen für abbiegende Radfahrerinnen und Radfahrer ableiten.

5.1.4 Grenzen der Methodensets

Da die Messfahrten während des üblichen Verkehrsgeschehens absolviert wurden, waren oftmals situationsbedingte, durch den Kfz-Verkehr hervorgerufene Situationen ausschlaggebend für einen „messbaren Stress“, welches die Vergleichbarkeit erschwerte.

Aufgrund der zeitlichen, personellen und finanziellen Restriktionen, denen ein Studierendenprojekt unterliegt konnte nur ein Methodenset getestet werden. Zudem sind die erhobenen Daten aufgrund der geringen Stichprobengröße von acht Personen wenig verallgemeinerbar. Um den Befund zu untermauern, bedarf es weiterer Testläufe und vor allem einer höheren Anzahl an Probandinnen und Probanden. Auch eine Optimierung bzw. Erweiterung der Messungen könnte angedacht werden. Vor allem bei der EEG-Messung besteht Optimierungsbedarf hinsichtlich der Handhabbarkeit. Die Befestigung an Stirn und Ohr, das Mitführen eines Laptops sowie die Bluetooth-Übertragung stellten sich für dieses Testszenario als nicht nutzerinnen- und nutzerfreundlich heraus. Ein Lösungsansatz dafür könnte die im Projekt Mind Rider erfolgte Integration eines EEG-Messgeräts in einen Fahrradhelm sein, mit dem eine verlässliche Erhebung der Daten bei gleichzeitig verbesserter Handhabbarkeit möglich sein dürfte (vgl. Ducao, Mind Rider 2016).

5.1.5 Abschließende Betrachtung

Mithilfe der Messung durch Sensoren konnten innerhalb des Projektes Indizien zur Verkehrssicherheit im Radfahrverkehr gesammelt und verortet werden. Veränderungen physiologischer Messwerte erlaubten Rückschlüsse auf den Stresslevel der Probandinnen und Probanden und somit auch auf wahrgenommene potenzielle Gefahren. Durch diesen neuen Ansatz können Gefahrenpotenziale identifiziert werden, was einen interessanten und innovativen Ausgangspunkt zur Entschärfung von Gefahrenstellen bietet. Dies bietet die Möglichkeit die Gründe für die häufigsten Unfallursachen im Radverkehr wie Abbiegen, Kreuzen oder hohe Geschwindigkeit des Kfz-Verkehrs (Difu 2012) vor Ort fundierter und differenzierter zu erkennen.

5.2 Fühl den Donaukanal

Durch die steigende Bevölkerungszahl muss sich die Stadt Wien mit neuen, komplexen Aufgabenstellungen auseinandersetzen, um attraktive öffentliche Freiräume für eine wachsende Zahl von Bewohnerinnen und Bewohnern zur Verfügung stellen zu können. Einer dieser Räume ist der Donaukanal, welcher verschiedene Teilräume mit unterschiedlichen Raumqualitäten aufweist. Diese Varietät ist für viele Bewohnerinnen und Bewohner die Hauptqualität dieses innerstädtischen Erholungs- und Freizeitraums. Im Zuge des Projekts „Fühl den Donaukanal“ wurden die Qualitäten der einzelnen Teilräume einer vertiefenden Untersuchung unterzogen und anhand dessen qualitative und quantitative Methoden zur Erhebung der räumlichen Wahrnehmung und ortsbezogener Empfindungen getestet.

5.2.1 Ziele

Nach einer Gliederung des Donaukanals in Teilräume unter Berücksichtigung funktionaler und gestalterischer Kriterien, wurden diese hinsichtlich des subjektiven Raumempfindens der Besucherinnen und Besucher untersucht und die Ergebnisse kartographisch dargestellt, um positiv und negativ konnotierte Teilräume zu identifizieren.

5.2.2 Angewandtes Methodenset

Für die Datenerhebung wurden vier unterschiedliche Methoden ausgewählt, welche in Tabelle 2 dargestellt sind. Die Erhebung mit den quantitativen Methoden erfolgte im Rahmen von Befahrungen des Donaukanal-Gebiets per Fahrrad. Für das Visual Mapping und die Autofotografie wurden zufällig ausgewählte Personen vor Ort herangezogen.

Quantitative Methoden	EEG (MindCap XL von NeuroSky) zur Messung von Gehirnströmen, Hautleitfähigkeit (eSense Skin Response von Mindfield) als Indikator für Stress
Qualitative Methoden	Visual Mapping: Kartografisches Festhalten von Empfindungen, die mit einzelnen Teilräumen assoziiert werden Autofotographie: Fotografische Dokumentation von Orten, Gegenständen etc. mit besonderer subjektiver emotionaler Bedeutung
Untersuchungsgebiet	Teilabschnitt des Wiener Donaukanals zwischen Siemens Nixdorf Steg und Rotundenbrücke, starke Frequentierung, verschiedene Nutzungen (Gastronomie, Grünflächen, Spazieren/ Rad fahren)
Probandinnen und Probanden	Visual Mapping: 40 Personen Autofotographie. 10 Personen EEG Messung: 5 Personen Hautleitfähigkeit: 5 Personen

Tabelle 2: Eckpunkte zu “Fühl den Donaukanal”

Folgende Ausführungen fassen überblicksartig sowohl inhaltliche Erkenntnissen aus dem Projekt und als auch eine Einschätzung zur Eignung der Messmethoden zur Beantwortung der oben skizzierten Fragestellung zusammen.

5.2.3 Ergebnisse aus der inhaltlichen Fragestellung

Für die Visualisierung der Messergebnisse zur Hautleitfähigkeit und EEG wurden zwei unterschiedliche Strategien verfolgt. In eine Heatmap, die den unterschiedlichen Teilräumen das damit assoziierte Befinden der Probandinnen und Probanden und Befragten zuordnet, flossen die Ergebnisse der quantitativen und qualitativen Erhebungen ein. Ein zweiter Layer visualisiert die Rohdaten der Messungen ohne qualitativen Input mit Fokus auf Extremwerte in den Messergebnissen. Demnach erfolgt die Visualisierung der Route in QGIS als vektorielle Darstellung in Form von Säulendiagrammen. So erhält man eine 3D Darstellung des gesamten Messvorganges und kann die Abnahmen und Zunahmen der Messwerte auf diese Weise ablesen. Durch diesen direkten örtlichen Bezug kann eine neutrale visuelle Bewertung der Messergebnisse im Untersuchungsgebiet durchgeführt werden. Gut erkennbar ist die annähernde räumliche Korrelation der beiden Visualisierungsvarianten.

Zusammenfassend konnten folgende inhaltlichen Ergebnisse für den Donaukanal ermittelt werden:

- Die Mehrheit der Probandinnen und Probanden empfand, dass ein „urbanes Feeling“, ein ausgewogenes Verhältnis zwischen Grünräumen und Konsummöglichkeiten, gute Aktivitätsangebote und eine schnelle Erreichbarkeit den Donaukanal als positiv auszeichnen.
- Die Grünräume tragen wesentlich zur Qualität des öffentlichen Raumes bei.
- Es wurde von der Mehrheit ein Gastronomiebetrieb genannt, in dem man sich gerne aufhält.
- Die weitere Ansiedlung von kommerziellen Betrieben (z.B. Gastronomie) wurde größtenteils abgelehnt.

Im Allgemeinen gibt es dem Donaukanal gegenüber, eine relativ positive Wahrnehmung seiner Qualitäten. Es ist naheliegend, dass Personen, die sich aus Freizeitgründen dort aufhalten, sich aus eigenen Beweggründen für diesen Raum entschieden haben und daher eine positive Grundstimmung aufweisen.

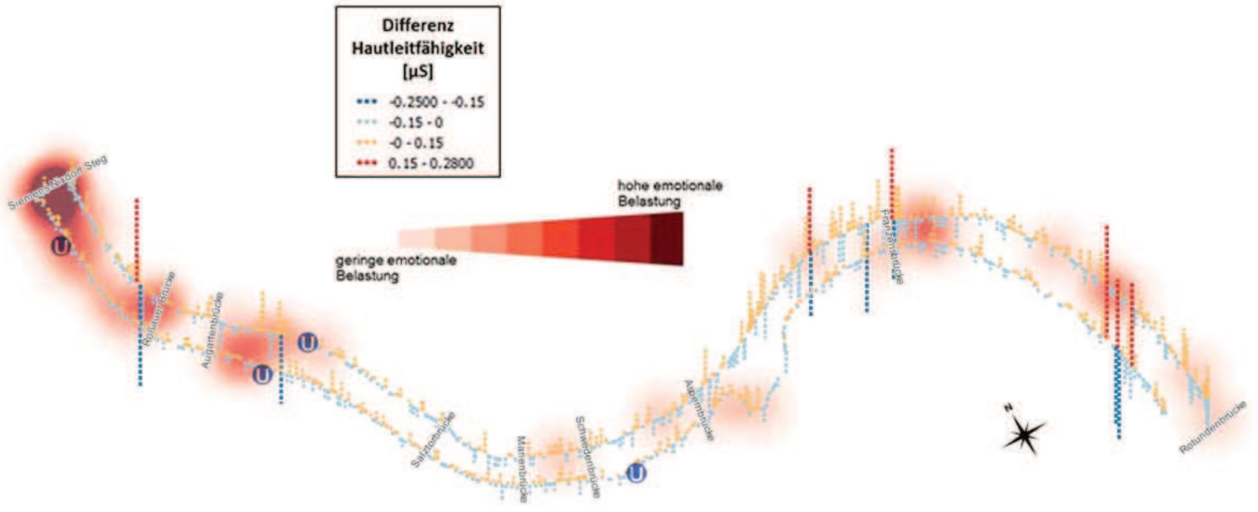

Abbildung 3: Ergebnisse der Messung zur Hautleitfähigkeit

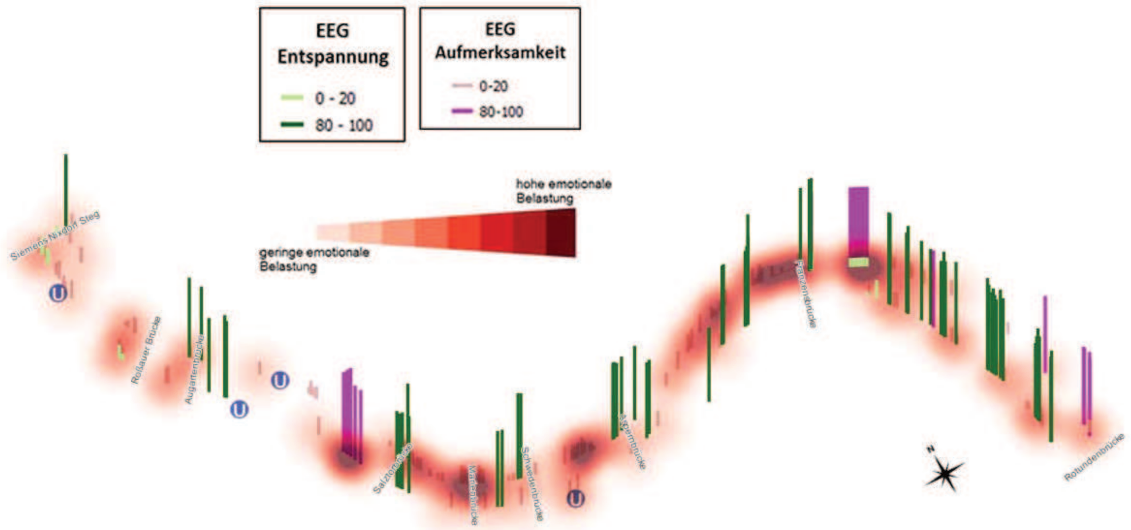

Abbildung 4: Ergebnisse der Messung mit EEG

5.2.4 Methodenbewertung

Beim Einsatz des EEGs wurde festgestellt, dass diese Art der Datenaufnahme einen sehr spannenden Ansatz der Emotionsmessung darstellt, prozesstechnisch aber nur mit viel Koordinationsaufwand in den Griff zu bekommen ist.

Die sensorische, „objektive“ Messung von Aufmerksamkeiten bzw. Entspannungszuständen birgt interessantes Potential, muss aber bedeutend sicherer und alltagstauglicher werden. Die Messwerte als Absolutzahlen besitzen zu wenig Signifikanz, um Planungsinformationen daraus ableiten zu können. Außerdem konnte bei den Messfahrten festgestellt werden, dass Außeneinflüsse die Messungen beeinträchtigen können.

In einer Gegenüberstellung der Methoden bezüglich ihres Potentials zur Verwendung als partizipatives Werkzeug kann Folgendes konstatiert werden: Die EEG Messung als Instrument zur Identifizierung von positiv oder negativ konnotierten Teilräumen im Untersuchungsgebiet muss für dieses Testszenario als wenig geeignet eingestuft werden. Zudem ist die Interpretation der Daten ohne Rückkoppelung mit den Beteiligten schwierig.

Eine bessere Eignung zur neuartigen Partizipation in räumlichen Planungsprozessen weist die Methode der Messung der Hautleitfähigkeit auf. Sie kann als valide und geeignet angesehen werden, um Veränderungen der körperlichen Reaktionen auf die Umwelt unmittelbar festzuhalten. Bei der Auswertung der Messdaten ist ein nachheriges Gespräch mit den Probandinnen und Probanden trotzdem empfehlenswert, da lediglich physiologische Veränderungen angezeigt werden. Die Applikationen zur Messung können auf den persönlichen Smartphones der Probandinnen und Probanden installiert werden. Die Auswertungen sind aufwendig aber präzise und geben detaillierte Ergebnisse der Strecke wieder. Die ausgewerteten Karten können dazu verwendet werden, mit der Person wieder in Kontakt zu treten und auffallende Ausschläge zu besprechen.

5.2.5 Abschließende Betrachtung

Die neuartige und kombinative Erhebung der Daten und der offene Umgang durch Feedback und Rückkoppelung hat das Potential das Vertrauen von Bürgerinnen und Bürgern in partizipative Planungsprozesse zu stärken und bietet die Chance für zusätzliche Formen des Inputs durch Teilnehmerinnen und Teilnehmer. Durch eine unverfälschte und diskursive Behandlung der auf der subjektiven Wahrnehmung von Räumen basierenden Interessen der Bürgerinnen und Bürger kann eine breite und konstruktive Unterstützung in planerischen Prozessen gewährleistet werden.

6 FAZIT UND AUSBLICK

Die zwei Fallanalysen ermöglichten Einblicke in den Einsatz sowie Kombinierbarkeit verschiedener sensorischer Methoden und erlaubten den Studierenden einen anthropozentrischen Blick auf die Stadt und deren Bewohnerinnen und Bewohner zu werfen. Werden subjektive Wahrnehmung von Menschen erfasst, so lassen sich unmittelbar Handlungsempfehlungen für (verkehrs-)planerische Prozesse ableiteten. Darüber hinaus ermöglichen diese kontextuellen Informationen neue Formen der Validierung nachhaltiger Planung – was sind die kritischen Punkte entlang des städtischen Fahrradweges oder wie wird die verlagerte Straßenbahnführung wahrgenommen? Wie fühlen sich Grünflächen, Gastronomie, etc. am Donaukanal an?

Nicht alle Sensing-Methoden konnten im Rahmen der Studierenden-Projekte als geeignet eingestuft werden. Es bleibt unklar, inwieweit das EEG für Forschungszwecke in Rahmen der menschlichen Wahrnehmung vor allem im räumlichen Kontext Einsatz finden kann. Des Weiteren besteht hinsichtlich der Handhabbarkeit sowie der Interpretation von EEG-Daten in Bezug auf die bauliche Umgebung noch Forschungsbedarf. Zukünftige technische Entwicklungen können dieser Tatsache im Sinne der „Usability“ (z.B. eingebaut in einen Fahrradhelm) und Datengenauigkeit allerdings entgegenwirken.

Ein zweites Seminar im Rahmen von “Fühl die Stadt” wird auch im Sommersemester 2016 angeboten, um eine Weiterentwicklung des Methodeneinsatzes von Humansensorik in der Stadt- und Verkehrsplanung zu erforschen und voran zu treiben. Spannend hierbei bleiben auch konzeptionelle Überlegungen, wie solche Methoden stärker in Planungsprozesse eingebunden werden können.

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reviewed paper

GIS Application for Improving Housing Conditions in Substandard Roma Settlements in Serbia

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1 ABSTRACT

In order to tackle socio-economic inequality problems of Roma minority population in Serbia, Serbian Government has adopted in 2009 the Strategy on Improvement of the Status of Roma in the Republic of Serbia (Roma Strategy). During last 7 years, this Roma Strategy has been implemented by different entities and through various projects, dealing with some of the major identified issues of Roma community in Serbia, like: substandard living conditions; low or no income at all; legal and other discriminations; lack of rights on social care and/or health insurance; etc.

Within the programme "We are here together – European Assistance for Roma Inclusion", the Organisation for Security and Co-operation in Europe Mission to Serbia (OSCE Mission to Serbia) provides technical assistance to the Serbian Government in implementation of the mentioned Roma Strategy. Since 2013, part of this assistance has aimed at creation of an information system, that is, centralized GIS application for the substandard Roma settlements (SRS) in Serbia. The main purpose of this GIS application is to support the Ministry of Construction, Transportation and Infrastructure (MCTI) together with local governments, to register, monitor and analyse quality of housing within SRS in Serbia, and make right decisions for improvement of Roma community living conditions in future.

Thus, in order for affordable housing solutions for SRS in Serbia to be identified and then proposed by MCTI for funding, the OSCE Mission to Serbia has implemented project "Mapping of substandard Roma settlements in GIS" for building GIS application for SRS. This project consisted of two main groups of activities: (1) spatial and alphanumeric data collection on SRS, and (2) GIS application building for SRS housing conditions monitoring and decision-making. As part of project methodology, the first conceptual data model for SRS was created using UML language. Based on this model, questionnaire for alphanumeric data collection on SRS housing conditions was developed, while spatial data for SRS boundaries were collected using CAD tool and orthophoto maps for each site where these settlements were located within Serbian municipalities. Also, in order for SRS data collection activity to be performed efficiently, network of 16 field co-workers throughout Serbia was established and appropriate training was provided. Finally, as second part of project methodology, collected SRS data were subject of quality verification before their conversion and integration within SQL database, which was basis for creation of appropriate GIS environment using QGIS open-source software advantages.

The aim of this article is to present project methodology and main results. First, recent activities on Roma community housing improvement in Serbia would be listed and the OSCE project "Mapping of substandard Roma settlements in GIS" would be presented. Then, selected methodology for the project aim and outputs achievement would be described. In following chapter, OSCE project main results would be presented together with their main characteristics and first data analysis results. Finally, project methodology and results would be discussed and conclusion would be made, including possible implications and future steps towards improvement of Roma community housing conditions in Serbia.

Keywords: GIS, housing, OSCE, Roma, Serbia

2 BACKGROUND

Starting in 2002, Serbian Government has adopted several strategic documents and measures to improve Roma community living conditions in Serbia; also, it participated in launching the international Decade of Roma Inclusion initiative in period 2005–2015. However, despite invested efforts, implementation of all policies and measures within education, employment, health and housing domains for Roma community has faced serious difficulties in Serbia.

According to Vuksanović-Macura (2012), noticed implementation difficulties in the housing domain are due to a poor understanding of the problems of Roma settlements, a lack of updated data and maps for the same, as well as a shortage of financial resources, among the other things. On the other side, lack of social inclusion, as one of the two main problems of Roma community in Serbia, has also territorial or spatial aspect. (URL2) This means that lack of Roma inclusion is not merely a consequence of individual or Roma community as a whole position in existing Serbian social structure, but result of existing substandard housing conditions within Roma settlements, produced by number of mutually connected problems, such as unemployment, poor public services, absence of roads, low income, etc.

In 2002, there were 593 settlements registered in Serbia with poor –i.e. substandard- housing conditions. Majority of those settlements were populated prevailingly by Roma population, and most of them had problems, such as (URL1):

- Legally unregulated status;
- Ownership status on land unregulated;
- Lack or poor utilities and infrastructure in general;
- Low worthiness and weak sanitation standards of houses;
- Overpopulation;
- Unregulated, poor and living environment with health risks; and
- Absence of other public services in settlements, and difficulties or obstacles for using these services in their neighbourhood.

Relaying on the spatial development vision, aims and objectives of the Serbian government, Spatial Plan of the Republic of Serbia for period 2010-2020 has identified two main models, that is, scenarios for SRS improvement (URL1):

(1) Retention and upgrading of housing conditions in those Roma settlements that (can) satisfied minimal quality standards of life; and

(2) Building new residential capacities for resettling population of those Roma settlements that lack basic standards of life.

In order for these two models to be planned and implemented in integrated, informed, justifiable and organized manner, following sustainable housing principles and measures prescribed by Serbian Government (URL1) and UNECE (URL2), up-to-date data on SRS need to be collected and mapped for establishing efficient monitoring and decision-making tool and process for Roma community housing in Serbia.

This is needed because some SRS have existed for decades in Serbia, but authorities have only started finding out about them when they were presented with data and analyses resulting from the mapping and enumerations. To this end, in the past two decades around 50 different initiatives for SRS improvement have been launched in Serbia requiring the mapping of individual settlements or a large number of Roma settlements at one time. (Vuksanović-Macura, 2012) The only mapping project of Roma settlements on national level included merely identification of their spatial distribution, that is, just relative –point data-locations collection without detailed data on SRS boundaries or the other housing conditions information. (Jakšić and Bašić, 2005)

Therefore, in order for relevant decisions and efficient actions on side of Serbian authorities for SRS improvement to be taken, Vuksanović-Macura (2012) confirms that quality and scope of existing SRS maps and data need to be upgraded, and methodological approach for data collection and management further standardized. Due to limitations of national funds and capacities, no one in Serbia was able to take necessary measures in this direction, so international programmes and funds have been identified as main sources for implementation of social inclusion and sustainable housing objectives for Roma community in Serbia.

3 GIS APPLICATION FOR IMPROVING HOUSING CONDITIONS IN SUBSTANDARD ROMA SETTLEMENTS IN SERBIA

Starting in 2001, the OSCE Mission to Serbia is supporting the integration of the Roma community, and dedicates considerable efforts in achieving the aims and objectives of the Decade of Roma Inclusion 2005-2015 in Serbia. (OSCE, 2009, 2013)

As part of these efforts and within its mandate, the OSCE Mission to Serbia is implementing since 2013 IPA-funded programme “We are here together – European support for Roma inclusion”. (OSCE, 2013) This programme is supporting implementation of the Roma Strategy in Serbia (URL3), and it is aimed to address existing social and economic discrimination issues and vulnerability of Roma community in general by improving access to basic human rights, like civic participation, employment, education, healthcare, social services, and adequate housing.

Being one of the mentioned programme aims, i.e. integration measure, adequate housing for Roma community in Serbia has included number of activities for long-term improvements of existing living conditions. Among those activities is, also, SRS mapping and development of information system – i.e. GIS application-, which is in a focus of this article. According to the programme objectives, it is expected that GIS application would help monitoring housing conditions in SRS, and support decision-making, housing improvement proposal writing as well as follow-up of chosen affordable housing solutions implementation by the national government.

Thus, to assist MCTI to monitor and make informed and timely decision for improving housing conditions of Roma community in Serbia, the OSCE Mission to Serbia has launched in 2013 a project for mapping and building GIS application for the SRS on national level. In this way, the OSCE Mission to Serbia has supported standardization of methodological approach to Roma housing conditions data management and analysis, and provided first national GIS database for SRS as an initial platform for future initiatives within sustainable housing domain for Roma community in Serbia.

4 PROJECT METHODOLOGY

The project titled "Mapping of substandard Roma settlements in GIS", which was implemented during 2014 and 2015, was aimed to enable the usage of the GIS technology advantages for SRS data management for the first time in Serbia. The main purpose of the project was to build efficient tool for SRS monitoring by national policy decision makers, which could additionally support already invested efforts by the Serbian Government, municipalities and OSCE for improving housing conditions for Roma community in Serbia.

Accordingly, project methodology framework was built for achieving the identified objectives and targeted functionalities of the future SRS database, that is, GIS application (Živković and Đorđević, 2015):

- To ensure municipal and national coverage and detail of information for SRS;
- To include the collection of both spatial and alphanumeric data on SRS;
- To provide platform for monitoring status and types of substandard quality assessment for each SRS;
- To develop conceptual data model for SRS needed for GIS database structuring and future GIS application interoperability with the other key databases in Serbia, as well as data from the other similar Roma community projects in Serbia; and
- To support standardization of methodological approach to the SRS issues management in Serbia in future.

Following above functional requirements from GIS application for the SRS monitoring and decision-making, project methodology included next 4 operational steps:

(1) Project scope definition, i.e. definition of SRS;

(2) Development of conceptual data model for SRS;

(3) Selection of data collection methods for spatial and alphanumeric data on SRS; and

(4) Identification of data quality, conversion and integration approaches for building GIS database and application.

4.1 Definition of SRS

Responding to the needs for standardization and data interoperability, project scope and methodology were identified based on the definition of substandard settlements given by the UN. (Živković and Đorđević, 2015) Similar to the Spatial Plan of the Republic of Serbia definition (URL1), this definition recognizes the following criteria as the key ones for the substandard settlements identification:

- Inadequate access to potable water;
- Inadequate access to sanitary and other infrastructure;
- Poor quality of housing units;

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- Overpopulation in terms of average density of population per unit area of the settlement; and
- Uncertainty of the legal status of houses on plots.

4.2 Conceptual data model

In next step, complying with the previously identified SRS definition as well as the project functional requirements related to expected outputs and results, a conceptual data model for SRS domain in Serbia was built using:

- UML language advantages; and
- International and national data management standards (ISO19115, i.e. INSPIRE, Serbian NSDI), where possible, as well as project needs.

4.3 Data collection

Selection of the methods for alphanumeric and spatial data collection for each SRS was adjusted then to the adopted SRS definition (4.1) and the conceptual data model (4.2).

The questionnaire method was used for collecting alphanumeric data on the SRS housing conditions. Created questionnaire in Excel file format consisted of total 26 questions, where most of them were of closed-end type. Advantages of this method for the SRS data collection and project aim achievement assumed:

- Simple filling in of the questionnaire and easy analysis of collected responses;
- Reducing risk of errors when filling in questionnaire; and,
- Assuring for the collected data to be enough standardized for GIS technology implementation.

The CAD technique combined with the Spatial Units Registry data and georeferenced orthoimagery, obtained both from the Republic Geodetic Authority (http://rgz.gov.rs/), was used for collecting spatial data on SRS boundaries.

As output, separated Excel file with alphanumeric data and CAD file with boundary data were created for each SRS identified in Serbia on the municipal level.

In addition to above listed methods for data collection for the SRS database, additional methods used within this phase of the project included data generalization, classification, and others.

Finally, organizational model for the SRS spatial and alphanumeric data collection on the field demanded formation and training of a small network of 16 associate experts, consisting mostly from the employees of urban planning offices in municipalities, coordinators for national minority issues, and other local-level professionals dealing with the housing issues of vulnerable social groups.

4.4 GIS application building: data quality, conversion and integration

In order for collected SRS data to be smoothly converted and integrated with the other data in GIS environment, project-specific data quality assessment procedure was conducted in view of achieving the goals of the project. This data quality assessment procedure for collected spatial and alphanumeric SRS data assumed their verification against the four standard quality criteria: completeness, consistency, accuracy and logical sense of the data.

After quality verification, SRS data were converted from Excel and CAD formats to the SQL database using the developed conceptual data model and other rules set for the output GIS application.

Finally, integration of SRS data with the other vector and raster data within GIS environment was based on different Web technologies and accepted data management standards, making thus SRS GIS database and resulting application scalable and extendable. Also, due to limited project budget as well as current trends in data management, proposed GIS software solution was required to be open-source one.

5 GIS APPLICATION FOR SUBSTANDARD ROMA SETTLEMENTS MONITORING AND DECISION-MAKING

In compliance with the established methodological framework and project aim, project team has produced and delivered two main outputs: 1) conceptual data model, and 2) GIS application.

5.1 SRS domain model

The conceptual data model for identified SRS issues and their descriptions was created using the UML language advantages.

Developed model includes 8 main objects or entities (Fig.1), and it covers basic issues for SRS status monitoring, evaluation and decision-making in Serbia. Modelled SRS objects could be grouped in the four categories (Živković and Đorđević, 2015):

- Data on relevant administrative, statistical and cadastral units for each SRS;
- General data on SRS, such as basic demographics, history and relative position to the other settlements;
- General data on access to utilities and transport network for each SRS;
- General information on the legal-property relations at the level of individual SRS, and those identifying the existence and status of the current planning documents, as well as the type of land ownership.

Created conceptual SRS model is in line with local as well as certain ISO19000 and INSPIRE standards, where applicable. It is expected that applied data standards for SRS model would ensure GIS database and application scalability and extension in future, as well as simple connectivity, integration and exchange of SRS data with the other databases that contain information relevant for Roma housing conditions improvement.

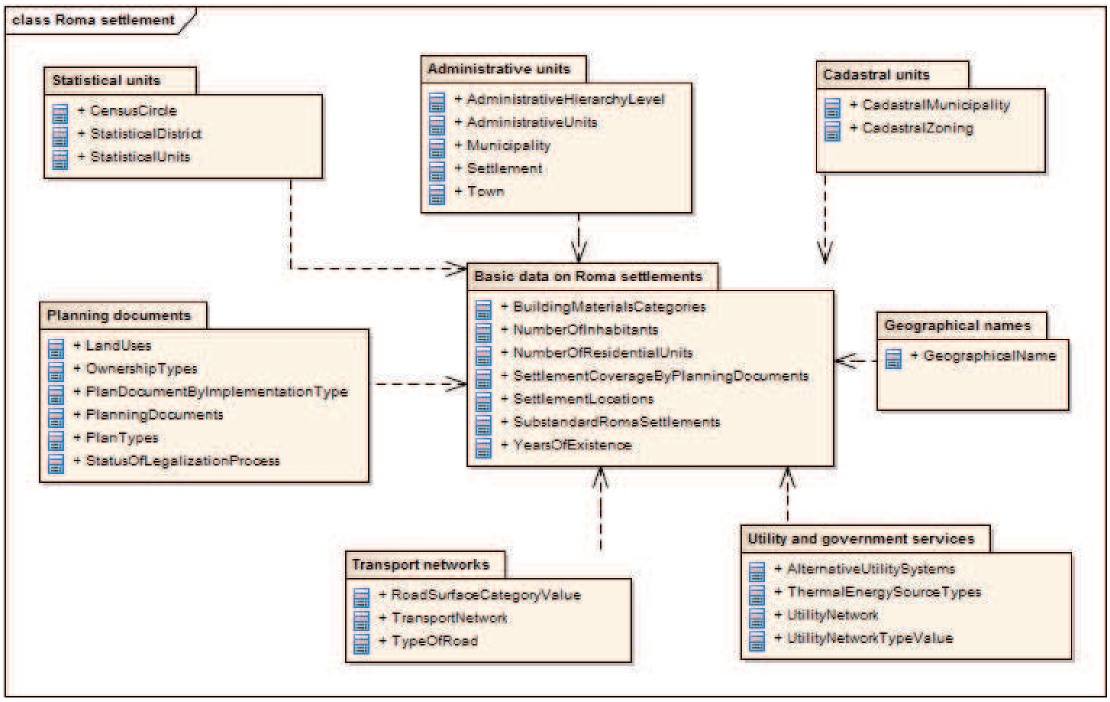

Fig. 1: Conceptual data model for SRS: overview (Živković and Đorđević, 2015)

Also, this conceptual data model supported the following project step (a) collection of alphanumeric data for the each SRS, by providing scope and content for questionnaire compilation in the Excel format, as well as (b) linking of SRS alphanumeric data via unique spatial unit ID to complementing SRS boundary data in CAD format.

5.2 GIS application for SRS management

Furthermore, developed conceptual model of SRS domain (5.1) provided basis for the structuring of GIS database in MS SQL Server 2014 software, and it streamlined SRS data conversion and integration with the other relevant data for SRS within the output GIS application, built using QGIS software advantages.

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Editors: Manfred SCHRENK, Vasily V. POPOVICH, Peter ZEILE, Pietro ELISEI, Clemens BEYER

5.2.1 SQL database

After SRS field data collection by local experts using selected methods and tools (4.3), and these data quality verification against project-specified criteria (4.4), alphanumeric and spatial SRS data were converted and integrated within MS SQL Server 2014 database.

First analysis of collected data in SQL database showed that substandard settlements of this type have been identified in more than half of municipalities in Serbia, as seen in Table 1. In general, there are 583 Roma settlements of this type in Serbia (NUTS0) in total (excluding Kosovo and Metohija). This is 3.4 SRS per municipality on average in Serbia (LAU1). On the level of districts (NUTS3), the average is 22.4 SRS, while per region in Serbia (NUTS2) there are on average 145.8 of these settlements.

Number of municipalities with SRS settlements	Number of municipalities with no SRS settlements	Total number of SRS settlements	Average number of SRS settlements per municipality	Average number of SRS settlements per district	Average number of SRS settlements per region
120 (71.01%)	49 (28.99%)	583	3.4	22.4	145.8

Table 1: Statistical overview of SRS in Serbia (Živković and Đorđević, 2015)

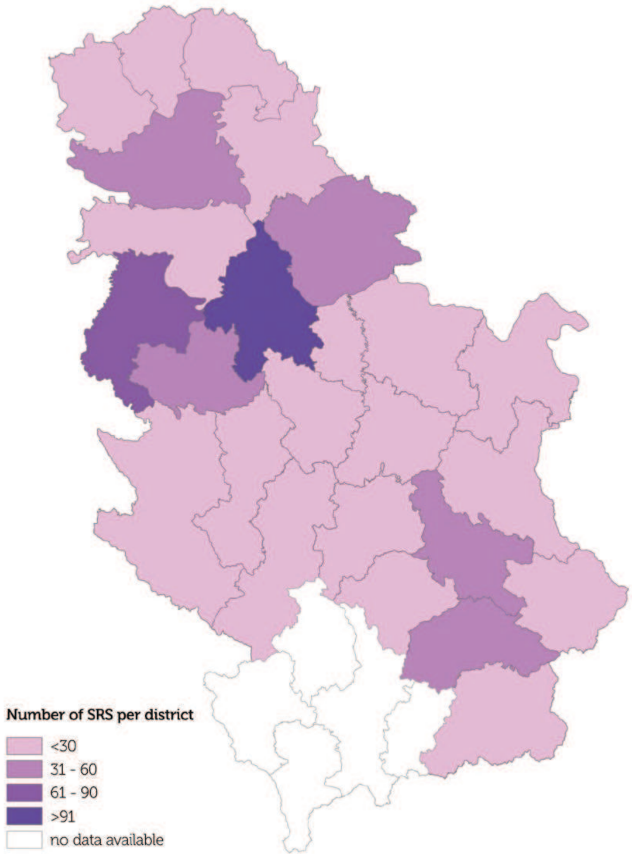

Fig. 2: Distribution of SRS in Serbia per district (Živković and Đorđević, 2015)

In other words, SRS has been registered in 71.01% of all municipalities in Serbia. The total number of 583 SRS on which data were collected corresponds to the estimates previously made by the OSCE and relevant Serbian experts. However, unlike some previous Roma housing conditions research and surveys, this project results included also information on spatial boundaries and areas of all SRS in Serbia. Also, this project provides information on spatial distribution of the SRS characteristics, like distribution of different housing conditions (utilities, infrastructure, etc.), or legal and property ownership status of SRS per municipality. Besides compliance of collected SRS data with the standards needed for using advantages of the complex GIS tools and analyses, these data revealed certain patterns of SRS in different regions in Serbia (Table 2). Additionally, SQL database has created possibility for identification of approximate size and scope of activities and funds required for improving the SRS housing conditions in future.

SRS		Serbia[1]			
Housing conditions	Types	Belgrade region[2]	Vojvodina region	South and East Serbia region	Šumadija and West Serbia region
Position in relation to formal settlement	Integrated into a formal settlement	58%	53%	54%	46%
	On the outskirts of a formal settlement	24%	44%	41%	39%
	Outside a formal settlement	18%	3%	5%	15%
Number of years of SRS existence	< 15 years	10%	1%	5%	6%
	15-45 years	55%	34%	34%	41%
	> 45 years	35%	65%	61%	53%
Construction materials used to build housing units in SRS	Poor quality materials, unsuitable for construction purposes	42%	63%	38%	20%
	Materials that guarantee durability and safety	58%	37%	62%	80%
Size of the SRS	< 15 units	19%	31%	32%	40%
	15-50 units	48%	49%	39%	41%
	51-100 units	24%	13%	17%	12%
	101-200 units	6%	5%	6%	5%
	> 200 units	3%	2%	6%	2%
Number of inhabitants in SRS	< 100 inhabitants	28%	49%	52%	55%
	101 – 200 inhabitants	31%	34%	17%	28%
	201 – 500 inhabitants	31%	13%	20%	12%
	501 – 1000 inhabitants	9%	2%	6%	4%
	> 1000 inhabitants	1%	2%	5%	1%
Status of infrastructure networks in SRS					
Water supply system	0% units connected	38%			
	< 30% units connected	10%			
	30 – 70% units connected	22%			
	> 70% units connected	30%			
Sewerage system	0% units connected	74%			
	< 30% units connected	6%			
	30 – 70% units connected	9%			
	> 70% units connected	10%			
Electrical power system	0% units connected	8%			
	< 30% units connected	8%			
	30 – 70% units connected	16%			
	> 70% units connected	68%			
Road network – asphalt-paved roads	0% roads asphalted	26%			
	< 30% roads asphalted	26%			
	30 – 70% roads asphalted	18%			
	> 70% roads asphalted	30%			
Public lighting	0% roads with public lighting	33%			

[1] NUTS0 level
[2] NUTS2 level

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SRS		Serbia[1]			
Housing conditions	Types	Belgrade region[2]	Vojvodina region	South and East Serbia region	Šumadija and West Serbia region
	< 30% roads with public lighting	14%			
	30 – 70% roads with public lighting	22%			
	> 70% roads with public lighting	31%			
Heating	No heating	1%			
	Gas	0%			
	Electrical heaters	2%			
	Solid fuel	97%			
Organized solid waste collection service	Exist	60%			
	No exist	40%			
Type of urban/spatial plan that covers the SRS area	Municipal spatial plan	50%			
	General urban plan	19%			
	General regulation plan	21%			
	Detailed regulation plan	10%			
Housing units in SRS in legalization process	< 30% units	80%			
	30 – 70% units	12%			
	> 70% units	8%			

Table 2: Housing conditions in SRS in Serbia: general overview of SRS characteristics by region

5.2.2 QGIS application

The concept of GIS application for monitoring the SRS housing conditions and decision-making for their improvement has been created using internationally accepted standards for data management, like ISO TC-211 and OGC standards, as well as open-source software advantages.

This approach allowed intensive usage of available Web technologies as well as creation of all technological functionalities required by the project stakeholders, like distributed multitier/client-server architecture; centralized administration and maintenance; intensive usage of Web and Web GIS services; and, usage of GIS data and services by number of distributed users simultaneously.

Conceptually, architecture of built GIS solution consists of standard DBMS, where intensive data editing and advanced analyses would be performed using GIS desktop application, while the SRS and other relevant data (Google maps, Bing and OpenStreetMap, and others) would be accessible directly both via Web and Desktop GIS applications. The architecture itself is open one, and thus would allow MCTI, as the project owner and main end-user of the SRS GIS application, to easily integrate data from the other databases, being them either in vector, raster or some other formats.

This openness and flexibility of GIS application has been achieved by implementation of OGC standards, like WFS and WMS, which allow sharing and integration for SRS relevant data from the other sources, i.e. databases. On this way, for example, RGZ's Registry of Spatial Units data are integrated within SRS GIS environment by available WFS service; also, orthoimagery data from RGZ's database are available via WMS service; and, relevant data from the Statistical Office of the Republic of Serbia are shared using implemented KML standard; etc.

Also, available DBMS administrative tools within developed GIS application would secure simple extension and scalability of the created SRS data model (5.1).

Finally, user interface of GIS application for SRS data management is in local –Serbian- language.

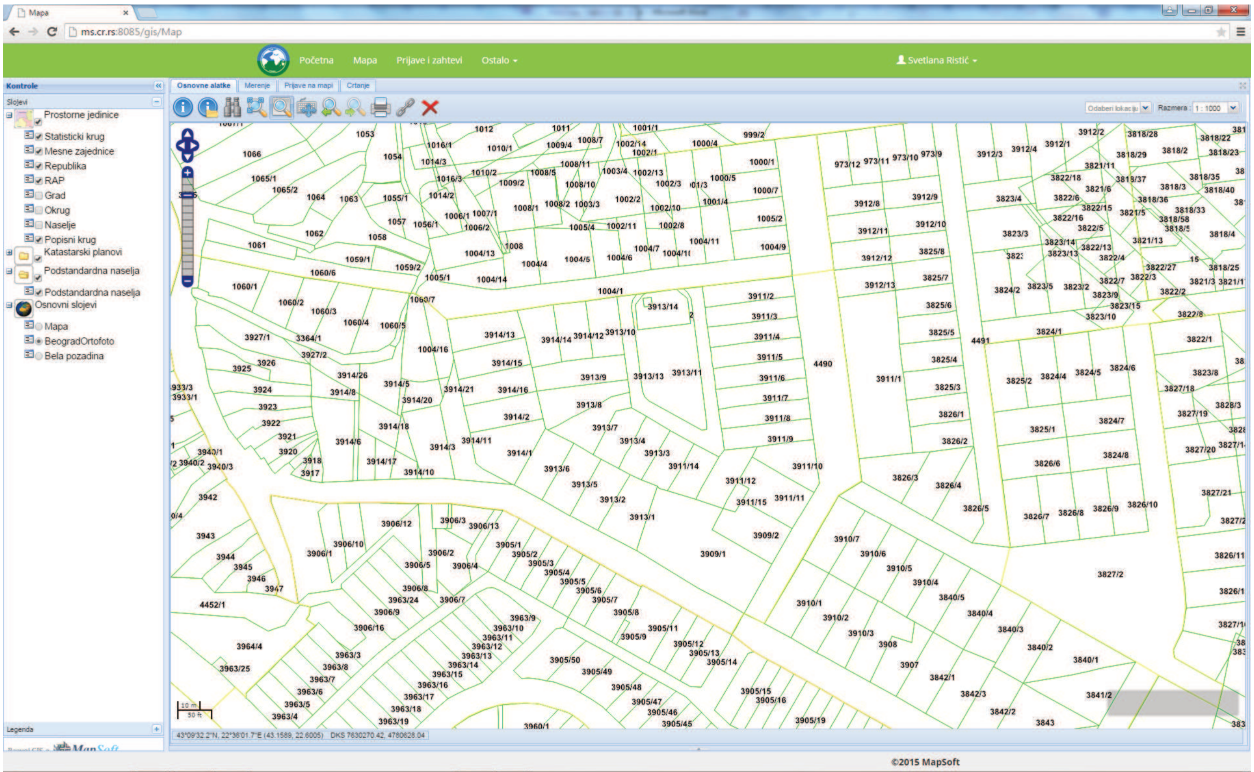

Fig. 3: Web GIS application for SRS housing and settlements conditions improvement: integration of geodetic maps data for SRS monitoring and decision-making (MapSoft, 2015)

Software platform for created concept of GIS application architecture is based on the several open source solutions today available:

- DBMS software: MS SQL Server 2014
- Desktop GIS software: QGIS
- Web GIS software: GeoServer, OpenLayers

On the technology side, taking into account current strict austerity measures of Serbian Government, implemented software platform would ensure next critical advantages:

- Free GIS software and minimal maintenance cost;
- Interoperability as well as compatibility with standard Web and GIS tools, data formats and software;
- Various analytical and visualisation tools available to many users at the same time;
- Simultaneous work with different data formats;
- Simple metadata administration;
- Easy roles and user rights administration; etc.

On the functionality side, in respect to the project aim of the housing conditions monitoring and improvement decision-making for the SRS in Serbia, it is expected that developed GIS-based information system would provide more benefits, such as: 1) implementation of basic spatial and attribute data analyses of the SRS data on the territory of the Republic of Serbia; 2) making informed and timely conclusions on the general status of these settlements and the living conditions of the Roma population in them; 3) proposing and adopting strategic/tactical decisions regarding further activities to be taken by the line ministry (today MCTI) towards affordable and sustainable housing solutions; and 4) identifying the detailed needs of these settlements, investment priorities and the scope of the necessary resources.

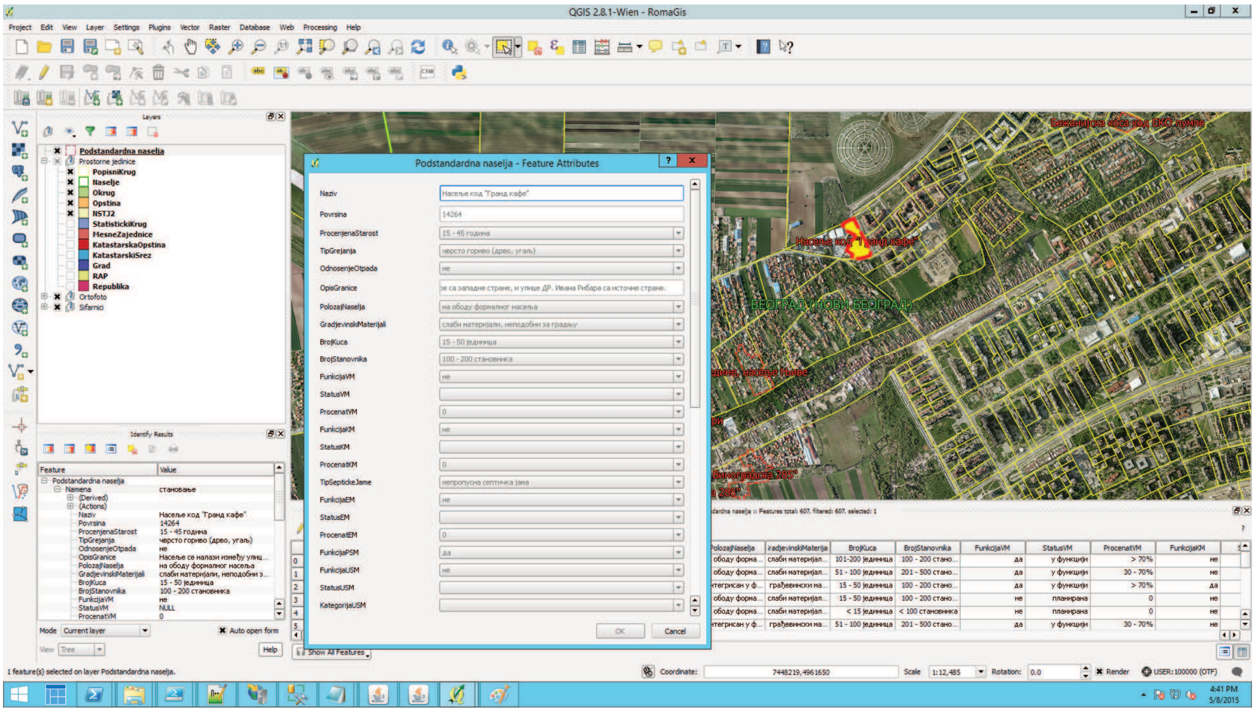

Fig. 4: Desktop GIS application for SRS housing and settlements conditions improvement: integrated vector and raster data for SRS monitoring and decision-making (MapSoft, 2015)

6 DISCUSSION

In line with the main project results presented in the previous chapter, as well as comparing them to the similar projects' results implemented before in Serbia, a number of advantages of the selected methodology can been identified. Some of these advantages include:

- Implementation of the applicable international and national data management standards, as well as open source software;
- Possibility of linking, sharing and/or integration SRS data with the other databases;
- Creating of first national GIS-based information platform on the SRS in Serbia;
- Possibility of a relatively simple replication of the project methodology for the other substandard settlements management in Serbia; etc.

The main disadvantages of the project results relate to the general character of collected SRS data, which are only estimations of selected housing conditions aggregated on the level of each individual SRS boundary in Serbia. This disadvantage is direct consequence of time and resources limitation of the project itself. Therefore, in future it should be launch new initiatives which would upgrade created GIS application to a more efficient and effective information platform, where housing conditions data within SRS would be more detailed and linked to each individual housing units (instead of SRS boundary data).

Also, amount and details of newly collected updated data and information on SRS demonstrate positive and collaborative attitude of the Roma community in supporting the increasing number of initatitives for improvement of currently poor living conditions of this minority in Serbia.

Additionally, first SRS data analyses revealed that majority of this type of settlements are integrated into the formal settlements and that are built from materials that guarantee durability and safety, which would enable their (SRS) easier legalisation and integration into the local public services system. This positive finding is further underlined by the fact that all SRS in Serbia are covered by at least one type of planning document, which would contribute to the smoother realisation of future investments in the Roma community living conditions improvement. This also means that participation of the Roma minority representatives in spatial and urban planning processes as well as local development policy implementation in Serbia could be intensified in future.

On the other side, preformed SRS data analyses showed also that Roma population in Serbia are missing some the basic utilities, where the worst situation is with a heating, water supply and sewerage system and services.

Also, in future, maintenance of created GIS application for SRS demands the establishment of an adequate and continuous process of monitoring, evaluation and updating of all categories of data that had been subject of collection activities under this project. The same applies to the implemented technology, which demands keeping the pace with new ICT solutions and advantages on market.

7 CONCLUSIONS

As part of its technical assistance to the Serbian Government in solving the problem of substandard living conditions of the Roma minority population in Serbia, the OSCE Mission to Serbia has supported creation of national GIS application for SRS within the project "We Are Here Together-European Support for Roma Inclusion: Mapping of substandard Roma settlements in GIS".

During several months period, the project team formulated and implemented the appropriate methodology framework, and developed conceptual SRS data model and GIS application with database for 583 identified SRS in the Republic of Serbia. This initial GIS-based information system for SRS in Serbia would be used for monitoring and evaluation of each settlement quality of life, as well as for making relevant development decisions and proposals for affordable and sustainable housing options for Roma community in the future.

This GIS platform, which today contains only basic and general information on the each individual registered SRS, should regularly be updated, developed and enlarged in future, increasing the detail and scope of collected data. Listed activities are critical for achieving improvement of the elementary infrastructure and superstructure in these settlements, as well as for Roma population in Serbia to gain equal rights in terms of their living conditions.

Besides the new initiatives for upgrading here developed GIS information platform in the future, definition of basic criteria and priorities for the investment decision in improvement of identified SRS categories in Serbia may be the subject of a new project as well.

Also, as part of new activities towards the development of SRS in Serbia, the line ministry could consider launching an initiative to define, design and build an integrated information system for the domain of substandard settlements in Serbia in general. This means applying the experience in collecting data gained during this Project onto other substandard settlements in Serbia, and creating a single GIS information system to serve for improvement of the living conditions and reduction of poverty for the most vulnerable social groups in Serbia -including refugees- in the future.

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reviewed paper

Hiking Trip Selection Based On Reachability By Public Transport

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1 ABSTRACT

Smart cities should enable the citizens to utilize available ressources. One of the goals is the reduction of individual motorized traffic. However, many citizens still use cars to get to the location of an ourtdoor activity. As a concrete example we use hiking trips and identify those that can be reached by public transport. The result is a map (and a corresponding GIS data set) showing the hiking locations for a single day hiking trip. The concept can be used for various other applications although there are still open questions, e.g., what part of the answer can be precomputed and what should be determined on demand.

Keywords: Hiking Trip, Individual choice, Public Transportation, GIS, Reachability Analysis

2 INTRODUCTION

Garau, Mundula, and Salustri define smart cities as systems of knowledge (Garau et al, 2014). However, this is only one vision. Smart cities should also be climate neutral (Montlleó et al, 2014), livable, innovative, and sustainable (Wendt et al., 2014). A brief overview on aspects and ideas has been presented by Bajracharya et al. (2014). One of the general goals, though, is the efficient use of available ressources. This is obviously space, energy, creativity, and money, but the existing infrastructure also belongs to these ressources. Public transportation of any form is part of this infrastructure and if it is used efficiently several goals are addressed simultaneously because motorized individual traffic is reduced. This requires less fossile fuel, produces less emmissions including noise, and requires less space. However, we need better tools to avoid extensive trip durations and make public transportation alternatives more visible. In this paper we show a reachability analysis for hiking paths around Vienna.

There are several databases on hiking paths in Austria and schedule data for public transport is available in digital form, too. A problem for an interested user is the combination of these sources. Selecting a hiking path from a webpage and use a car to get there is simple. Checking the possibility to use public transportation to get to the hiking path may be frustrating, though since some destinations are not reachable or the trips to the hiking track simply take too long. A user-centreed approach could consist of the following steps:

(1) User preferences are collected (start location, maximum duration of the whole trip, hiking length, difficulty level, etc.)

(2) Possible choices are determined and presented on a map

(3) The user selects a destination and receives all necessary information for the trip (required tickets, departure times, etc.)

A similar analysis has been performed by Neis et al. (2007). They illustrated a web based reachability analysis in order to assess the housing market in Rheinland Pfalz in Germany. They describe the architecture of the analysis, the calculation, request and response parameters as well as the prototype of the frontend. In the outlook Neis et al. refer to further potential uses of web based GIS analysis such as disaster management or individual tour suggestions for tourists, an idea pursued further in this paper. The focus is on the determination of possibilities. The reachability analysis should be able to obey sets of data: the schedule data which is in fact the travel time of the public transport system and the information on hiking trips, e.g., the duration. The results of the reachability analysis is displayed on a map and could then be offered as a web service.

The structure of the paper follows the workflow of such a project. We start with the description of available data and services. Then we present the design decisions used to simplify the concept. In section 5 we focus on the implementation and briefly discuss error handling. Results are shown in section 6 and their discussion concludes the paper.

3 AVAILABLE DATA AND SERVICES

Analysis requires data and—if the data is accessible on the Internet—methods to access the data. In this section the data and services used for the project are described.

3.1 Hiking Data

Data on hiking routes in Austria were provided by Outdooractive, a platform for outdoor activities such as hiking. In order to get data of high quality, the company cooperates with tourism institutions and Alpine clubs. According to the information of the Outdooractive website , the platform provides around 95,000 outdoor activity tours (hiking, cycling, and other outdoor adventures) and corresponding official maps. The service provides an API to access the content as UTF-8 XML documents . In order to get access to the data a valid API key as well as a valid project key is necessary.

Data on tours or points of interest (POIs) can be requested. Geographical selection is possible based on hierarchical regions:

- Political: continent, country, province, district, community
- Tourism: tourism area, custom area
- Nature: mountain area, protected area

Each political area is split into tourism regions and each tourism region may contain information on the nature type.

Tour element contains a number of interesting elements:

- text elements,
- tour geometry,
- numbers,
- related POIs,
- elevation profile,
- and exposition.

Several of these elements are necessary for the reachability service. Each destination must be labeled for the user and the title of the hiking tour is stored in the description. Further important elements include the starting point description, safety guidelines or required equipment. The tour geometry itself is stored as a line string of geographical 2D coordinates based on WGS84 following the OGC (Open Geospatial Consortium) specifications. Finally, information like duration, length, elevation, rating, difficulty, and season is also available. Difficulty, for example is assessed in three classes fom easy to difficult.

3.2 Public Transportation Data

ITS Vienna Region provides the routing platform “AnachB”. It is a traffic service for Austria with a special focus on the federal provinces of Vienna, Lower Austria and Burgenland. The route planner allows to determine the fastest route between two locations using individual or public transport. ITS Vienna Regions emerged from a cooperative telematics project founded by the three federal provinces of Vienna, Lower Austria and Burgenland and embedded in the public transport association Verkehrsverbund Ost-Region (VOR) in 2006. Therefore, the data used by AnachB is the same data used by the various branches of public transportation in the region and the data described the schedule up to date, completely, and correctly.

3.3 Routing Service

The routing service itself is already available at ITS Vienna Region. It is part of the route planer platform “AnachB”. The routing algorithm for public transport was developed by HaCon, a company specialized on high-quality software solutions for traffic, transport and logistics. The timetable information system is called HAFAS. HAFAS contains an external XML-Interface, which enables a client to query HAFAS. The routing request is transmitted to the server in XML format via the POST method of the HTTP protocol. The server processes the request and answers with a response in XML format.

The server can handle three different requests. A location validation request checks an address and returns the closest matches together with the geographical coordinates of the location. A connection request asks for public transport connections between two points. A station board request provides schedule information for a specific station. Finally, an intermodal routing request asks for a connection using individual transport modes such as a car or bicycle or public transport.

4 DESIGN DECISIONS

In order to keep the first prototype simple, several design decisions were made:

- Hiking trips should be finished within a single day including the trips to and from the hiking area. The target group are people looking for a hiking trip on a specific day.
- The results are precomputed. Each test if a hiking location fulfills above criterion requires several requests (at least two connection requests). In the eastern part of Austria 1,353 hiking paths are registered. Thus, if the result is created from scratch for each user, more than 3,000 requests would be necessary.
- Reasonable starting locations were selected to allow precomputation. Users starting in Vienna are assumed to start from a major railway station, Westbahnhof or Hauptbahnhof. Major train stations were used for Lower Austria and Burgenland.
- Different schedules on workdays, Saturday, Sundays, and public holydays are included. However, school holidays were ignored because they vary between the federal provinces. Schools are closed, for example, on November 11 in Burgenland and on November 15 in Vienna and Lower Austria due to the different patron saint.
- Duration of daylight is ignored, i.e., it may happen that a proposed trip requires walking in dark conditions.
- Public transportation is restricted to rail, tram, and bus lines. Although, theroretically airplanes would also count as public transportation, flying to Nicosia for a 2 hours hiking trip is neither economically justifyable nor ecologically sound.

Fig. 1 illustrates the idea of a single day trip. The user starts the trip and returns on the same day. Since hiking paths do not need to be circular, the start and end point of the hike may vary. This is an added benefit when using public transportation.

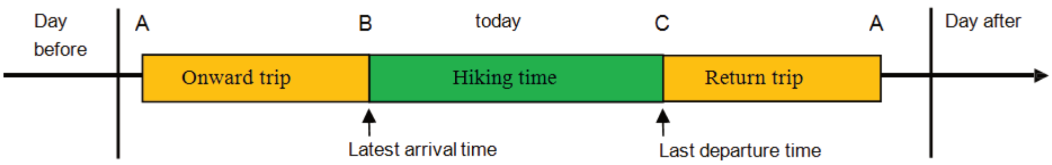

Fig. 1: Travel times and hiking time within one day (Wagner, 2015, p. 12).

5 IMPLEMENTATION

Figure 2 shows the concept of the reachability analysis. The blue elements represent data in XML-format. It is either data from HAFAS on public transportation schedules or data from the Outdooractive API on hiking paths. The violet elements indicate the two connection requests. The first connection request is sent to the server for getting the latest possible public transport connection on a specified day from the endpoint of the hiking path to the starting location. It does not matter if the first or the last connection is requested first. Depending on that, either the time calculation is processed in forward or backward direction. The description here used the backwards computation. The second request asks for the latest possible connection to reach the hiking destination early enough to go hiking and still have a public transport connection back home. The green elements indicate calculations. The time calculation computes the necessary arrival time for the second connection request by subtracting the hiking time from the departure time of the return trip. The second calculation decides if the trip takes less than a day and returns True or False. The grey arrows between the violet and blue elements represent server-client communication and show where the corresponding information is used.

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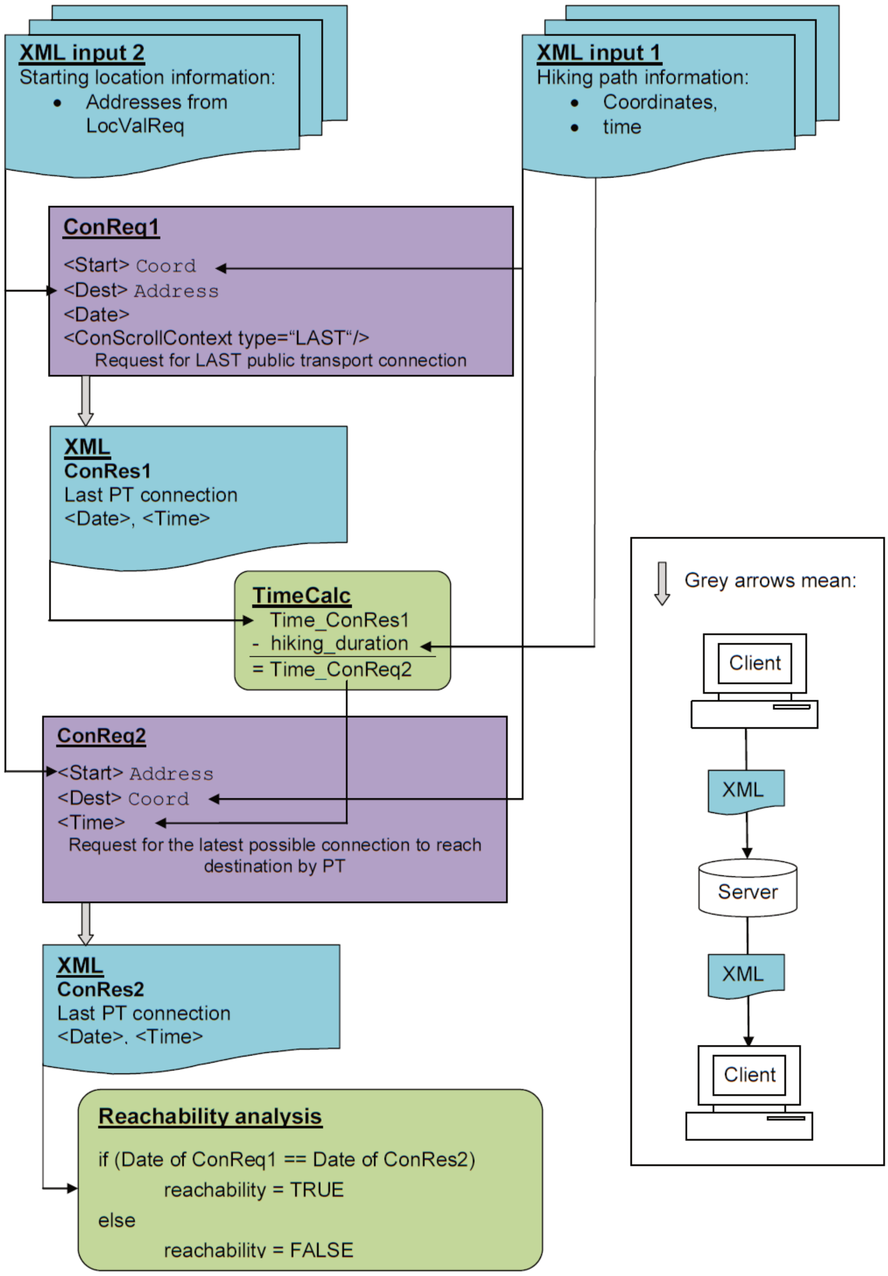

Fig. 2: Concept of the reachability calculation (Wagner, 2015, p. 40).

Errors may occur in two different locations of the flowchart. The first connection request may reveal that there is no public transport connection to the specified start of a hiking trip. The same may also happen during the second connection request for the start point of the return trip (the end of the hiking path). The errors may have two reasons. Either there is no public transportation station nearby the given coordinate or no connection in general could be found at all. The second case is rare and would reveal unconnected subnetworks of the public transportation system. The first case, however, results from that fact that hiking trips will rarely start or end precisely at public transportation stations. The start or end is specified by a set of coordinates and the server needs to identify the closest public transportation station. The server automatically sets a request to an individual transport router, which identifies the closest public transportation station and computes a walking route. The error occurs if no suitable station is found.

6 RESULTS

Fig. 3 provides a geographical overview. The names in the map indicate the starting locations. The territory of the Czech Republic, Slovakia, and Hungary is not represented because public transportation routing is restricted to Austrian territory and thus adding additional territories could be confusing. Of course, in times of international cooperations and open boundaries, a service like the one discussed in this paper should not stop at national boundaries. However, this is an issue of service availability and data reliability and can only be solved by international cooperation.

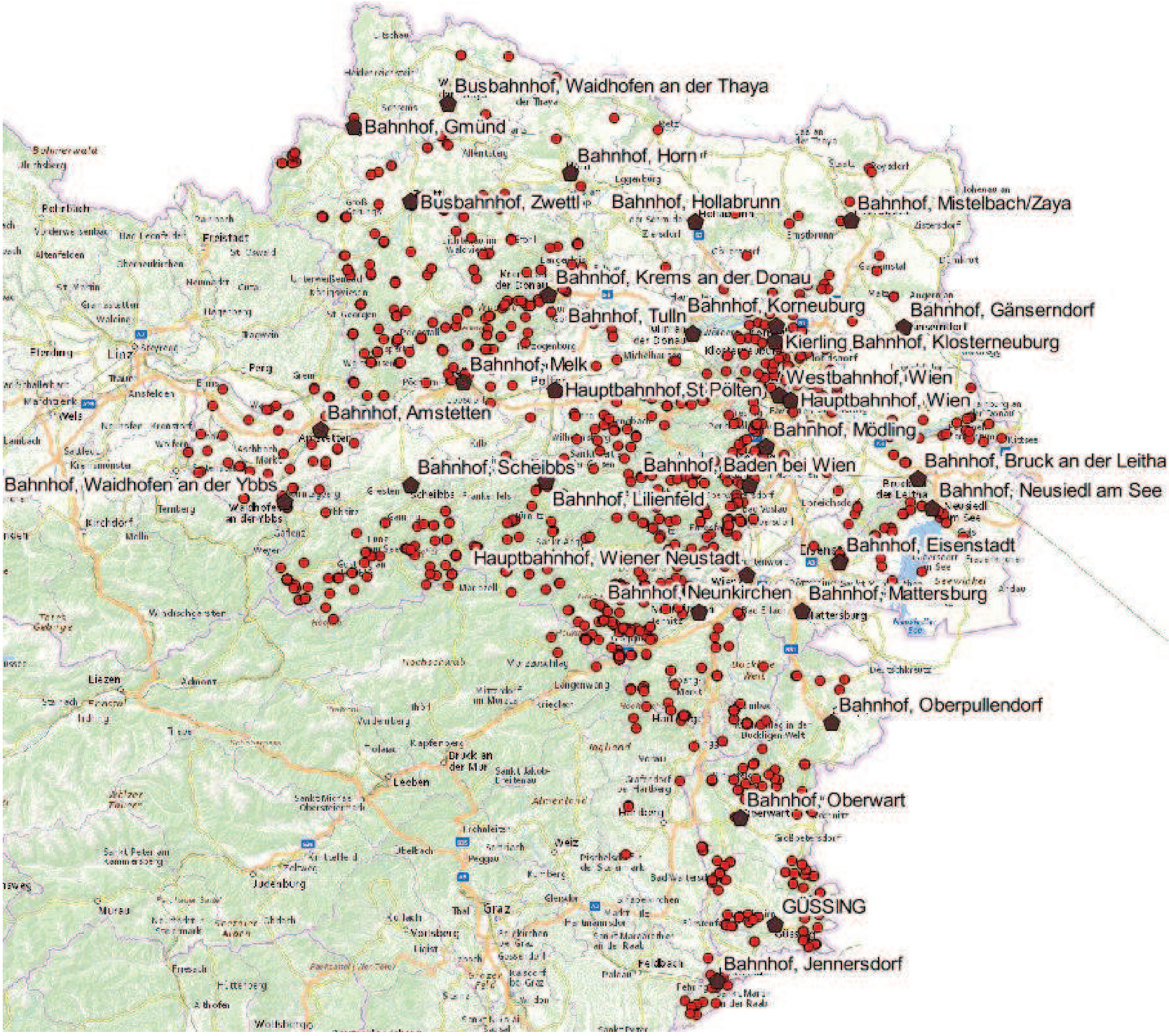

Fig. 3: Starting positions (brown pentagons) and hiking paths (red dots) used in the calculations (Wagner, 2015, p. 76). Background: Basemap.at

Fig. 4 shows the results of the reachability analysis for the starting location of Westbahnhof in Vienna (indicated by the star in the upper right sector). Green dots represent possible hiking locations. Yellow dots represent hikes that do not fit the selection criteria, i.e., the whole trip takes more than a day. A strange spatial pattern is visible between green and yellow dots: Sometimes the distance between a yellow and a green dot is small. The yellow dots then typically show hiking routes where the hiking itself already requires more than a day. Finally, the red dots represent hiking paths which are not reachable by public transport. There also seem to be a correlation between reachability and distance from the railway system (the thick lines in Fig. 4).

The balance between red and green dots may vary with the day. For example, on weekends some lines may not be served and thus the location is not reachable by public transportation. This is visualized in Fig. 5. The upper left image represents workdays (Monday - Friday). The upper right image represents Saturdays and the lower left image represents Sundays and public holidays. In the centre of the images (close to the starting point in Vienna), the differences are small. However, in remote areas patches of red dots pop up on Sudays. Thus, these locations cannot be reached at all using public transportation. However, some hikes that are possible on workdays turn to yellow on Saturdays and Sundays because the schedule of public transportation may start later or end earlier and the trip cannot be completed within a day.

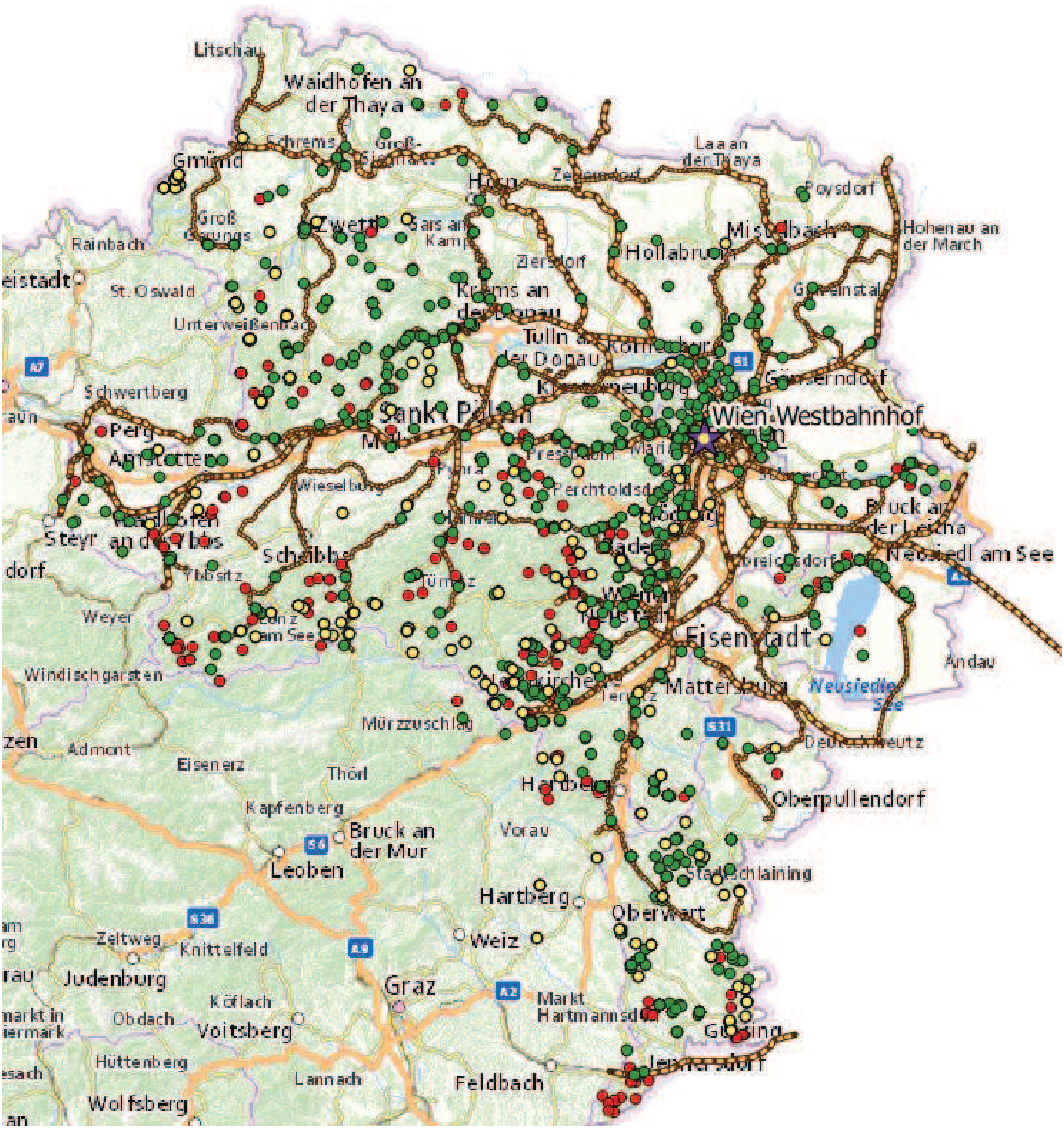

Fig. 4: Results for starting location Vienna, Westbahnhof. Background (Wagner, 2015, p. 77). Basemap.at

7 DISCUSSION AND CONCLUSION

In this paper a reachability analysis for ITS Vienna Region was developed to identify hiking possibilities that can be completed within a day including hiking and travelling by public transport. The first step was to develop a concept how to combine the data and which criteria have to be defined to meet the specifications of ITS Vienna Region. The results show the effect of the design decisions: User preferences were generalized and therefore the exclusion of hiking possibilities was mainly based on the availability of public transportation. However, once this data set is available, a selection based on arbitrary additional criteria like vertical extent, duration, or difficulty of the hike are easily possible in a web based end user application. The same is true for the length of the public transportation segments: while a five hour rail travel and a 30 minute hike would fit in a day, it will probably not be a clever choice. However, this step is just an application of standard multi-criteria selection (e.g., Achatschitz 2006).

One of the challenges was data supply. The quality of the analysis is determined by the quality of the used data. Both, up to date schedule data of a whole region or country and reliable data about the hiking paths are required. Schedule data typically is authoritative and reliable. The only difficulty is accessing the latest version. Data on hiking trips is more difficult. Some aspects like length or vertical profile are observable. Others, like duration of the hike vary with persons involved and the weather condition. In addition, there is no general procedure to collect, harmonize, and integrate this kind of data. Thus every data provider may have different coverage, different attributes, and even different classification based on the attributes.

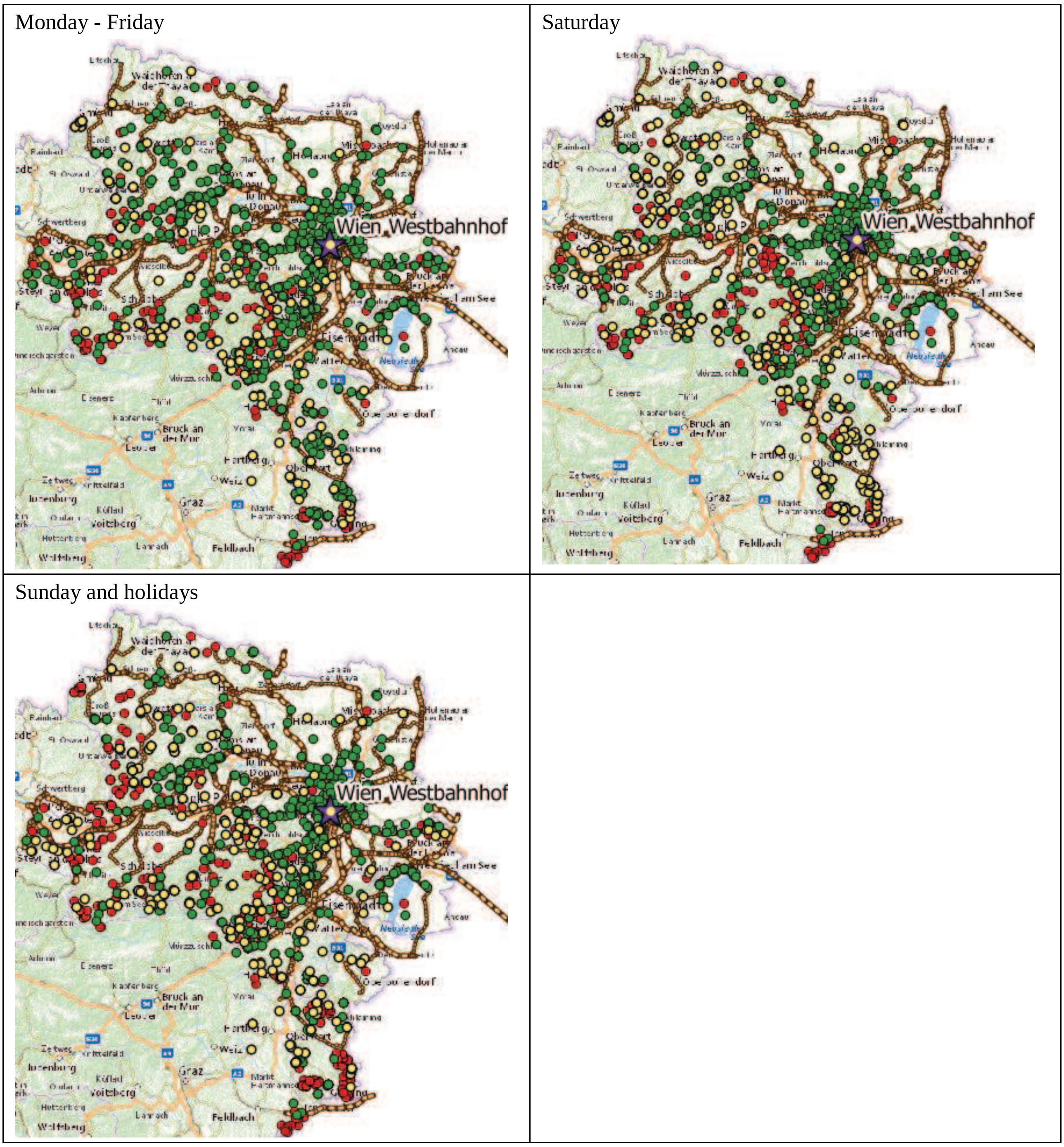

Fig. 5: Results for starting location Vienna, Westbahnhof (Wagner, 2015, p. 81). Background: Basemap.at

The situation gets worse when planning a transnational service. There is a single point of access for public transportation schedule data in Austria but cross-border trip planning typically involves numerous sources of information. The problems range from different service concepts and different time zones to varying national holidays or the shift of the weekend from Saturday and Sunday to Thusday and Friday in some countries. Addressing all these issues would be challenging.

Computation time is another challenge. Due to the numerous requests the calculation of the reachability of one starting station to all hiking paths lasts around 15 minutes for a workday or a Saturday or a Sunday. Thus, the average duration of a single request is approximately 30 ms. This necessitated the use of

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predefined starting stations. This is not an ideal solution for a flexible search instrument. Differentiation between elements that should be prepared in advance and elements that can be determined on the fly will be necessary.

It has been shown, though, that there are numerous hiking tracks around Vienna that can be reached by public transport. Making this kind of information visible to the citizens can help them make clever decisions and this is one of the main goals of smart cities or regions.

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How to stay a Smart City? Inspiration from a Place-Based Spatial Policy in Ghent – Working Together with Local, Smart Citizens

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1 ABSTRACT

Spatial planning in Europe and in Flanders is changing fundamentally. In the Europe 2020 strategy (2010-2020) Europe introduced the idea of a 'place-based approach' as an alternative or addition to traditional spatial planning. It refers to the context-dependent nature of efficiency and equity problems that the policy deals with, and to the fact that design of integrated interventions must be tailored to places, as it largely depends on the knowledge and preferences of the people living in it. Nevertheless, little research has examined the use of the place-based approach in Flanders.

In this paper the place-based approach, also called area development, is referred to as a proactive planning approach, characterized by an intensive coordination of initiators, plans and projects in one specific area, in order to implement the plans and projects in the field. Participating with citizens in planning processes is not new. In general, we can distinguish three generations in citizen participation: from consultation by the authorities, to co-creation initiated by the authorities, and recently to citizen initiatives which are only supported and stimulated by the authorities.

This paper reports results from a case-study in Ghent, Flanders. Within the neighbourhood around the main railway-station inhabitants and the local government are working together to create a new concept for the area, and are co-realising these new ideas in the field.

We found earlier that authorities have been experimenting with place-based planning in Flanders for several years, but that results, actors and instruments differ. The new insight from the local, urban case in Ghent can be used to develop future place-based planning, programs and projects in Flanders and in cities within Flanders.

Keywords: smart citizens, coproduction, Flanders, local inhabitants, spatial policy

2 INTRODUCTION

Developping spatial policies is traditionally a task for the authorities. Of course, this policy is created together with other actors, from local municipalities, to experts and citizens. Recently the top down planning model has switched to a more open interactive planning proces in which public and private partners become more equal, and civil initiatives demand their place in the network (Van Damme, 2013).

Traditional land use planning – being a more passive planning approach aimed at controlling land use through a zoning system and regulations - has not always been able to deal with the new actors that come forward (L. Albrechts, 2006). Planning authorities are struggling with the growing importance of citizens, and more general with the broad range of actors involved in a planning process. There is a need for cross-fertilization between model-based and top-down planning views, with bottom-up experiences, to construct an integrated approach. In current policy settings, spatial planning tends to emphasise the achievement of policy intentions through realisation of actual spatial interventions and growing importance of citizens as spatial actors (Sager, 2011).

Meanwhile Europe introduced the so-called 'place-based approach' as an alternative or addition to traditional spatial planning, referring to the context-dependent nature of efficiency and equity problems that the policy deals with, and to the fact that design of integrated interventions must be tailored to places, since it largely depends on knowledge and preferences of people living in it (ESPON & Politecno di Torino, 2014). Place-based development policy can be defined as 'a long-term development strategy whose objective is to reduce persistent inefficiency and inequality in specific places, through the production of bundles of integrated, place-tailored public goods and services, designed and implemented by eliciting and aggregating local preferences and knowledge through participatory political institutions, and by establishing linkages with other places; and promoted from outside the place by a system of multilevel governance where grants subject to conditionalities on both objectives and institutions are transferred from higher to lower levels of government.' (Barca, 2009, pag. 5). Place policy making is embedded in multiple institutional domains and arenas, which challenge the hierarchical setting of planning levels and the traditional administrative boundaries. All relevant actors (public and private) need to be involved in new planning processes, for different reasons: procedural competences, acceptance and legitimacy, substantive contributions, etc.

This place-based planning approach is related to a more general approach of strategic planning. In the nineties, in many countries a different type of planning was needed, moving away from regulatory policy and instruments to a more development-led approach that aims to intervene more directly, more coherently and more selectively in social reality and development (L. Albrechts, 2006).

A place-based environmental policy was already introduced in Flanders in the Flemish Mina-2 plan 1997-2001 and has been more recently developed within the context of spatial planning. Albrechts et al.(1999). It can be considered as a specific form of strategic planning, with special attention to the organization of planning processes, and dynamic networks of various actors from different policy domains interacting in arenas and fora (J. Van den Broeck, 2001). Since that moment, different experiments with this planning methodology have started, but the regional authorities have decided not to formalize this planning method in the legacy system. Recently, several Flemish authors have described actual trends in the planning system, using keywords related to the place-based planning such as strategic planning, project-planning, transitions, governance and co-production (Boussauw & Boelens, 2013; Coppens et al., 2014; P. Van den Broeck, 2008).

Participating with citizens in planning processes is not new. In general, we can distinguish three generations in citizen participation (Lancksweerdt, 2009): from consultation by the authorities, to co-creation initiated by the authorities, and recently to citizen initiatives which are only supported and stimulated by the authorities.

The first generation is based on consultation. In the past participation was mainly achieved through the organization of a public inquiry or by the organization of advisory boards. Consultation is basically one-sided and does not offer the opportunity for a real dialogue. More and more of these kind of planning processes are ending in court, with groups of citizens appealing the decisions of the authorities.

The last fifteen years however the step of consultation to real interaction between the government and civil society actors is made more often. Within interactive policy the government and participants are cooperating from a very early stage. In the field, authorities and citizens meet each other on a regular basis in advice councils, informal meetings, local platforms, … These initiatives fit participation processes in which different actors develop spatial plans and projects together.

While the second generation of participation is still a top-down approach in which the initiatives still originate from the government, the third generation of participation starts bottom-up. Today, citizens are not only involved in what the government does, but also the other way around: the government must respond to the citizens' initiatives and support it. The third generation of participation is linked to a government that is withdrawing more and more. The critical assessment on which tasks are a governmental responsibility and which tasks should be left to the society, has its impact. Together with the increasing assertiveness of citizens, self-organization and initiatives are becoming more frequent. This implies that the government should support and stimulate spontaneous citizen initiatives.

This can be related to more general, societal changes (Van Damme, 2013): protesting residents, weak government and failed democracy. The rise of social media makes it easier for likeminded people to organise themselves in new groups. People develop new projects and strategies for different reasons. Within a recent Dutch research (WRR, 2012) two main drivers for civil initiatives are distinguished. At first they describe a fear of changes, next an exploration of new futures. In the first case, they describe a conservative reaction against recent modifications, such as new traffic circulation plans or a new housing block, but also against more slowly evolving situations which, in the end, can no longer be accepted, such as the increase of local traffic. Within the second case, people aim to improve their current situation and are developing ideas to innovate, inspired by other projects. They share concern about the local living environment and the aim to maximise their own wellbeing.

Cooperating with people, policy makers can use their knowledge, experience and holistic perspective to develop spatial initiatives which can improve wellbeing and living quality. During a recent debate about the spatial policy plan of the city of Ghent, the city launched the concept of 'planning for and by humans (mensgerichte planning)'. They refer to planning which (1) gives more attention to the daily use of the area by the people; (2) and which is developed by cooperating not only with experts, sectoral organisations and policy makers but also by co-creation with civics (Oosterlynck, 2016).

The paper deals with diverse bottom-up initiatives in the area Sint-Pieters-Buiten in Ghent. Firstly, the local committee Sint-Pieters-Buiten is introduced, and consequently four different projects are described. These illustrate the general trend towards more participation, a more active cooperation with the inhabitants and fit within the 'planning for and by humans (mensgerichte planning)' as introduced by the city of Ghent, and within the place-based approach described in reports by the European Union. The projects can be understood as a reaction against recent modifications, as well as attempts to improve the current situation with innovating, inspiring ideas (WRR, 2012).

The four projects allow to reflect on the coexistence of top down and bottom-up initiatives in a specific spatial context. Also they introduce new themes like health, wellbeing, sustainable mobility, … which were addressed by the local inhabintants and are typical examples of themes that are recently introduced in traditional planning.

3 LOCAL COMMITTEE SINT-PIETERS-BUITEN

Since the beginning of the nineties, the local committee Sint-Pieters-Buiten, organised several activities within the area around the main railway-station of Ghent. At first they focussed on the prevalence and development of natural values within the neighbourhood. More recently, under impulse of the real estate project of Ghent Sint-Pieters, they welcomed new local members and broadened their focus.

The local committee Sint-Pieters-Buiten distributed in 2012 a "local manifesto". Some fragments:

"We want a nice neighbourhood in which people like to live, work and pass by. Our district is traditionally a quiet, hospital neighbourhood. People visit our area because of the availability of public transport, schools, local shops, …

Besides this our living environment is extremely important for the city and region as:

- mobility hub for commuters
- entrance for visitors arriving in Ghent by train, tram or bus
- educational centre for students and scolars in local schools, high schools and university

We believe that to develop and maintain a sustainable living environment it is important to support and keep families and house owners in the area.

In the future we would like to develop different initiatives to create a more attractive and sustainable area, together with all people living in this area."

In the months before the local elections of 2012, this local manifesto was discussed with politicians at a debate organised by the local committee.

Because of this, the cooperation between local residents and authorities grew and up till now this has led to several initiatives, which will be developed in this article: a traffic circulation plan, projects to re-open pedestrian and bicycle roads, a demand to start a participation process for the Queen Mathilde Square, and the idea to make the Voskenslaan more green.

3.1 Traffic circulation plan

In 2015 the neighbourhood of Sint-Pieters-Buiten was on a regulary basis present in the (regional) news items because of a bottom-up initiative of the local committee to reduce the increased mobility in the residential area between Voskenslaan and Kortrijksesteenweg. During a test period the city placed traffic cones in the Maaltebruggestraat, Reigerstraat and Tuinwijklaan. The cones created three separated circuits in the area, and made it impossible for cars to drive directly through the neighbourhood (see figure 2).

In 2013-2014 the local committee informed the city of the problematic situation of increasing mobility and the growing unsafety in the neighourhood between the Kortrijksesteenweg and the Voskenslaan. Countings done by the inhabitants and later on by the city itself showed that cars were driving too fast, and that the acceptable vehicle capacity for residential streets was exceeded by far. In the Tuinwijklaan, more than 3300 vehicles/hour were counted. 60 tot 70 % of the traffic had no destination in the area, but was just passing through. Because of several real estate projects in the area, for example the residentials towers and offices at the railway-station, it was expected that the traffic would only increase durig the coming years, so it was necessary to try to reorganise the mobility in the neighbourhood. In total the local committee organised three information and discussion meetings, besides two discussion events organised by the city. During these evenings all possible options to decrease the mobility were studied: speed humps, one-way streets, or other tools for traffic calming. For each meeting more than 3000 inhabitants were invited. Finally the inhabitants, together with the local authorities, chose the introduction of three separate circuits in the neighbourhood, realised by the placement of traffic cones in strategic places. During the coming years, this concept will be introduced in the city in different places, because it fits into the more global mobility plan that is developed by the local authorities.

Fig. 1 photograph of traffic cones, 2015

The city realised the circulation circuits, but always communicated this as a temporal situation. After six moments, all adults living in the area could deliver their personal opinion about the plan. This referendum must prove that the new circulation plan in the area was supported by a majority of the inhabitants.

In reality, the circulation plan led to a heavy discussion between supporters and opponents of the plan. Local inhabitants, but also a broader group of individuals (often not living in the neighbourhood), had strong opinions, resulting in news paper articles, facebook groups and facebook insults, but also in physical threats and in the burning down of one of the traffic cones during the night. Because of this, the city decided to organise the referendum much earlier, only two and a half months after the implementation of the plan. The result of the referendum was not decisive: 50% of the inhabitants favoured the new situation, 50% wanted the traffic cones to be removed, but most of them stated that there was a problem with the increased traffic in the area.

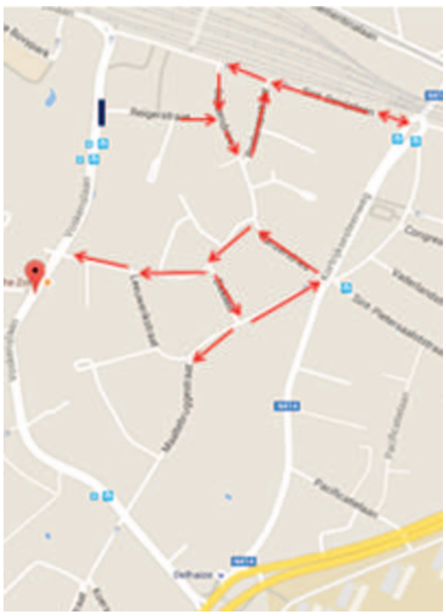

Fig. 2 original proposal traffic circulation, Fig. 3 compromise traffic circulation, end of 2015

Finally it was decided to remove the traffic cones immediately, and to work on a compromise between both parties. In December 2015 the civil council of the city decided on the compromise proposal (figure 3). This plan has the same goals as the original plan, namely to reduce the traffic in the area, but realises this not by cutting the streets but by introducing a few one-way streets. Today this plan is not realised yet.

3.2 'Ruimte voor Gent': designing the Voskenslaan as a greener alley

In 2015, because of the actualisation of the spatial structure plan for the city of Ghent 'Ruimte voor Gent - structuurvisie 2030', the city launched an online-platform for inspiring ideas. They were looking for ideas and projects that could mean something for the city in the future, and they engaged themselves on the short term to support a selection of these ideas by doing studies, creating maquettes and 3D-representations, organising exhibitions, … All proposals were documented and an online voting was organised to search for the most popular or inspiring projects.

The local committee Sint-Pieters-Buiten used this initiative to launch some of their ideas of the local manifesto. Finally the city withheld 8 pilot projects. One of the pilots was introduced by the local committee Sint-Pieters-Buiten. They proposed to make the three main roads in the area: Voskenslaan, Krijgslaan and Kortrijksesteenweg, all connectiong the main railway-station of Ghent to the southern part of the city, more green. This idea fits in a more global dynamic to introduce more green in the urban tissue (Agentschap Natuur en Bos i.s.m. Ruimte Vlaanderen, 2015; Departement Leefmilieu-Natuur en Energie. Afdeling Lucht-Hinder-Risicobeheer-Milieu en Gezondheid, 2011; Technum & VITO, 2015).

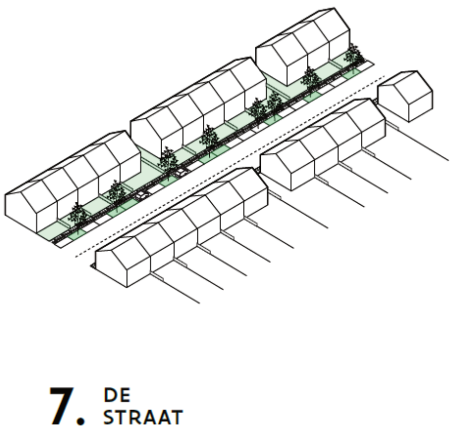

Fig. 4 Typical solutions for local challenges: the street (Technum & VITO, 2015, pag. 74)

At the beginning of 2016, the city talked this idea through with the local administration and engaged themselves to develop in the short term a roadmap to realise a small-scale network of green structurea, in co-creation with groups of local inhabitants. They were thinking about green walls, green pavements or other green elements, … . The students of green management of the university college Ghent were challenged to visualise the possibilities in 3D. Inhabitants, supported by public servants of the Participation Department and the Green Department, will work together during a planting day, and will be asked to manage the green infrastructure after realisation. Firstly, they will focus on one axis, Voskenslaan. The general purpose is to upscale this concept, participation and realisation to the rest of the city.

3.3 Slow roads: roads for pedestrians and bicycles

At the beginning of 2016 the local committee Sint-Pieters-Buiten undertook some actions for slow roads in the neighbourhood. This was facilitated by 'Trage Wegen vzw' in cooperation with the city of Ghent and the provincie of East-Flanders. They started, in the mid year of 2015 (untill 2018), a project in which the inhabitants of Ghent can develop a vision for the slow road network in Ghent. The final aim is to introduce this network in 'Ruimte voor Gent – Structuurvisie 2030', the new policy plan for the city. To make this possible, Trage Wegen vzw, has put maps online with indications of historical and current pedestrian and bicycle roads. These maps can be manipulated interactively, everyone can introduce new roads, comment on pavements, …

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The local committee Sint-Pieters-Buiten organised guided walks in the area, looking for the remainings of these alternative connections. They (re)discovered slow roads which connect the area with the natural area Overmeers, the recreational centre Blaarmeersen, the railway-station or the Parkbos Ghent (an urban forest).

An online inquiry was designed to address more residents with the following questions:

- Which among the current slow roads do you think are necessary, which ones are not?
- Do you think we need new slow roads in the area? Where?
- Do you have any other suggestions? For example about the realisation of a public seating bench or a public playground? Are there specific places where the pavement can be approved?

Fig. 5 entrance to the natural area Overmeers from Sint-Denijslaan

The map 6 gives an overview of the potential slow roads in the neighbourhood.

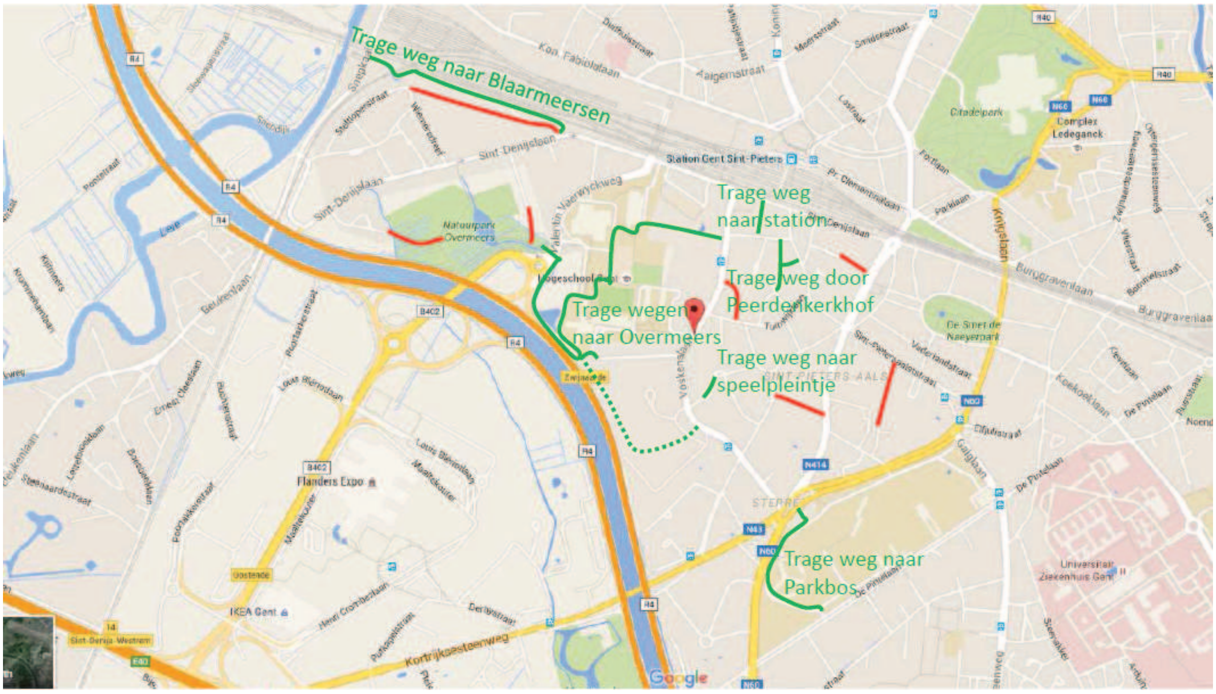

Fig. 6 most important slow roads in the neighbourhood (based on field observation and discussions with residents)

3.4 Wanted: a participation process for the design of the Queen Mathilde Square

From the beginning of 2010, demolition works started at the backside of the railway-station in order to realise a square. Several houses and cafés were disposessed and demolished. The city of Ghent has adopted a local zoning plan for the southern part of the station. Through this plan an extra main entrance to the station will be created, together with a new station square, and with a building that will demarcate the borders of the square. In the building, the so called S-building, new offices and houses as well as services for public transport users, inhabitants and workers will be integrated.

Six years later the terrain is partly used as a bike station, partly unaccesable and used as a construction area. The area looks chaotic and untended, travellers leaving the station at the backside are led by sideways through the construction area… It takes a lot of phantasy to discover a qualitative square.

Fig. 7 photograph of bike station on the Queen Mathilde Square

On the official website of the project Ghent-Sint-Pieters, it is found that the realisation of the Queen Mathilde Square will start in 2022, and will take approximately 14 months...

Meanwhile, the local committee has introduced this problem to the local authorities. They are represented in the advice council of the project Ghent-Sint-Pieters and used this platform to spread their ideas. For them it is unacceptable that the realisation of the public domain takes so long. They demand a quicker realisation, eventually only for a part of the square and with a temporarily character. Similtaniously they ask for an active participation process, together with the inhabitans but also with representatives of the schools in the area, the biker movement, … They already brainstormed about the design and the functioning of the terrain and the S-building. In a letter written to the elderman is noted: “We see the prinses Mathildesquare as a characteristic square where the busy station activities and the more green southern part of the city come together. On this square local people can meet and passengers can rest for a while. We imagine a square with a green area and with water, designed for young and for old people, delivering opportunities to stay and enjoy the area.”

More specifically they suggest a square without cars and without loading docks, a bike parking under the railway-station and not under the square itself, a substansive number of large trees and bushes, unpaved areas, sitting equipment, green roofs and green walls on the S-gebouw, a market hall for local agricultural products and public services in the building, …

Fig. 8 Photographs of paved and less paved squares (source: presentation, by Frederik Lerouge, expert workshop BRV 21/03/2016)

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4 CONCLUSIONS

This paper addresses the place-based environmental policy that has recently been developed within the area of spatial planning in Flanders. The place-based approach, also called area development, is a proactive planning approach, characterized by an intensive coordination of initiators, plans and projects in one specific area, in order to implement the plans and projects in the field. In this paper local initiators for this planning approach have been identified.

Only four cases were analyzed, all situated in the area of the railway-station of Ghent-Sint-Pieters and in a way examples of the place-based approach. It could be interesting to elaborate this research with more cases in the future. The selection of the cases can form a basis for discussion. The specific cases were selected because of the involvement of the authors in parts of the planning processes in the past and because of previous research within these areas. All these projects are examples of holistic, people-oriented plans, linked with themes like health, wellbeing and environmental quality.

The four projects illustrate the more theoretical elaborations in the introduction of this paper.

The traffic circulation plan is an example of a real bottom-up initiave, illustrating how citizens challenge the authorities to co-create. The inhabitants counted the traffic movements, collected pictures, organised meetings, … In the end the city was forced to take an initiative and decided to change the traffic circulation in the area. What is striking in this process is the hesitating attitude of the local authorities – "does the local committee really represents the majority of the residents?"- and the initiative for a referendum. This polarised the neighbourhood and created two opposing groups. Political parties interfered in the discussion. In the end the political authority took the initiative to develop a consensus plan. Untill now this plan is not implemented, but the initial intention to minimize the traffic in the area was kept.

The slow roads and the greening of the Voskenslaan are examples of co-creation at an early stage of the planning process. The two processes were organised by external groups, namely the 'Trage Wegen vzw' in cooperation with the city of Ghent and the province of East-Flanders. New media seem to be very important in these processes (digital voting, interactive maps of ancient local roads, …). The local committee is playing an active role in this by bringing local people together in organised walks, discussions, …, and by launching projects themselves. What is striking is that several dynamics come together: the themes fit with the local manifesto of the committee, people in the neighbourhood have the expertise to launch qualitative proposals, the network is powerfull enough to get the proposals selected in digital polls, …

The most recent initiative, the demand for a participation process for the Queen Mathilde Square, is an example of consultation, the first generation of civic participation as described by Lancksweerdt. In this case the city and the real estate development company already took many initiatives without consulting the neighbourhood or societal groups, acting from a more traditional top down perspective. Today, the local committee is reacting by asking a participation process and by trying to bring in some inspiring ideas in the discussion. We must be critical about this process until now. Many decisions about the size of the square and the S-builing, the real estate programme, the traffic circulation on the square, … are already made and anchored in the zoning plan. The future will show if the local committee succeeds in influencing a few decisions still to be made in order to ameliorate the quality of the square.

In conclusion we found that local authorities together with inhabitants have been experimenting with place-based planning in Flanders and more specifically in Ghent for several years now, but results, actors, instruments and participation processes differ. In this paper we focussed on a place-based planning processes on a very local, neigbhourhood level. These results can be used to develop future place-based, smart planning programmes and projects in Flanders and in Ghent together with local, smart citizens.

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Human's Digital Space in a Digital City

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1 ABSTRACT

The major idea of this paper is to discuss a question about free space around a human from a computer science point of view. As we well know, every animal has its own 2D or 3D region of freedom. If something or somebody tries to go inside or cross a border of this area, in most cases, it will be defined as an intruder. We will not discuss philosophical or humanitarian aspects of human freedom in this paper. We will speak about problems regarding the digital world of each of us only. In case we are going to talk about human's digital space (HDS) let us first investigate the phenomenon of the digital world. If we take a look at linear algebra we can find definitions such as "space" and "subspace". Therefore, the major idea of our discussion is to determine space and subspace in HDS and to introduce some measures for dynamic HDS borders and other properties that can be calculated by different methods. Another question concerns the interference of personal HDS.

According to a HDS idea, a Digital City (DC) is a special terrain or a limited digital world. This world (DC) contains a number of humans and many of them (not everybody) have their own HDS.

The major theoretical idea of the proposed paper is to discuss two phenomena, Digital City and Human's Digital Space.

Keywords: Digital Track, Digital Profile, Digital City, Digital World, Human's Digital Space

2 INTRODUCTION

What means HDS as a subject of research? Let us go back (or go ahead, nobody knows exactly which) in to the early stages of our civilization. Free space around an animal or a human played a key role from different points of view as follows:

- safety reason as a most important thing for the animal world and early people
- Information retrieval around conditions such as trees, hills, mountains, and rivers ets.
- Warming, fresh water and air conditions and many other features.

Most of them remain valid in our days but we have other not typical but not less important things for humans in our days. It is very hard to imagine a modern city or village without cell phones, TV, credit cards, Wi-Fi, etc. On the one hand, such possibilities bring us many positive properties but on the other hand it is a way of intrusion into private space of all people.

What is a private space? In a physical world, it is practically evident because it is as a rule a distance. However, what about a digital not physical world?

3 DIGITAL WORLD

The word combination "Digital World (DW)" could be understood by everyone of us from everyday life level to scientific level. In our days, a drift from the real world to the abstract world can be created inside DW space. Dependence on digital devices such as cell phones, tablet PS, social networks, credit cards, etc. forms a special abstract space for every human who is using up to date digital devices and technology. In addition, from year to year it is very hard to avoid being in touch with DW because everyday life is a part of activities inside of DW. As a rule people receive money only by credit card, and often can make purchases in different stores also by credit cards. Some operations we can make only by credit cards: control bank accounts, internet payments, etc. Possibilities, dependence and vulnerabilities inside a DW forms a special digital space (DS) for every active actors inside DW. Moreover, we have a rather big set of such actors. Most important among them are:

- sources of energy: energy understood in common sense (food, electrical power, gas, oil, etc,);

- friends, satellites, members of social groups, etc.;
- neutral subjects and existences;
- enemies, predators, and some other actors.

4 DIGITAL SPACE

Digital Space (DS) is a part of DW. DS belongs to DW. The main difference between DS and DW is the possibility to present or describe DS by some theory or by model. DW could not be presented by one model or by one theory. For example, an ocean is a world; channel for sound distribution in the ocean is a space.

In historical retrospective, not a bad example could be a specific tactic of German submarines during the Second World War, a tactic called "pack of wolves". A key characteristic of this tactic is for a submarine to understand in which of the four subspaces she is located. For more details see [http://www.u-boote.ru/operate/areal_w.html], for example.

If we take for investigation a world of humans, it is also impossible to develop a unified theory or model. This is also true for a human as a subject of research. Around a human, we have philosophy, anthropology, medicine, and many other subject domains. According to this idea, human's digital space (HDS) is a part of the digital world around a human. DHS can be investigated by theory or by model, as is not the case with DW.

5 HUMAN'S DIGITAL SPACE

Let us see what is a digital space around a human. If we try to present a list of features that belongs to digital it will be not enough all the time. The world IT industry develops new devices, technology and utilities for everyday using, scientific research and other applications. Every human has two sides of life, physical and social ones. It is easy to see that up to date IT infrastructure influences both sides, physical and social. According to this the contemporary human fully depends on IT. Physical influence is a direct intrusion into physical health of humans. They include phenomena such as: microwave, Wi-Fi, Bluetooth, cell phones, PC and many other radiations. In case of social life, human dependence on DW is more evident. Most important things of DW influence are as follows: Internet in common case (social networks & groups, news pages, information and data resources, etc.); bank systems and credit cards support; e-money and e-bay systems; local networks and Intranet; cell phones, tablet PC, PC as devices for communications and as tools for work and pleasure.

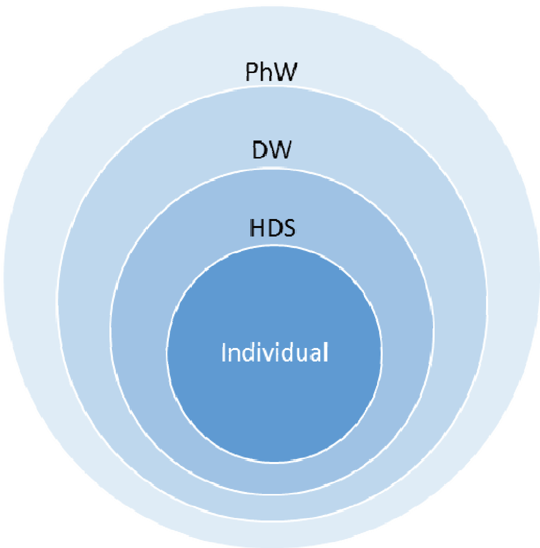

Fig. 1: Individual and World.

DW brings for humans new possibilities, life comfort and progress support. However, DW together with new possibilities are facing new demands and new problems from the two sides of human existence. At this step of investigation, it is possible to formulate an abstract statement of the problem. An abstract human interacts with an abstract existence DW. In comparison with the physical World let us determine digital space as a subspace of DW that reflects some properties of a sub world, or in other words the human's world. Why do we need to investigate DHS? Because it is a very important indicator for a human to understand his (her) safety and vulnerability position in real life. This is a way to feel comfortable in everyday life, during work, shopping, vacations etc. It is also a method to understand what you can meet if you are doing something. Let us give some examples. Wi-fi: If you connect to or through this system, you should be sure in your firewall protection or believe in the provider of the network.

In the physical world, many things are suitable for our mentality. As an example, very typical metrics like length, square, volume etc could be used for a measure. What a thing could be used as an analog in a DW? Let us examine some ideas on the surface of the problem.

a) Chain of IP addresses from a source to a destination. Not sure.

b) A point and a fact for entrance into a “digital cloud”. Not sure.

c) Quantity and type of identifications of humans (credit cards, counts in banks, payment’s procedures, different tickets obtaining etc.). More “Yes” than “No”. Nevertheless, what about the measure?

It seems to us that it is very hard or just impossible to find a single criterion and linked variables for such a human’s estimation.

The physical world around us is a rather well investigated phenomenon and every human tries to investigate it from the very beginning of his existence to the end of his life. For DW things are not so evident. The major question is what is an individual for (in) DW? In our recent research we proposed to investigate two representations of an individual: human’s digital profile and human’s digital track [3].

5.1 Human’s Digital Profile and Human’s Digital Track

Let us consider the meaning of English words “profile” and “track”, as they are defined, for example, in the system of English-Russian and Russian-English ABBY Lingvo dictionaries: Profile (noun) – «brief biography», «biographic data», «complex of parameters», «description of the system characteristics in table of graphic form»; (verb) «give brief biographic data». Track – «line or series of marks», «course or development of events».

Based on the stated strict sense of words “profile” and “track”, we could treat “profile” as a “complex of parameters” describing an individual biography, and “track” as a “complex of parameters” describing an array of consequential events in an individual life with a linkage of these events to time and place of realisation.

Such understanding of the considered terms “profile” and “track” matches well the recognition of statistic data and operational data, reviewed in section 2.

The above-stated allows us to give a preliminary verbal definition of the terms “profile” and “track” of individuals (“individual profile” and “individual track”):

(1) “individual profile” – a complex of biography parameters fixing important facts of individual history (place and date of birth, education, religion, religion changes, ethnic group and nationality, etc.);

(2) “individual track” – a complex of parameters characterising individual behaviour with a linkage of these events to time and place of realisation (time and place of departure to a certain destination, time and addressee of the last mobile phone calls, etc.).

Therefore, though differing by its content and means of gathering, individual profile and track data conform to the same mathematical form – a form of a vector x=(x1,…,xn) of parameters x1,…,xn, where each parameter is measured by the certain scale (nominal, order, numeral, etc.). Consequently, using the same mathematical methods for processing both individual profile and individual track data is reasonable.

Since our goal is the feature detection of the individual potential vulnerability in the DW, all data considered should disclose relevant, i.e. to the point of purpose, essential information. This relevant data condition could be stated as follows: every parameter x1,…,xn, combined into profile and/or track is necessary, and all of them taken together are sufficient for the definition of intrusion in a private life activity.

If the mentioned condition of the parameters x1,…,xn relevance is met, then one could consider an individual profile and individual track, or in other words, the person's profile and the person's track.

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The stated similarity of the mathematical form of the individual profile and track representation as a vector of values of a specific set of characteristics allows us to combine the methods of individual "track" identification and individual "profile" identification.

In other words if we have definitions of a "track" and "profile" of an individual we know what we should protect in DW from hostage activities or intrusion.

5.2 Situation Awareness and Situation Assessment

Every individual that has some electronic device such as cell phone, credit cards etc. has a reflection in DW by its profile and track. Such reflection can be called a situation. Moreover, it does not even matter, whether an individual knows it or not for a situation to exist. In some subject domains similar situations have a special name: "tactical situations". A tactical situation is regarded as a combination of some parameters, expressly or by implication defining the explored system state at a given moment of time under a defined goal. A human digital tactical situation (HDTS) is regarded as a tactic situation in the system of defence against DW malicious threats.

The classification of the HDTS itself should be performed in addition to gridding (area coordinates, coordinates of supposed electronic devices (ED) carriers or ED itself) and definition of every other tactic situation component. TS should be also correlated with the available analytical and decision-making tools, keeping in mind quantitative or model analysis.

Tactical situation assessment (identification) is the key problem during situation analysis in the interests of making decisions about a digital threat character.

Time is a determinant parameter for making a decision in real-time systems, such as a system of defence against a digital threat. As a result, one inevitably comes to the idea of preliminary development of TS variants (creation of so-called "TS library") which could occur in the responsibility area of any given control, and TS assessment automation.

It should be noted that this is only a theoretical discussion and no real work applications or tools exists yet.

6 DIGITAL CITY

The digital city exists in abstract and physical forms, no doubt. It seems to us that in our investigation, the digital city (DC) can be a restricted area of DW. On the one hand, however, it is not so simple, because DC is not a typical city with borders, internal law conditions, communities etc. The Internet in the common sense, cell networks, satellite networks are not windows but fields in to other worlds, in short worlds which are wide ways to go in to the DW. On the other hand, DC forms a physical, technological and political background to form HDS. In addition, the position of DC has to be understood within a region and a country. It is evident that a region and a country influence DC, but for us the only important thing is DC's direct influence on HDS.

The digital City involves networking activities (based on a variety of e-devices). Each user has his (her) network based on a list in the personal address book. The concept of the network functions includes network security, which consists of the strategies directed to prevent and monitor unauthorised access, to support authentication, encryption, etc.

It should be useful to implement Social network analysis (SNA) to investigate networks structures using network and graph theories to trace human movements. Such data sets are usually obtained from cell phone or GPS data. In city space, humans and the communication tower might be only a few hundred meters from each other. Therefore, there is a high degree of accuracy to locate a person using cell phone data. Network analysis is closely connected to the research of a set of personal networks which create a cloud of intersected networks in DC.

7 CONCLUSION

Our investigation is in a very early stage. Introduced abstract conceptions "Digital City" and "Human's Digital Space" will be investigated in algebraic form and will have numerical exspression by PC. Freedom was and is the most important thing for the individual during the long human history and in our days its importance is not less than in previous years.

According to this it is very important to understand the meaning of well known conceptions such as a City and an individual in our digital world.

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Identifikation geschlechterspezifischer Mobilitätsbarrieren anhand einer drittvariablengestützten Mobilitätsverhaltensanalyse

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1 ABSTRACT

Eine wesentliche Qualitätsanforderung an Smart Cities stellt die sozial nachhaltige Entwicklung der städtischen Infrastruktur dar. Insbesondere die Bereitstellung von Verkehrsinfrastrukturen und Mobilitätsangeboten ist auf bestehende Nutzerbedürfnisse auszurichten und unterliegt dadurch Anforderungen hoher Diversität. Schlüssel zu einer sozial nachhaltigen Mobilität ist die Sicherstellung einer hinreichenden Erreichbarkeit relevanter Ziele, wie Arbeitsplätzen, Bildungs- und Versorgungseinrichtungen oder Freizeitangeboten für alle Personengruppen. Personengruppen können in der Ausübung ihrer Mobilität jedoch durch gruppenspezifische Barrieren eingeschränkt werden. Für Menschen im Rollstuhl können beispielsweise Hochborde, Treppen oder nicht-barrierefreie ÖPNV-Zugangspunkte Barrieren bilden. Menschen mit Migrationshintergrund und begrenzten Deutschkenntnissen können hingegen durch deutschsprachige Fahrgastinformationen in Ihrer Mobilität beschränkt sein. Analog ist davon auszugehen, dass spezifische Barrieren bei der Realisierung geschlechterspezifischer Mobilitätsbedürfnisse vorliegen. Um Männer und Frauen gleichwertige Mobilitätschancen zu ermöglichen, müssen ihre jeweiligen Zugangsvoraussetzungen und Mobilitätsbedürfnisse erkannt und ihre spezifischen Barrieren identifiziert werden. Daher wurde am Institut für Stadtbauwesen und Stadtverkehr anhand der Mobilitätserhebung „Mobilität in Deutschland 2008" eine umfassende Analyse des geschlechtsspezifischen Mobilitätsverhaltens durchgeführt. Die Analyse erfolgte in zwei aufeinander aufbauenden Stufen. In einer ersten Stufe wurde eine statistisch-deskriptive Analyse der Daten vorgenommen, in der unterschiedliche Mobilitätskennwerte untersucht wurden. Anschließend wurden die gewonnenen Ergebnisse in einer zweiten Stufe durch eine Drittvariablenkontrolle validiert. Anhand der Ergebnisse wurden Personengruppen identifiziert, für die geschlechtsspezifische Unterschiede im Mobilitätsverhalten deutlich stärker auftreten, als in der Gesamtstichprobe. Dabei handelte es sich um Personen, die in einem Haushalt mit Kindern bis 14 Jahren leben, Personen ohne Hochschulabschluss, Rentner und Pensionäre, sowie Personen mit moblitätseinschränkender Behinderung.

Keywords: Gender Mainstreaming, Drittvariablenanalyse, Geschlechtsspezifisches Mobilitätsverhalten, Identifikation von Nutzerbedürfnissen, Mobilitätsbarrieren

2 EINLEITUNG

Personengruppen weisen gruppenspezifische Mobilitätsbedürfnisse auf, die mit unterschiedlichen Barrieren bei der Realisierung dieser Bedürfnisse korrespondieren. Die Einbeziehung unterschiedlicher Nutzerbedürfnisse stellt daher eine Grundlage zur Planung smarter Infrastrukturen dar. Zielgruppenspezifische Belange sind zu erfassen und planerisch zu berücksichtigen. Vorreiter bei der Entwicklung geeigneter Verkehrs- und Mobilitätsangebote für alle Bevölkerungsgruppen war die 2003 von der britischen Regierung veröffentlichte Studie „Making the Connections: Final Report on Transport and Social Exclusion". Die Studie basiert auf fünf Fallstudien, die sowohl in ländlichen als auch urbanen Regionen Großbritanniens durchgeführt wurden. Das zentrale Ergebnis der Studie ist der Nachweis eines Zusammenhangs zwischen der Anbindung eines Quartiers an Ziele wie den Arbeits- und Ausbildungsplatz, Gesundheitsvorsorgeeinrichtungen, Einkaufsmöglichkeiten und Freizeitaktivitäten und der sozialen Exklusion der Einwohner [Social Exclusion Unit 2003, S.2]. Der Fokus der Studie liegt nicht auf der Evaluation des tatsächlichen Mobilitätsverhaltens der Teilnehmer, sondern in der Prüfung der Erreichbarkeit relevanter Ziele. Damit wurde der Begriff „Erreichbarkeit" („Accessibility") als wesentlicher Indikator für die sozialgerechte Planung von Mobilitätsangeboten und Verkehrsinfrastruktur anhand folgender Definition etabliert [Social Exclusion Unit 2003, S.2]. Erreichbarkeit umfasst hier die Widerstände Kosten, Zeit und Komfort sowie Verfügbarkeit, Zuverlässigkeit und Sicherheit des Verkehrsmittels. Die inn persönlichen Entscheidungen begründete Komponenten des Mobilitätsverhaltens werden hier nicht erfasst oder durch verkehrsplanerische Maßnahmen beeinflusst. Der Vorteil der Betrachtung von Erreichbarkeit gegenüber der

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Betrachtung des Verkehrsverhaltens liegt entsprechend darin, dass eigenverantwortliche Entscheidungen, die Personen aufgrund ihrer komplexen Lebenssituationen treffen, nicht bewertet werden. Die mobilitätsbezogene, soziale Exklusion einer Person wird stattdessen aus dem Spannungsfeld zwischen der räumlichen Distribution relevanter Ziele, ihrer verkehrlichen Anbindung, dem Vermögen der Person die Anbindung zu nutzen, sowie persönlichen Plänen, Vorlieben und Umständen abgeleitet [Kaufmann et al. 2004, S.750].

Dem Vorteil der Unabhängigkeit der Erreichbarkeitsplanung gegenüber persönlichen Entscheidungsprozessen stehen große Hürden bei der Evaluation der Maßnahmenwirksamkeit entgegen. Bislang liegen für die Bundesrepublik Deutschland keine Erhebungen vor, die Auswirkungen von Maßnahmen der Erreichbarkeitsverbesserung auf unterschiedliche soziale Gruppen in repräsentativem Umfang evaluieren. Dies ist vor allem auf die hohe Sensibilität der benötigten Daten zurückzuführen, da für eine Bemessung der Erreichbarkeit von Aktivitätenstandorten für vulnerable, soziale Gruppen sowohl georeferenzierte Daten zu Wohn- und Arbeitsstandorten, umgebenden Dienstleistungs- und Versorgungseinrichtungen, als auch persönliche Angaben zu erfassen sind. Die adressgenaue Zuordnung von Informationen, wie dem Haushaltseinkommen oder mobilitätseinschränkenden Behinderungen, ist ethisch problematisch und vermindert die Teilnahmebereitschaft entsprechender Erhebungen. Aufgrund des bislang ungelösten Problems der Datengenerierung eignet sich der für die Verkehrsplanung typische Kreislauf der Maßnahmenplanung, Umsetzung und Wirkungskontrolle als Grundlage für die Wirkungsabschätzung ähnlicher Maßnahmen nicht für solche Fälle, in denen Erreichbarkeitsverbesserungen zielgruppenscharf bestimmt werden sollen. Die Evaluation der sozialgerechten Gestalung von Mobilitätsangeboten wird daher im Folgenden anhand des Verkehrsverhaltens durchgeführt, auch wenn theoretischen Ansprüchen somit nicht optimal entsprochen wird.

Ein soziodemographischer Faktor, dessen Einfluss auf Mobilitätsmuster diskutiert wird, ist das Geschlecht. Die Gleichstellung der Geschlechter stellt einen der europäischen Grundwerte dar und wird von allen politischen Ebenen Europas vorangetrieben [Europäische Komission 2011, S.3]. Regelmäßige Prüfungen der Verkehrsinfrastruktur und Mobilitätsangebote auf eine geschlechtergerecht ausgelegte Nutzbarkeit sind aufgrund dessen zur Bereitstellung gleichwertiger Mobilitätsmöglichkeiten notwendig. Das Geschlecht eines Menschen setzt sich aus biologisch bedingten, universell vorhandenen Geschlechtsunterschieden und empfundenen, sozial bedingten Merkmalen zusammen [Pschyrembel 2013, S. 769]. Die Differenzierung zwischen biologischen und sozialen Geschlechtsunterschieden ist eine Grundlage für gleichstellungspolitische Maßnahmen, da sozial bedingte Geschlechterunterschiede, im Gegensatz zu biologisch bedingten, veränderlich und dadurch beeinflussbar sind [Bergmann und Pimminger 2004, S.18]. Rollenbilder unterliegen einem stetigen gesellschaftlichen Wandel. Die sich dadurch ändernden Aktivitätenmuster haben einen direkten Einfluss auf das Mobilitätsverhalten, was fortlaufend veränderliche Anforderungen an Mobilitäsangebote und Verkehrsinfrastrukturen bedingt.

3 DATENBASIS

Die Datenbasis der Auswertungen bilden die Ergebnisse der Erhebung „Mobilität in Deutschland 2008“ (MiD 2008). In der MiD 2008 wurde das Mobilitätsverhalten der bundesdeutschen Bevölkerung letzmalig erfasst. Bei der Verwendung des Datensatzes, handelt es sich um die Nutzung einer sekundärstatistischen Erhebung. Die verwendeten Daten wurden nicht für die vorliegende Auswertung erhoben, eignen sich aufgrund der umfangreichen Abbildung der Soziodemographie und des Mobilitätsverhaltens der Erhebungsteilnehmer dennoch für die Untersuchung der bestehenden Forschungsziele. Da der Datensatz im Jahr 2008 erhoben wurde, ist die uneingeschränkte Übertragbarkeit der Ergebnisse auf das aktuelle Jahr nicht gegeben. Die Forschungsergebnisse sollten nach der Veröffentlichung der Erhebungsergebnisse der in 2016 startenden MiD 2016 mit aktuellen Daten überprüft werden.

Die Mobilitätserhebung „Mobilität in Deutschland 2008“ wurde durch das Bundesverkehrsministerium für Verkehr, Bau und Stadtentwicklung in Auftrag gegeben und gemeinsam vom „Institut für angewandte Sozialwissenschaft GmbH“ (infas), sowie dem Institut für Verkehrsforschung am „Deutschen Zentrum für Luft- und Raumfahrt e.V.“ (DLR) durchgeführt. Die Erhebung wurde in zwei aufeinanderfolgenden Phasen durchgeführt [INFAS 2010, S.8]. Phase 1 bestand aus einer Haushaltsbefragung, in der haushaltsbezogene Daten erfasst wurden. In Phase 2 wurden personen- und wegbezogene Daten erhoben.

4 METHODEN

Die Analyse der Datenbasis erfolgte in zwei Stufen. Bei der bivariaten Analyse (Stufe 1) wurden Abhängigkeitsstrukturen von jeweils zwei Variablen untersucht. Bei der multivariaten Analyse (Stufe 2) wurden Drittvariablen in die Analyse miteinbezogen. Das Geschlecht wird bei allen Auswertungen als unabhängige Variable betrachtet und mit jeweils einer Mobilitätskenngröße, als abhängiger Variable, kombiniert untersucht. Folgende Mobilitätskenngrößen wurden als abhängige Variablen betrachtet:

- Wegezweck,
- Wegehäufigkeit,
- Modal Split,
- Wegedauer,
- Tageswegedauer,
- Startzeit,
- Wegelänge und
- Tageswegelänge.

Für die jeweiligen Kombinationen aus unabhängiger und abhängiger Variable wurden Häufigkeitsverteilungen sowie Lage- und Streuungsparameter ermittelt. Die bivariate Analyse erfolgt unter Berücksichtigung sämtlicher erhobener Ausprägungen.

Im Unterschied dazu wurden in der multivariaten Analysestufe Ausprägungen der abhängigen Variablen aggregiert. Für alle in Stufe 1 identifizierten signifikanten Zusammenhänge wurden in Stufe 2 Drittvariablenkontrollen durchgeführt, mit denen Einflüsse weiterer soziodemographischer Merkmale auf die festgestellten, bivariaten Zusammenhänge untersucht wurden. Die Drittvariablen können Zusammenhänge zwischen dem Geschlecht und einer Mobilitätskenngröße jeweils abschwächen oder verstärken oder keinen Einfluss auf den Zusammenhang ausüben. Für den Kontext der Geschlechtergleichstellung sind Fälle, bei denen der Zusammenhang zwischen dem Geschlecht und einem Mobilitätskennwert durch eine Drittvariable verstärkt werden, von besonderer Relevanz. An ihnen lassen sich Personengruppen identifizieren, für die sich das Mobilitätsverhalten von Männern und Frauen, verglichen mit der übrigen Stichprobe, stärker unterscheidet.

Bei der Untersuchung von Stichprobenerhebungen, besteht die Möglichkeit, dass für die Stichprobe analytisch festgestellte Zusammenhänge durch Auswahlverzerrungen bei der Stichprobenziehung erzeugt wurden und nicht für die Grundgesamtheit existieren [JANSSEN 2012, S. 259]. Da die vorliegende Datenbasis eine Stichprobenerhebung darstellt, ist eine Absicherung der Übertagbarkeit der Ergebnisse auf die Grundgesamtheit notwendig. Bei zufallserhobenen Stichproben, ist die Absicherung, gegenüber zufallsbedingten Ergebnissen, mit einem Signifikanztest möglich. Für Untersuchungen bei denen die statistische Signifikanz von Zusammenhängen zweier Variablen geprüft werden soll und die abhängige Variable ein kategoriales Skalenniveau aufweist, ist der χ^2-Unabhängigkeitstest durchführbar [JANSSEN 2012, S. 259]. Die Prüfgröße χ^2 ist ein Maß für den Grad der Abweichungen der erwarteten Häufigkeiten e_{ij} von den beobachteten Häufigkeiten n_{ij} einer Kontingenztabelle [JANSSEN 2012, S. 260].

$$\chi^2 = \sum_i \sum_j \frac{(n_{ij} - e_{ij})^2}{e_{ij}}$$

Das Ergebnis des χ^2-Unabhängigkeitstests ist die Aussage, ob ein Zusammenhang, der in einer Stichprobe erkannt worden ist, mit einem festgelegten Signifikanzniveau auch in der Grundgesamtheit zu erwarten ist. Mit einem χ^2-Unabhängigkeitstests ist keine Aussage über die Stärke eines Zusammenhangs möglich. Kennwerte, die den Grad des Zusammenhangs zweier Variablen quantitativ abbilden, werden als Assoziationsmaße bezeichnet [JANSSEN 2012, S. 266]. Die Eignung eines Assoziationsmaßes für die Beschreibung eines Zusammenhangs ist vom Skalenniveau der betrachteten Variablen abhängig. Da die, in der Analyse betrachteten, Variablen nominal oder ordinal skaliert vorliegen, wird für die multivariate Analyse das Assoziationsmaß „Cramers V“ gewählt. Dabei handelt es sich um einen χ^2-basierten Kennwert, der für nominal skalierte Variablen mit beliebig vielen Merkmalsausprägungen geeignet ist [JANSSEN 2012, S. 267].

$$V = \sqrt{\frac{\chi^2}{n(k-1)}}$$

n: Stichprobenumfang, k: Minimum der Anzahl der Reihen und Spalten der betrachteten Kontingenztabelle

Das Cramers V ist ein normiertes Assoziationsmaß, mit einem möglichen Wertebereich zwischen 0 und 1 [JANSSEN 2012, S. 267]. Der Wert 0 indiziert, dass die betrachteten Variablen voneinander unabhängig sind. Bei einem Wert von 1 besteht ein perfekter Zusammenhang [JANSSEN 2012, S. 266].

Die multivariate Analyse erfolgt in Form von Drittvariablenkontrollen. Drittvariablenkontrollen ermöglichen die Identifikation des Einflusses dritter Variablen auf den Zusammenhang zwischen einer unabhängigen und einer abhängigen Variable. Sie stellen somit ein Instrument zur Prüfung der Gültigkeit bivariater Zusammenhänge dar. Bei der Drittvariablenkontrolle lässt sich nur der Einfluss von Variablen untersuchen, die in der Datenbasis abgebildet sind. Für einen weitreichenden Ausschluss von Drittvariableneinflüssen bei der Untersuchung bivariater Zusammenhänge sind potenzielle Drittvariablen in der zugrundeliegenden Erhebung zu erfassen. Die Identifikation potenziell beeinflussender Drittvariablen muss bereits im Rahmen der Erhebungserstellung, anhand theoretischer Überlegungen zu inhaltlichen Zusammenhängen verschiedener Merkmale erfolgen. Da in der vorliegenden Arbeit auf eine sekundärstatistische Datenbasis zurückgegriffen wird, sind Drittvariablenkontrollen nur bezüglich der erhobenen Merkmale der MiD 2008 möglich.

Das Vorgehen bei der Drittvariablenkontrolle ist abhängig von der Skalierung der betrachteten Variablen. In der vorliegenden Analyse besitzen sowohl die unabhängige Variable „Geschlecht“ als auch die betrachteten Drittvariablen ein kategoriales Skalenniveau. Die als abhängige Variablen untersuchten Mobilitätskennwerte liegen ebenfalls kategorial vor, da sie entweder nominal oder ordial skaliert werden. Für kategoriale Variablen ist die „erweiterte Tabellenanalyse“ eine geeignete Methode der Drittvariablenkontrolle [KÜHNEL UND KREBS 2001, S.463].

Das Vorgehen bei der erweiterten Tabellenanalyse erfolgt in drei Schritten [KÜHNEL UND KREBS 2001, S.463]:

- Berechnung der Assoziation zwischen der unabhängigen Variable X und der abhängigen Variable Y, mittels einer Kontingenztabelle, ohne Betrachtung der untersuchten Drittvariablen Z (Marginaltabelle),
- Berechnung der Assoziation zwischen der unabhängigen Variable X und der abhängigen Variable Y, mittels Kontingenztabellen, unter Betrachtung der untersuchten Drittvariablen Z (Partialtabellen) und
- Vergleich der Ergebnisse aus Schritt 1 und Schritt 2.

Für jede Merkmalsausprägung der betrachteten Drittvariablen wird jeweils eine Partialtabelle mit unabhängiger und abhängiger Variable erstellt [KÜHNEL UND KREBS 2001, S.465]. Die Untersuchungseinheiten einer Partialtabelle weisen demnach alle die gleiche Drittvariablenausprägung auf, können aber beliebige Ausprägungen bezüglich der abhängigen sowie unabhängigen Variablen annehmen..

5 ERGEBNISSE DER BIVARIATEN ANALYSE

Insgesamt ergaben sich sich aus der bivariaten Analyse die nachfolgenden, zentralen Erkenntnisse für die Unterschiede im Mobilitätsverhalten von Frauen und Männern. Die geringsten Abweichungen bestanden für die Merkmale „Startzeit des Weges“ und „Wegehäufigkeit“. Zwar sind Männer nachts etwas häufiger unterwegs als Frauen, insgesamt aber bestehen nur geringe Differenzen zwischen beiden Geschlechtern bei den Stunden des Wegebeginns. Bei der Wegehäufigkeit führen Frauen leicht häufiger fünf und mehr Wege pro Tag durch, Männer dafür häufiger zwischen zwei und vier Wegen. Für beide Subpopulationen ergibt sich ein Median von drei Wegen pro Tag und Person sowie Mittelwerte von 3,26 (Frauen) und 3,20 (Männer) Wegen pro Tag.

Größere, aber dennoch begrenzte Unterschiede ergeben sich für die übrigen erfassten Kennwerte. Wichtigste Einflussgröße ist dabei, mit dem Merkmal „Wegezweck“, eine der erfassten Mobilitätskenngrößen selber.

Wird zunächst die Häufigkeitsverteilung des Wegezwecks betrachtet, zeigt sich, dass Männer häufiger erwerbstätigkeitsbedingte Wege zurücklegen (Wegezwecke „Arbeit“ und „dienstlich“), Frauen dagegen häufiger familienarbeitsbedingt Wege (Wegezwecke „Einkaufen“ und „Begleitung“). Dies spricht dafür, dass die Aufgabenteilung in einigen Haushalten eher einer traditionellen Rollenaufteilung zwischen beiden Geschlechtern entspricht.

Der Hauptwegezweck, und damit auch dessen geschlechtsspezifische Unterschiede, wirkt sich auf die wegbezogenen Kenngrößen „Modal Split“ (vgl. Abb. 1), „Wegedauer“ und „Wegelänge“ aus. Während Frauen im Vergleich zu Männern häufiger zu Fuß gehen oder als MIV-Mitfahrer unterwegs sind, legen Männer ihre Wege deutlich häufiger als MIV-Fahrer zurück. Die Hauptwegezwecke mit den größten MIV-Anteilen sind dabei die berufsbedingten Zwecke „Arbeiten“ und „dienstlich“, jene Zwecke also die bei Männern einen größeren Anteil ausmachen, als bei Frauen. Der MIV-Modalsplit-Anteil der Männer liegt allerdings auch bei allen übrigen Wegzwecken jeweils über dem der Frauen.

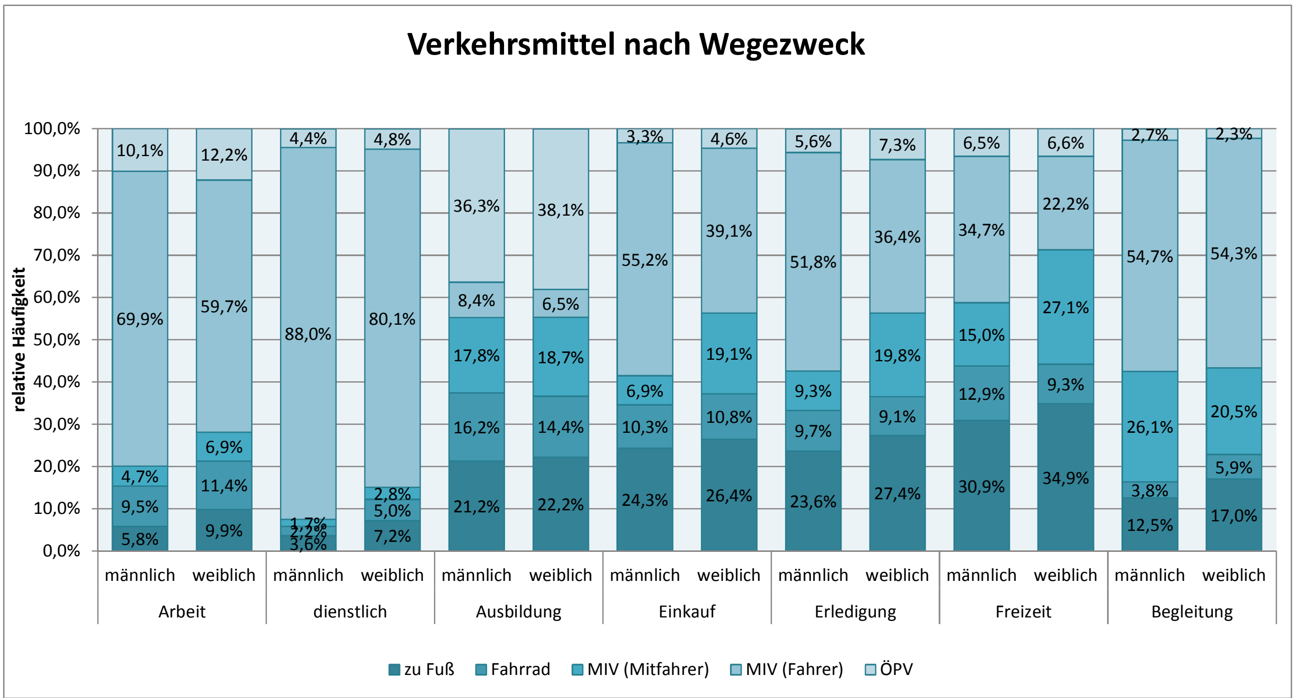

Abbildung 1 Modal Split nach Wegezweck (eigene Darstellung; Datenquelle: MiD 2008)

Der Median der Wegedauer liegt für beide Subpopulationen bei 15 Minuten pro Weg. Da von Männern jedoch häufiger einzelne sehr hohe Wegedauern absolviert werden, liegt das arithmetische Mittel der männlichen Subpopulation über dem der weiblichen Subpopulation. Die größten geschlechtsspezifischen Unterschiede im arithmetischen Mittel liegen für die berufsbezogenen Wegezwecke „Arbeit“ und „dienstlich“ vor. Für diese beiden Wegezwecke weisen Frauen einen niedrigeren Median auf als Männer.

Für die Wegelänge liegen bereits geschlechtsspezifische Unterschiede bei Betrachtung des Median vor. Der Median der männlichen Subpopulation liegt mit 3,80 km pro Weg rund ein Drittel über dem Wert der weiblichen Subpopulation (2,85 km). Damit liegt für die Wegelänge die größte geschlechtsspezifische Abweichung des robusten Lageparameters vor (vgl. Abb. 2).

Die Ergebnisse der wegbezogenen Mobilitätskenngrößen „Wegedauer“ und „Wegelänge“ finden sich auch in den korrespondierenden, personenbezogenen Kenngrößen „Tageswegedauer“ und „Tageswegelänge“ wieder. Die Tageswegedauer weist, analog zur Dauer der einzelnen Wege, für beide Subpopulationen den gleichen Median auf, allerdings einen niedrigeren Mittelwert für Frauen. Bei der Tageswegelänge dagegen liegen analog zur Länge der einzelnen Wege sowohl Median als auch Mittelwert bei Frauen niedriger als bei Männern. Die Abweichungen bezüglich des Medians, sowie des arithmetischen Mittels, für die weibliche Subpopulation, liegen bei der „Wegelänge“ sowohl absolut als auch relativ, stärker über dem der männlichen Subpopulation, als bei der „Wegedauer“. Die Wege von Männern weisen demnach im Vergleich mit den Wegen von Frauen deutlich stärkere Zuwächse bei der „Wegelänge“ als bei der „Wegedauer“ auf. Im Mittel legen Männer demnach größere Strecken pro Zeiteinheit zurück als Frauen.

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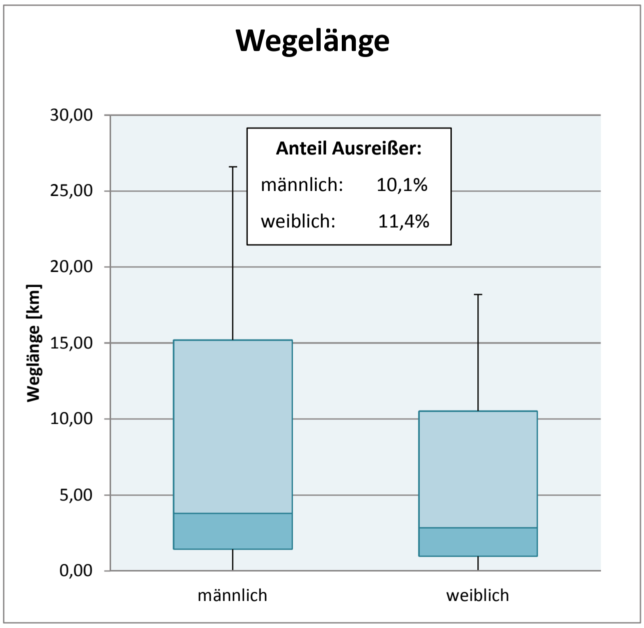

Abbildung 2 Wegelängen - Boxplot (eigene Darstellung; Datenquelle: MiD 2008)

6 ERGEBNISSE DER MULTIVARIATEN ANALYSE

Ziel der multivariaten Analyse war die Erforschung des Einflusses weiterer soziodemographischer Merkmale auf den Zusammenhang zwischen Geschlecht und Mobilitätsverhalten. Im Rahmen der Kontrolle wurde die Stichprobe bezüglich jeder Drittvariablen jeweils in homogene Subpopulationen eingeteilt. Für jede Ausprägung einer Drittvariablen wurde demnach eine eigene Subpopulation durch Filterung des Gesamtdatensatzes gebildet. Innerhalb einer Subpopulation wiesen alle Untersuchungseinheiten dieselbe Drittvariablenausprägung auf. Die Assoziation zwischen Geschlecht und Mobilitätsverhalten kann innerhalb einzelner Subpopulationen stärker oder schwächer ausfallen, als in der Gesamtpopulation, oder unbeeinflusst bleiben.

Folgende soziodemographische Merkmale wurden als Drittvariablen untersucht:

- Lebensphase (Gibt den Stand der Erhebungsteilnehmer im Lebenszyklus an und bildet dadurch die Merkmale Alter sowie Art und Umfang der Berufstätigkeit kombiniert ab.),
- Kinder unter 14 Jahren im Haushalt (Es wird zwischen volljährigen Erhebungsteilnehmern unterschieden, die in einem Haushalt mit oder ohne Kinder unter 14 Jahren leben.),
- Kreistyp (Bildet den Wohnort auf Kreisebene nach Einwohnerdichte ab, in dem der Haushalt der Erhebungsteilnehmer lebt. Die Ausprägungen der Variablen entsprechen den vom Bundesinstitut für Bau-, Stadt- und Raumforschung (BBSR) entwickelten Kreistypen.),
- Bildung (Gibt den höchsten formalen Bildungsabschluss der Erhebungsteilnehmer an. Schüler und Kinder im Vorschulalter sind nicht erfasst.),
- Führerscheinbesitz (Bildet den Führerscheinbesitz der Erhebungsteilnehmer ab. Dabei sind alle Führerscheinarten erfasst. Berücksichtigt werden nur Personen im führerscheinfähigen Alter.),
- Kfz-Verfügbarkeit (Gibt die Kfz-Verfügbarkeit der Erhebungsteilnehmer sowohl als Fahrer wie auch als Mitfahrer für einen Stichtag an.),
- Behinderung (Gibt an, ob bei den Erhebungsteilnehmern eine mobilitätseinschränkende Behinderung vorliegt.) und
- Ökonomischer Status (Bildet das haushaltsbezogene, gewichtete Nettoeinkommen der Erhebungsteilnehmer ab.).

Für die Kennwerte „Wegehäufigkeit“ und „Startzeit des Weges“ wurde aufgrund des bereits ursprünglich geringen Zusammenhangs zum Merkmal Geschlecht auf eine weiterführende Drittvariablenanalyse verzichtet. Für die übrigen Mobilitätskenngrößen lieferte die Drittvariablenkontrolle je nach Kennwert und betrachtetem soziodemographischem Merkmal sehr unterschiedliche Einflüsse der Drittvariablen auf den ursprünglichen Zusammenhang. Für einzelne Subpopulationen und Mobilitätskennwerte ergaben sich erheblich stärkere Zusammenhänge gegenüber dem Durchschnittswert, für andere aber auch deutlich verringerte Zusammenhänge.

Wichtigstes Ergebnis der Drittvariablenanalyse ist die Identifikation von Personengruppen, bei denen der Zusammenhang zwischen Geschlecht und Mobilitätskennwert deutlich stärker ausfällt, als bei der Gesamtstichprobe. Die Personengruppen, bei denen das Assoziationsmaß für mehrere Mobilitätskennwerte deutlich über dem Bezugswert ausfällt, sind

- Personen, die in einem gemeinsamen Haushalt mit Kindern unter 14 Jahren wohnen,
- Personen ohne Hochschulabschluss,
- Rentner und Pensionäre sowie
- Personen mit mobilitätseinschränkender Behinderung.

Innerhalb dieser Bezugsgruppen bestehen demnach stärkere geschlechtsspezifische Unterschiede in Bezug auf das Mobilitätsverhalten als in der Gesamtstichprobe.

Modalsplit	χ2-Test	Cramers V	Differenz abs.	Differenz rel.
Bezugswert				
Bezugswert Geschlecht-Modalsplit		0,16		
Lebensphase				
Berufstätge(r) - Vollzeit	sign.	0,156	-0,004	-2,50%
Berufstätige(r) - Teilzeit	sign.	0,071	-0,089	-55,60%
Schüler	sign.	0,08	-0,08	-50,00%
Student	sign.	0,126	-0,034	-21,30%
Kind	sign.	0,051	-0,109	-68,10%
Hausfrau | Hausmann	sign.	0,09	-0,07	-43,80%
Rentner(in) | Pensionär(in)	sign.	0,36	0,2	125,00%
Sonstiges	sign.	0,178	0,018	11,30%
Kinder unter 14 Jahren im Haushalt				
Haush. ohne Kinder unter 14 J.	sign.	0,23	0,07	43,80%
Haush. mit Kindern unter 14 J.	sign.	0,137	-0,023	-14,40%
Bildung				
Hauptschule oder niedriger	sign.	0,291	0,131	81,90%
Realschule	sign.	0,193	0,033	20,60%
(Fach-)Hochschulreife	sign.	0,146	-0,014	-8,80%
(Fach-)Hochschulstudium	sign.	0,173	0,013	8,10%
Behinderung				
Person mit gesundh. Einschr.	sign.	0,292	0,132	82,50%
Person ohne gesundh. Einschr.	sign.	0,196	0,036	22,50%

Tabelle 1 exemplarische Drittvariablenkontrolle die Variable „Modal Split“ (eigene Darstellung; Datenquelle: MiD 2008)

7 FAZIT

In der bivariaten Analyse wurde das Vorhandensein geschlechtsspezifischer Unterschiede im Mobilitätsverhalten anhand der Mobilitätskennwerte Wegezweck, Wegehäufigkeit, Modal Split, Wegedauer, Tageswegedauer, Startzeit, Wegelänge und Tageswegelänge untersucht. Geschlechtsspezifische Unterschiede bei Wegehäufigkeiten und Startzeiten wurden dabei nicht festgestellt. Bei den übrigen Kennwerten ergaben sich begrenzte Unterschiede zwischen beiden Geschlechtern. Bei Betrachtung des Kennwerts „Wegezweck“ fällt auf, dass Männer häufiger Wege zurücklegen, die sich aus ihrer Erwerbstätigkeit ergeben. Bei Frauen treten dagegen öfter familienarbeitsbedingte Wege auf. Die Wegezwecke, mit dem höchsten MIV-Anteil bei beiden Geschlechtern, sind erwerbstätigkeitsbedingte Wege. Die geschlechtsspezifischen Unterschiede beim „Wegezweck“ wirken sich daher auch auf die Kennwerte „Modal Split“, „Wegedauer“ und „Wegelänge“ aus. Während Männer bei ihrer Verkehrsmittelwahl häufiger auf den MIV zurückgreifen, legen Frauen mehr Wege zu Fuß zurück. Bei dem Kennwert „Wegedauer“ fällt das arithmetische Mittel der Männer leicht höher aus, als das der Frauen. Das Ergebnis ist vor allem durch einzelne Wegedauern im hohen Wertebereich bedingt, die sich bei Männern durch erwerbstätigkeitsbedingte Wege ergeben. Auch bei der Wegelänge äußert sich der Einfluss

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erwerbstätigkeitsbedingter Wege, die die Wegezwecke mit den höchsten Wegelängen darstellen. Die Werte der Männer liegen hier leicht über denen der Frauen. Die Ergebnisse der wegbezogenen Mobilitätskenngrößen „Wegedauer“ und „Wegelänge“ spiegeln sich auch in den personenbezogenen Kenngrößen Tageswegedauer und Tageswegelänge wieder, die bei Männern ebenfalls leicht höher ausfallen.

Der Einfluss des wegbezogenen Merkmals „Wegezweck“ auf die anderen erfassten Merkmale und deren geschlechtsspezifischen Unterschiede ist besonders relevant. Wäre im Rahmen dieser Arbeit eine Geschlechterungerechtigkeit bezüglich der betroffenen Mobilitätskenngrößen festgestellt worden, läge der eigentliche Auslöser für die Ungleichheit nicht im Mobilitätsangebot sondern in den Wegezwecken und damit den Tätigkeitsprogrammen der Befragten begründet. Allgemeiner ausgedrückt wäre die eigentliche Ursache durch die Lebensentwürfe der Befragten und noch allgemeiner formuliert durch gesellschaftlich geprägte Rollenbilder bestimmt. Auf diesen Ebenen wären in diesem Fall auch Ziele und Maßnahmen der Geschlechtergleichstellung zu planen und zu verankern und nicht etwa auf Ebene der Gestaltung von Mobilitätsangeboten. Vor der Entwicklung von Strategien und Maßnahmen zur Beseitigung mobilitätsangebotsbezogener Geschlechterungerechtigkeit sind demnach die zugrundeliegenden Ursache-Wirkungs-Zusammenhänge identifizierter Ungerechtigkeiten zu betrachten. Dies sollte insbesondere zur grundlegenden Überprüfung der Eignung des Handlungsfelds Mobilität als Ansatzpunkt für wirksame Gegenmaßnahmen dienen, um unzweckmäßige Eingriffe zu vermeiden.

Die Identifikation besonders vulnerabler Personengruppen anhand der Drittvariablenanalyse war eines der zentralen Ergebnisse der Datenanalyse. Das durchschnittliche Mobilitätsverhalten innerhalb dieser Subpopulationen unterscheidet sich, hinsichtlich unterschiedlicher Mobilitätskennwerte, von dem der Gesamtstichprobe. Für die weitere Forschung im Bereich der mobilitätsbezogenen Geschlechtergerechtigkeit könnten sie als Teilmengen betrachtet werden, deren Mobilitätsverhalten es vertiefend zu untersuchen gilt. Die im bivariaten Analyseteil erfassten geschlechtsbezogenen Unterschiede könnten innerhalb der Gruppen verschärft bestehen. Insbesondere wären für weitere Untersuchungen die Ergebnisse der Drittvariablenkontrolle anhand weiterer Daten zu validieren, da die hier vorgenommenen Auswertungen auf einer sekundärstatistischen Erhebung basieren und damit die Anzahl der kontrollierbaren Variablen begrenzt ist.

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This section (pp. 357-367) was removed due to cancellation of the author's conference participation.

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🏆 *reviewed paper*

Informationstechnologie unter Erreichbarkeit – intelligentes Transportsystem: eine Studie für den Stadtverkehr in Istanbul

Bilge Ulusay Alpay

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1 ZUSAMMENFASSUNG

Die Verkehrsplanung als ein Grundstein der Stadtplanung beeinflusst die Lebensqualität in den Städten und lenkt Mobilität, sondern auch die Verbindung zwischen Stadtraum erstellt. Daher eines der Hauptziele des Transportes ist das Konzept der Erreichbarkeit, die gleichermassen von den Chancen und Möglichkeiten jedes einzelnen Leben in der Gemeinschaft zu protifitieren festlegt. Dieser Fall zeigt, wie wichtig des "Universal Design" Ansatzes, der jeder lebt in der Stadt, den Umzug frei zu machen und ohne Unterschied Anspruch, einen einfachen Zugang auf öffentlichen Bereichen zu ermöglichen erzielt.

Bedürfnisse und Erwartungen der Gesellschaft mit der technologischen Entwicklung erhöhen und differenzieren. Mit dieser Entwicklungen wird um die Verbesserung der Qualität des Lebens und Lösungen für städtische Verkehrsprobleme zu finden bemüht. Das intelligente Verkehrssysteme für nachhaltige und sichere Verkehrsinfrastruktur mit dem Einsatz moderner Informationstechnologien entwickelt heute und den Tag zu erstellen Ziel, wird zunehmend genutzt. Die Elemente wie Sicherheit, Komfort, Zeitersparnis, Kosten betreffen die Erreichbarkeit, aber auch diese Elemente darstellen die Ziele von intelligenten Verkehrssystemen.

Mit dieser Studie wird das intelligente Verkehrssysteme als ein Ansatz zur Lösung des Problems im Rahmen der smarte Mobilität zu prüfen und eine Bewertung über die Anwendungen im Individualverkehr und öffentlichem Verkehr in der Stadt Istanbul zu schreiben beabsichtigt.

Keywords: Erreichbarkeit, Informationstechnologie, Mobilität, Stadtplanung, Verkehrsplanung

2 ERREICHBARKEIT, UNIVERSAL DESIGN UND INTELLIGENTE TRANSPORTSYSTEME (AUS)

2.1 Erreichbarkeit (Zugänglichkeit)

Im allgemeinen, Erreichbarkeit kann als "von einem Ort zu einem anderen Ort in gewünschter Zeit, in einer sparsamer, sicher, komfortabel und ohne Schaden für die Umwelt gehen oder annähern zu können " definiert werden (KUNTAY, 2006). Im Laufe der Zeit war es klar dass Zugänglichkeit in Verkehrsplanung wichtiger als die Mobilität ist. Das Konzept Zugänglichkeit berücksichtigt den Komfort und ist eine der wichtigen Wohl-Kriterien, die für die Festzustellung der kürzesten Strecke zwischen zwei Punkten, die die benötigte kürzeste Zeit sichert, mit der Anwendung der verschiedenen Verkehrsmittel Methoden, mit der gegebenen Route verwendet (YEREBAKAN, 2009). Für jede in Stadt lebende Mensch, Zugang in den öffentlichen Raum, Ausnützung der angebotenen Dienstleistungen, freie Umgang ohne die Notwendigkeit zu jemand anderem ist eine Voraussetzung beide für das Bürgersein und der natürlichsten Menschenrechte.

Zugangskriterien müssen optimiert werden damit jede der Metropolregion eine ausgewogene Transportnetzwerk hat. Zugänglichkeit schafft nicht nur ein ausgewogenes Wachstum, aber auch die gefahrlose Zugänglichkeitslösungen insbesondere für die Behinderten.

2.2 Universelles Design

"Universelles Design" ist als ein Design-Ansatz, das die Benutzung aller Produkten und Umgebungen, unabhängig von Alter, Fähigkeiten und Status verfügbar von vielen Menschen, ermöglicht und Vollständigkeit bietet (DOSTOĞLU, ŞAHİN, & TANELİ, 2009) definiert.

Universelles Design hat den Benutzer an seine Anlaufstelle und deckt nicht nur die Behinderten aber alle Menschen. Die Grundidee ist dass jede Mensch aus verschieden Gründen, wie Alter, Geschicklichkeit, irgendwie ein Behinderte ist. Universelles Design wurde als ein Design-Konzept, das die soziale Ungleichheit in der Gesellschaft unterscheidet und daraus ohne jegliche Diskriminierungen, ganz im Gegenteil, die Verwendung einer möglichst größten Teil der Gemeinschaft wahrnimmt, kristallisiert

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(YAŞAR & EVCİL, 2011). So wird die Fähigkeit der Individuen wie die Behinderte, ältere Menschen, schwangere Frauen, die des einzelnen, um die gemeinschaftliche Integration erreicht.

Als die Prinzipien des Universellen Designs können; Gerecht mäßige Benutzung, Flexibilität in Benutzung, einfache und intuitive Benutzung, Erkennbare Information, Toleranz für Fehler, geringen Körperkraftbedarf, als die geeignete Größe für Ansatz und Benutzung aufgezählt.

2.3 Intelligente Transportsysteme (AUS)

Heutzutage, Transport ist ein wichtiger Dienst, der die Individuen in ihrer gesellschaftlichen Leben entweder direkt oder indirekt angreift. Aus diesem Grund muss der Transportdienst sicherer, schneller, komfortabel und erschwinglich (KUNTAY, 2006).

Intelligente Verkehrssysteme sind die fortgeschrittene Technologieanwendungen, die die Verschaffung von innovativen Dienstleistungen über verschiedenen Verkehrsträger und Verkehrsmanagement abzielen; eine bessere Information für verschiedene Benutzer ermöglichen und die Benutzung der Transportnetzwerke sichererer, mehr koordiniert und "intelligenter" machen.

AUS besteht aus den Einsatz von echtzeitige und aktuelle Datenbanken, die durch den Einsatz von Kommunikation, Computer und Elektronik, und ähnlichen fortgeschrittene Technologien erhalten sind. Der Zweck dieses Systems ist wichtige Transportlösungen für die Probleme, wie Staus, Unfälle und Umweltverschmutzung zu erstellen; verschiedene Transporttypen zu integrieren und eine sicheren, zugänglichen und zukunftsfähigen Verkehrsinfrastruktur durch die Steigerung der Mobilität zu erstellen.

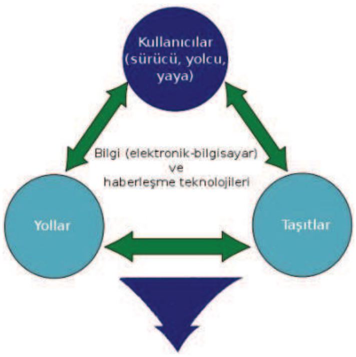

Abbildung 2.1: Intelligent Transport Systems Unit und deren Beziehungen (Akbas 2010)

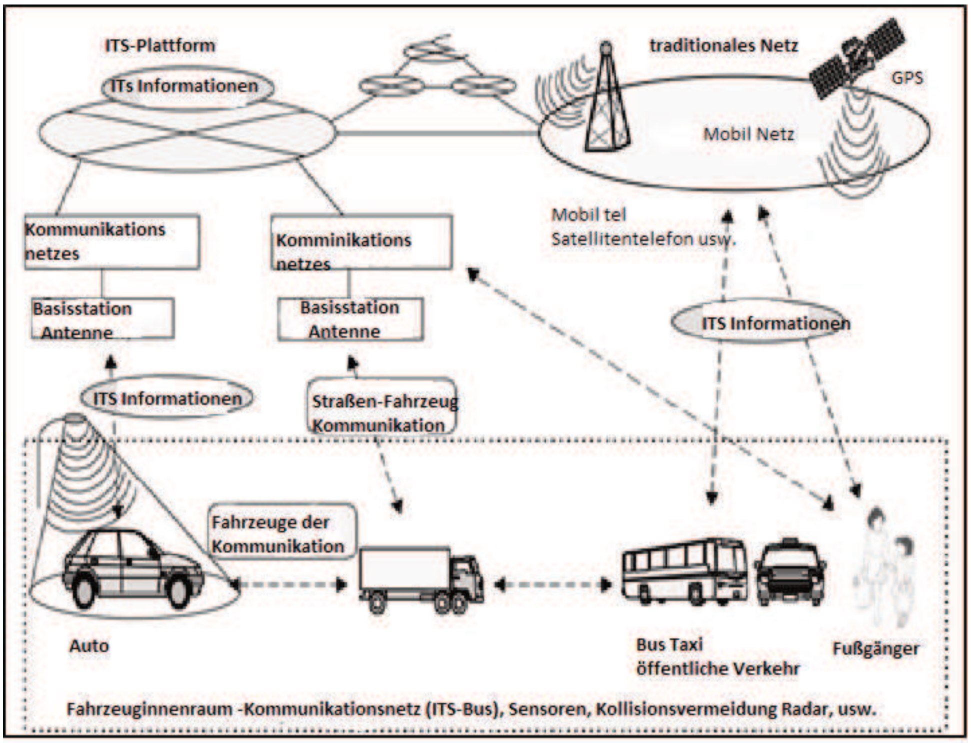

Abbildung 2.2: Intelligent Transportation Systems (ITS) (Akbas 2010)

AUS; sind Systeme, die den Informationsaustausch zwischen der von Fahrer-, Beifahrer- und Fußgänger bestehender 'Benutzer' Einheiten und 'Weg' und 'Fahrzeuge' Einheiten möglich machen.

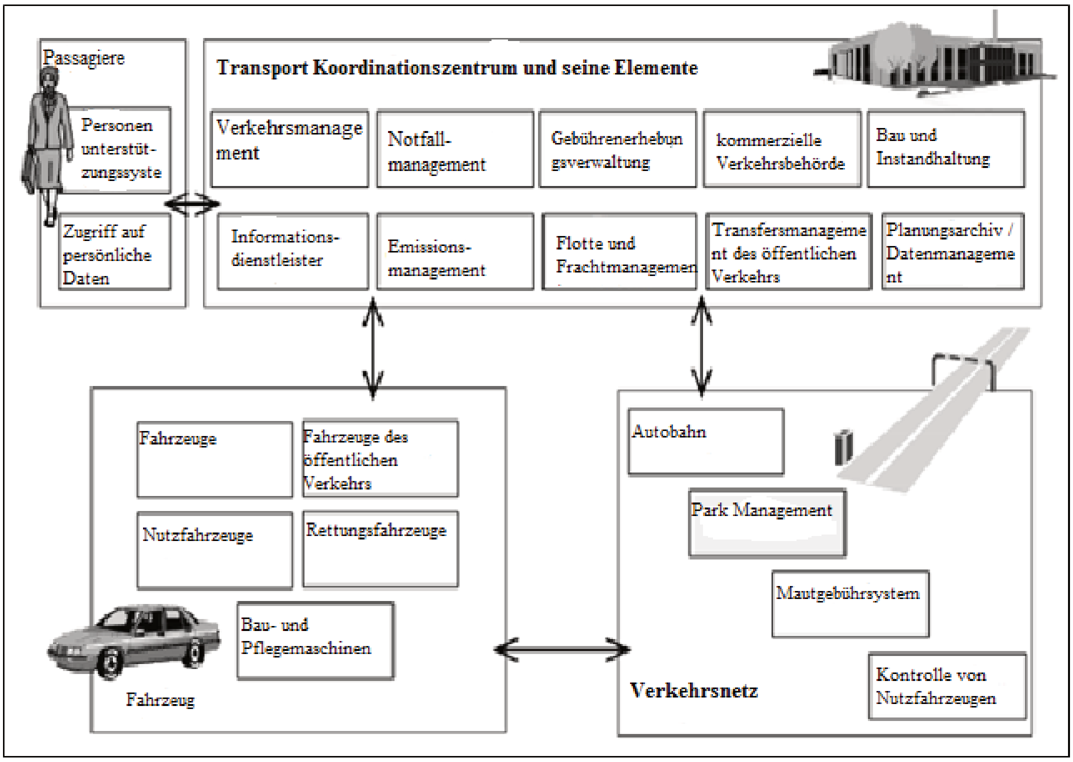

Abbildung 2.3: Intelligent Transportation Systems Architecture (AID UND EISEN 2009)

2.4 Hauptanwendungsgebiete

Eine Vielzahl von Anwendungen im Rahmen der Intelligente Transportsysteme wurden entwickelt. Diese Anwendungen bestehen aus Event-Management, Straßenmanagement, Preisgestaltungssysteme, Informationssysteme, Notfallmanagement, Flottenmanagement, usw.

Diese Anwendungen sind; Fortgeschrittene Fahrgastinformationssysteme, Fortgeschrittene Transport-Management-Systeme, Transportpreisgestaltung-Systeme, Fortgeschrittene Öffentlicher Verkehrssysteme, Fortgeschrittene Fahrzeug Prüfung und Sicherheit Systeme.

2.4.1 Beitrag der Verkehrstelematik zur Informierung

Informationstechnologie bildet die Grundlage der intelligenten Transport-Systeme und zielt Informationenaustausch zwischen drei Komponenten, nämlich Benutzer (Passagier, Fußgänger, Fahrer), Straßen und Fahrzeuge zu ermöglichen.

Die in dem System befindlichen Fahrgast-Informations-Systeme beitragen zu dem Informierungsprinzip, welcher von großer Bedeutung für die Zugänglichkeit ist. Die echtzeitliche Erkundigung der reisenden Benutzer zu Hause, irgendwo anders, an Haltestellen über ihre Reise ermöglicht die Individuen sich frei bewegen zu können. Welche Strecke die Individuen für ihre Reise benutzen werden, an welche Haltestellen die öffentliche Verkehrsmittel zu benutzen aufhält, welche öffentliche Verkehrsmittel durch diese Haltestelle vorbeifährt, und wann die öffentlichen Verkehrsmittel ankommen zu wissen wird ihnen Vertrauen zu sich schaffen.

Übermittlung der Informationen an Benutzer durch die weit verbreitete Anwendungen wie , Internet, Fernsehen, Rundfunk, mobile Anwendungen wird die Nutzung dieser Dienste für Alle erleichtern.

Die in dem öffentlichen Verkehrsnetz-System befindliche Information-Anwendungen im Fahrzeug informieren die Passagiere wo sie gerade sind, ob sie an ihre Haltestelle angekommen sind oder nicht, ohne jemand anderen zu brauchen. Die Benutzung dieses Systems mit akustischen Warnsysteme wird auch dazu dienen dass die Sehbehinderten oder Menschen mit Sehschwierigkeiten von diesem Dienst zunutze zu machen.

3 DIE IM RAHMEN DER STADT ISTANBUL ENTWICKELTE VERKEHRSTELEMATIK

Die ersten Anwendungen von Verkehrstelematik in der Türkei waren in Istanbul. Die, in der Türkei und in Istanbul angewandte erste Verkehrstelematik-Anwendung ist die „Verkehrsüberwachungszentrum“. Das, von Verkehr-Koordinationszentrum unter Istanbul Großstadtgemeinde geleitete Verkehrsüberwachungszentrum enthält viele Anwendungen. Von dem öffentlichen Verkehrsbetriebszentrale der Busse in Istanbul (IETT) gebildete AKYOLBIL Projekt umfasst Verkehrstelematik-Anwendungen.

Das, von Istanbul Großstadtgemeinde UKOME gebildete Verkehrsüberwachungszentrum besteht aus vier wichtigsten Verkehrstelematik-Anwendungen. Dies sind; Signalisierungswerke, Verkehrsinformationen Systeme, elektronische Überwachungssysteme, Tunnel Betriebszentrum.

Akyolbil im Rahmen des Projekts entwickelt IETT sind drei Hauptanwendungen . davon; Fahrgastinformationssysteme, elektronische Mautsysteme, Tunnelbetriebszentrale.

Es gibt keine Zusammenarbeit unter diese Verkehrstelematik, die von Istanbul Großstadtgemeinde UKOME und IETT getrennt erstellt wurden. Beide Einheiten wenden diese Systeme die sie getrennt entwickelt haben, getrennt an.

Die Einzelheiten der Anwendungen, die unter Akyolbil Projekt von UKOME Verkehrsüberwachungszentrum und IETT durchgeführt sind, werden unten eingegangen.

3.1 Verkehrsüberwachungszentrum

Das Verkehrsüberwachungszentrum wurde unter der Transport-Management-System, das eine Verkehrstelematik-Anwendungen ist, entwickelt. Das Verkehrsüberwachungszentrum ist das erste Verkehrstelematik in Istanbul.

Durch den Einsatz von fortgeschrittener Hightech-Anwendungen, die als Verkehrsüberwachungszentrum (AUS) bezeichnet und ein Schlüsselelement zur Lösung der Probleme der jeden Tag zunehmende Verkehr ist, sofortige vorkommende Verkehrsfluss in der Stadt wird 24 Stunden am Tag in Echtzeit überwacht und geleitet.

Alle visuellen und digital Informationen durch die Verkehrsmessung, Beobachtung, Überwachungssysteme in verschiedenen Punkten der Stadt und Tunnel Betriebszentrum werden durch Computer und andere Technologien analysiert und andere Informationen, die das gesellschaftlichen Leben und die Transportation in der Stadt beeinträchtigen könnten werden gesammelt, dadurch die Stadtverkehr ist verwaltet und überwacht.

3.2 Signalisierung Werke

Um die Bewegungen der Fahrzeuge und Fußgänger an gleichrangige Kreuzungen und Fußgängerüberwege unter Kontrolle zu nehmen, die Sicherheit zu erhöhen und den Verkehrsfluss in einer bestimmten Reihenfolge zu gewährleisten, die Kreuzungen sind ausgeschildert. Signalisierten Kreuzungen werden durch online Verkehrsknotenpunkt Kontroll-System bei dem Verkehrskontrolle-Zentrum geleitet.

3.3 Verkehrsinformationssystem

Verkehrsinformationssystem enthält; Bandmanagementsystem, Call Center, Variable Message System (DMS), Variable Verkehrszeichen, Verkehrsdichtekarte, Verkehrs TV und Verkehrs Radio

3.4 Verkehrsüberwachungssysteme/elektronische Überwachung Systeme

Die Forschungen über die Ursachen der Verkehrsunfälle zeigen dass rund 95 Prozent der Unfälle durch Fahrerfehler verursacht wurden. Deshalb, eine der Verkehrstelematik-Anwendungen, die um die Überwachung der Fahrerfehler entwickelt wurde, ist das elektronische Überwachungssystem.

Das elektronische Überwachungssystem umfasst die Feststellung von Rotlicht-Verstoß, Verstoß gegen das Verbot der Sicherheitsleiste, Nichteinhaltung Geschwindigkeit, Parkverbot Verletzung, Fahrzeuge in entgegengesetzte Richtungen fahren und die Feststellung der Nummernschilder der verstoßenden Fahrzeuge nachdem sie angezeigt sind durch die Software für Nummernschilderkennung und Bestrafung durch die zuständigen Behörden mit einer gesetzlich bezeichneten Strafe.

3.5 Tunnelbetriebszentrum

Um die maximal sicheren, komfortablen und effiziente Betrieb der in 2009 eröffnete Kagithane-Piyalepasa und in 2010 eröffnete Bomonti-Dolmabahçe und weitere zukünftige Straßentunneln, wurde in Piyalepasa ein Beobachtung und Kontrolle Zentrum gebildet. Das Kontrollzentrum hier nutzt alle Möglichkeiten, die die Verkehrstelematik um die Beobachtung und Kontrolle der Tunneln in einer dynamischen Weise auf 7/24 bietet.

3.6 IETT Fahrzeugortung und Fahrgast-Informations-Systeme (Akyolbil Projekt)

Akyolbil ist ein intelligentes System, das aus Istanbul Karte, Flottenbeobachtung und Flottenmanagement zum Informieren der Fahrgäste über die Busse und Zeiten besteht um die pünktliche Überwachung in öffentlicher Nahverkehr, durch die Sicherstellung der Kreuzfahrten der Busse zwischen den verschiedenen Punkten gemäß dem Plan und die Beseitigung der auftretenden Störfälle (ÇELEN, 2010).

Durch das AkYolbil Projekt, die Lokationen /geographische Koordinaten der von IETT aufgezeichneten öffentlichen Verkehrsmittel, werden eingetragen. Dank der Standortinformationen von den Fahrzeugen in der Flotte, die zeitlich gefolgt sind:

- Passagiere in dem Fahrzeug und an den Haltestellen können über die Position des Fahrzeugs informiert werden.
- Unter Umstände, die den Zeitplan verzögern können, die Flottenmanagement kann sofort durch das Zentrum geleitet werden.
- Änderungen in der Zuweisung können sofort an die Passagiere mitgeteilt werden.
- Dank der vergangene Verkehrsdaten, die Passagiere können über die voraussichtliche Ankunftszeit des Fahrzeugs, darauf sie warten, informiert werden.
- Die Ankunftszeiten der Busse, der vorbei fahrenden anderen Busse, die an intelligente Bushaltestellen angezeigt sind, werden in Berücksichtigung der Verspätungsfälle ständig aktualisiert.

Akyolbil Projekt ist durch Pilot-Anwendungen in Istanbul durchgeführt. Jedoch, Verspätungen wegen Verkehrsstau wirkt negativ auf diese System und die Informationen über die Ankunftszeiten der Busse auf dem Bildschirm können an Passagiere falsch mitgeteilt werden.

4 SCHLUSSFOLGERUNGEN

Zu den Faktoren, wie Sicherheit, Informierung, Beschleunigung und Zeitsparung haben einen wichtigen Platz im Verkehrssystem. Wobei das Verkehrstelematik, das durch die Informatik um den Ziel von einer sicheren, komfortablen und zugänglichen Reise zu gewährleisten entwickelt wurde, bietet den Nutzern zahlreiche Annehmlichkeiten und Komfort. Die Verwendung von Verkehrstelematik, bietet einfacher Verkehrsmanagement und hilft in Probleme wie eines Notfalls, Staus, Kreuzung Probleme durch Transport-Management-Systeme zu intervenieren.

Passagier-Informations-Systeme; bieten augenblickliche Verkehrsinformationen für öffentliche Verkehrssysteme, Passagieren und Fahrer und informiert wo es Stau oder freie Straßen gibt. Damit können die Passagiere und Fahrer ihre Routen reorganisieren und den Zeitverlust verringern. Die Passagier-Informations-Systeme in Verkehrstelematik gewährleisten visuelle sowie auditive Mitteilungen. Dies wird zu der unabhängigen Bewegung von sehbehinderte, ältere Menschen, und so weiter. Übermittlung der Informationen an Benutzer durch die weit verbreitete Anwendungen wie Internet, Fernsehen, Rundfunk, mobile Anwendungen wird die Nutzung dieser Dienste für Alle erleichtern.

Nahverkehr Probleme in Istanbul, hat nachteilige Auswirkungen auf die Lebensqualität der städtischen Leben der Individuen, führt zu Zeit- und finanziellen Verlust. Schnell wachsenden Bevölkerung und Bauflächen, Anstieg der Zahl der Fahrzeuge, ungenügende Verkehrsinfrastruktur, Bevorzug von oberflächliche und günstige Lösungen mit temporäre Ergebnisse statt radikale Lösungen und Hintanstellung der Planung hat zur Entstehung von komplexer und zur schwerwiegenden Problemen in Verkehr geführt. Viele Anwendungen zur Lösung dieser Probleme in der Türkei wurden zuerst in Istanbul, wo AUS entwickelt war, in Gang gebracht.

Die Anwendungen wie EDS, Passagier und Fahrer-Informations-Systeme, Signal-Kontrollsysteme, helfen zum Erstellen eines komfortablen, sicheren und schnellen Transportstruktur. Akyolbil-Projekt, mit dem Bereich, zeigt, dass die öffentliche Verkehr schnelle, sichere und kostengünstige Transport durch Angaben über Reise an Passagiere, Reise-Planung, gewährleisten kann. Aber wegen ungenügende Anwendung des Projekts, noch nicht abgeschlossene Pilotprojekt Anwendungen, erschweren die Bewertung der Effizienz des Projektes.

Obwohl sie für die Bequemlichkeit, Komfort und Sicherheit im Verkehr gebildet sind, solche Anwendungen für die Stadt Istanbul sind noch nicht in der Lage diese voll zu bieten. Die mangelnde Integration zwischen Transporteinheiten, verursachen die Verzögerung der Projekte. Darüber hinaus die mangelnde Kooperation zwischen Einheiten verzögert die Entwicklung neuer Projekte.

Hinweis: In dieser Studie, würde ich Hilal Pişkincan danken.

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Innovative Approaches to Urban Data Management using Emerging Technologies

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1 ABSTRACT

Many characteristics of Smart cities rely on a sufficient quantity and quality of urban data. Local industry and developers can use this data for application development that improves life of all citizens. Therefore, the handling and usability of this data is a big challenge for smart cities. In this paper we investigate new approaches to urban data management using emerging technologies and give an insight on further research conducted within the EC-funded smarticipate project.

Geospatial data cannot be handled well in classical relational database environments. Either they are just put in as binary large objects or have to be broken down into elementary types which can be handled by the database, in many cases resulting in a slow system, since the database technology is not really tuned for delivery on mass data as classical relational databases are optimized for online transaction processing and not analytic processing.

Document-based databases provide a better performance, but still struggle with the challenge of large binary objects. Also the heterogeneity of data requires a lot of mapping and data cleansing, in some cases replication can't be avoided.

Another approach is to use Semantic Web technologies to enhance the data and build up relations and connections between entities. However, data formats such as RDF use a different approach and are not suitable for geospatial data leading to a lack on usability.

Search engines are a good example of web applications with a high usability. The users must be able to find the right data and get information of related or close matches. This allows information retrieval in an easy to use fashion. The same principles should be applied to geospatial data, which would improve the usability of open data. Combined with data mining and big data technologies those principles would improve the usability of open geospatial data and even lead to new ways to use it. By helping with the interpretation of data in a certain context data is transformed into useful information.

In this paper we analyse key features of open geodata portals such as linked data and machine learning in order to show ways of improving the user experience. Based on the Smarticipate projects we show afterwards as open data and geo data online and see the practical application. We also give an outlook on piloting cases where we want to evaluate, how the technologies presented in this paper can be combined to a usefull open data portal. In contrast to the previous EC-funded project urbanapi, where participative processes in smart cities where created with urban data, we go one step further with semantic web and open data. Thereby we achieve a more general approach on open data portals for spatial data and how to improve their usability.

The envisioned architecture of the smarticipate project relies on file based storage and a no-copy strategy, which means that data is mostly kept in its original format, a conversion to another format is only done if necessary (e.g. the current format has limitations on domain specific attributes or the user requests a specific format). A strictly functional approach and architecture is envisioned which allows a massively parallel execution and therefore is predestined to be deployed in a cloud environment.

The actual search interface uses a domain specific vocabulary which can be customised for special purposes or for users that consider their context and expertise, which should abstract from technology specific peculiarities.

Also application programmers will benefit form this architecture as linked data principles will be followed extensively. For example, the JSON and JSON-LD standards will be used, so that web developers can use results of the data store directly without the need for conversion. Also links to further information will be provided within the data, so that a drill down is possible for more details.

The remainder of this paper is structured as follows. After the introduction about open data and data in general we look at related work and existing open data portals. This leads to the main chapter about the key

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technology aspects for an easy-to-use open data portal. This is followed by Chapter five, an introduction of the EC-funded project smarticipate, in which the key technology aspects of chapter four will be included.

Keywords: Smart City, UrbanAPI, Semantic Web, Open Data, Machine Learning

2 INTRODUCTION

Publishing data on city portals as open data is a growing trend, which is also promoted by the European Commission. However, the prevalent experience when investigating such data is that it is just a more or less raw dump of data that was created sometimes as a by-product due to technical reasons. It's hard for laymen to interpret the data sets, yet even impossible to tell if the content is useable for anything as mostly no meta-information is given. Also keeping up-to-date can be hard under such circumstances. Especially when talking about data, that has not been issued by public authorities also the question of trust in data rises: who collected it and when? Is there some attempt to defraud? This is very important as building services on faulty data consequently leads to faulty results and this undermines the reputation of Open Data as a whole. Another important aspect is in which way should data be published? Many open data portals publish them in PDF, Excel or some image format. It's very much like the traditional data, which was published as printout. Geospatial 2D data such as zoning plans are often published as ESRI-shapefiles, which need special tools such as Q-GIS to work with them. There are already a lot of tools like Geoserver or CityServer3D, which can work with these data sets. However, the problem of linking into the data remains the same. The solution can be to reduce the format to atomic entities capable to represent the data to manage. The semantic web initiative proposes a whole technology stack, but it has not gained the momentum to innovate information systems as needed. In this context the term "5 star open data principle"[1] has been coined to set out the ultimate goal for data availability. While the levels 2 or 3 are quite easy to reach, the most useful layer 5 needs a lot more involvement. In our view it ultimately does boil down not to a question of standardised file formats but to interoperable dynamic information systems, considering the needs of users and developers first. Such a system has to deal with aspects of heterogeneity, distribution of data and systems, support for multiple formats and standards, whilst providing openness for innovation.

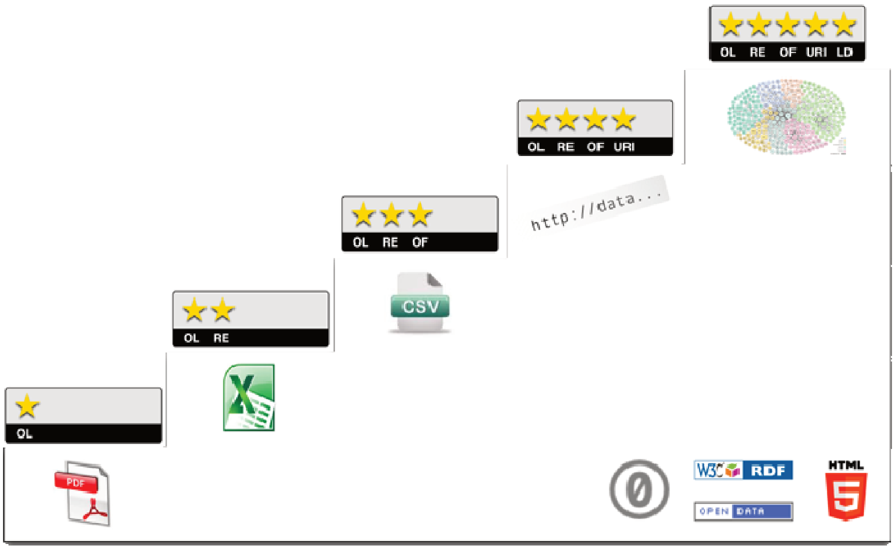

Fig. 1: Five-star open data principle as of Tim Berners-Lee.

3 RELATED WORK

3.1 The urbanAPI project

The urbanAPI project[2] innovated public participation through the use of interactive 3D-Web technology, as shown by Dambruch and Krämer (2014). Furthermore, a new way of interaction with data was proposed by Malewski, Dambruch and Krämer (2015) using Domain-Specific Languages. The biggest issue identified as

[1] 5stardata.info
[2] www.urbanapi.eu

obstacle to wide application of such systems was that there is some substantial effort required in pre-processing and annotating the data to be used. Most of these steps are not supported well by tools and gathering input for a particular use case had several steps to be done over and over again – with very little but important differences. The results of the pre-processing was not useable in other use cases as it was tied to the special needs of the use case. So the major observation was that the basically the same steps had to be carried out again and again, as the parameters changed. This is the motivation for the service platform in smarticipate.

3.2 The semantic web

The semantic web was originally conceived by Tim Berners-Lee (Berners-Lee 1998) as a universal standard for describing, encoding and annotating data along with formal ontology and interlinking data sets with other data. For this a lot of technologies for advanced information encoding and processing in a standardised way were proposed such as XML/RDF[3], RDFS, OWL[4], SPARQL[5].

Based on this, ontologies and vocabularies have been defined to model aspects such as a thesaurus via SKOS[6] or physical units, quantities and dimension as QUDT[7]. Also meta data in general has been described as the Dublin Core initiative[8] and many others also supported by government authorities and standardisation bodies. But several aspects needed by nature to remain vague as the relations of things to describe are not as clear as one might suspect from a data perspective. It turned out that it is hard to grasp the essence of a thing relevant in general, therefore it is also hard to encode it in a formal system. Certain aspects of a thing might only be relevant in certain contexts or use cases, others might also be only of historical interest. A taxonomy like SKOS therefore defines vague concepts of identity such as closeness or exact match which are quite hard to understand from a programmer's point of view, but are needed from the ontology-engineering perspective.

3.3 Existing open data portals

Schäfer (2016) gives an overview of existing open data portals and catalogue applications. A key observation is that most of them are not designed well and usability wasn't taken into account appropriately. Major concern is that there is no overview provided and exploration not supported as references between data items is not given, if at all, only references between datasets as a whole may be provided.

A necessary key feature of open data portals is a well performing search function. The user usually uses domain specific search terms which needs to be used correctly by the search engine. The availability of open data in existing portals is another key feature. If the users are able to find the data they are looking for the data must be available for download immediately, ideally without registration or verification of mail address or other individual data.

4 KEY TECHNOLOGY ASPECTS

Open data should be provided in an open and widely established format. Especially accessability on fact level without the need for proprietary tools is important. The web technology and especially the semantic web initiative provided mechanisms to do this (see 3.2). The typical user first needs to get an overview on data he needs for his purpose and which data is available at all, therefore the first step is exploration of data. Current experiences show that the immense amount of data available, the heterogenity of datasets and distribution of data as well as the lack of well maintained catalogues makes the exploration a tedious and time consuming process. This is especially true for open data as this data often is published „as is“, e.g. a dump of results originating from arbitrary activity.

Today people expect search engines to be as easy as using google, but most open data and geo portals are miles away from this expectation. Finding data by simple keyword matching works in some cases, but to improve results and especially to find related data sets needs some more sophisticated approaches. Semantic

[3] https://www.w3.org/RDF/
[4] https://www.w3.org/2001/sw/wiki/OWL
[5] https://www.w3.org/2001/sw/wiki/SPARQL
[6] http://www.w3.org/2004/02/skos/vocabs
[7] http://www.qudt.org
[8] http://dublincore.org

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relationships can already be modelled by semantic web technologies, e.g. RDF and ontologies, but this has not gained much prominence although being developed for more than 10 years. One big problem is that data has to be transformed in RDF, and therefore data has to be replicated in this particular format, which means maintenance of doubled data sets. Apart from costs regarding additional infrastructure mainly the efforts for dedicated personnel is a clear limit for such an approach.

Another interesting question is about the search results. The range of possible results is also mandated by the form of query that can be issued. E.g. from simple facts such as how many people live in the city to more complex answers such as what is the best cycling path to work or even complex 3D visualizations. A query is the first step in this by saying “what” I want to get and the second step is “how” I want to view it.

Data sets that do not adhere to a common structure with normed semantics are most likely using a vocabulary of their own. This necessitates a preprocessing step called harmonisation and mapping where common terms are identified and how the terms will map on terms defined in other data sets. The consequence of this approach is that a normal ontology is to be defined in which all terms can be mapped.

Ultimately such an approach leads to endeavours such as the inspire directive, mandated be the European Commission, which has the goal to define a common ontology for spatial infrastructure for all European countries. However, such an approach has severe drawbacks in terms of usability (Janowicz et al. 2013) as it tends to make projects and applications overly complex and draws attention away from the real problems users are facing.

Instead Janowicz et al. propose the concept of Microontologies where the conceptualisation of data is closely tied to the problem to solve, the domain of it and the application or service to be developed. The consequence for such an approach is that the mapping of vocabularies and ontologies has to be provided on a case by case basis and can build on smaller units. With this the solution of the problem can be defined in a more convenient way, as generalized ontologies need to define globally valid definitions, which is a hard task, if possible at all. So the vocabulary to use in the query considers the “what” or use case they are designed for and secondly a special vocabulary for visualizing the results can be defined as defining the “how”.

The interesting part comes into play when these definitions can be changed: A new set of “what” and “how” for a completely new domain can view data in a completely different context. Based on this experts and laymen can consider observations of other people easily and switch perspectives.

As already said results need to be presented in a convenient way to users. For geospatial data this means to visualize it in a map in 2D or 3D along with some context. This context can be determined by the vocabulary/ontology used in the query considering different visual styling or highlighting important aspects.

The next important thing is to support data exploration at a more useful layer. Most classical GIS do just provide one layer of results and no further refinement. Integrating other data sources in a mash-up style provides new opportunities to drill down on results in a convenient “web surfing” style, which means to provide related datasets for some particular feature or search results.

4.1 Search technology

Search engines are a crucial part of today’s web architecture. Finding the right data and getting information of related or close matches guide people in information retrieval in an easy to use fashion. The same principles should be applied to geospatial data. Combined with data mining or big data technologies this would improve the usability of open geospatial data and even lead to new ways to use it. By helping with the interpretation of data in a certain context data is transformed into useful information. As mentioned above users expect a search engine similar to google and therefore they expect search results in a comparable quality and time. To achieve this, state-of-the-art search technology has to be used. Fortunately, real-time data analytics and search engines have been improved rapidly over the past years. A combination of elastic search for the analytics engine, cabana for the visualization of data and logstash for data preparation is used by multinational companies (e.g. Netflix, Wikipedia, Facebook) that face similar problems.

4.2 Linked Data, JSON LD

Linked data is in principle already available via web technology and especially semantic web technology. However, it is not as simple as this. HTML and websites are ubiquitous nowadays and have gained a lot of success. But the sites are not interoperable and reusable as needed for data services. This issue is mostly addressed via the RDF encoding standards and related semantic web facilities. But the paradigm behind this seems to be not very tempting for most developers and users.

Manu Sporny points out a lot of concerns in his blog[9] about the origin of the JSON LD standard, especially if non elementary things are to be modelled. A very specific domain may use terms and concept in such a way, that it does not make sense to even discuss it a general level. Also Janowicz and Hitzler conclude that standardized meaning is a misconception in many cases: Mostly it is to be considered in a certain context or you also may say use case. Our conclusion regarding this is that such a technology needs to involve experienced ontology engineers on a local level to cope with the inherent complexity. Otherwise the problem of losing focus on practical application and problem solving and overloading of users with irrelevant details dismantles the reputation of such a system in general. Apart from this the RDF and OWL specifications are not easy to understand and use, as they apply paradigms not very familiar with web development. JSON LD on the other hand just extends the web programming model in a simple and pragmatic way, without breaking the minds of users or technology.

The semantic web has yet played a minor role for geo information and GIS but also geo information standards play a minor role in other communities. This is because of nature of standardisation bodies such as the Open Geospatial Consortium (OGC) as there are only GI experts designing for their own community (Hart and Dolbear, 2013, p. 40). Also the standardisation itself is mostly perceived as a barrier to modern development approaches as a top-down definition of governmental driven use cases such as the INSPIRE[10] directive tend to be long-lasting and tedious and off scope in many cases. Especially the goal to set normative semantics is totally against the ideas of the semantic web and the needs and goals of users and creators of geo information.

On the other hand, publishing data should be made easy, without the need for a lot of cleansing and preparation. If the data published has no special purpose than just publishing it, it is hard to say what people can make out of it. So the best approach for this seems to keep it as simple as possible and choose pragmatic approaches. For example, JSON LD as web affine encoding standard, which could be used right away with any modern browser.

4.3 Machine Learning

Data pre-processing and especially semantic annotation is a time consuming and tedious task. Especially maintaining meta data is a crucial point in many geospatial applications to make data usable. Therefore, such tasks should be automated as much as possible. A key technology which could help in this comes from the Artificial Intelligence domain and deals with machine learning. With this a computer can be trained to recognise patterns in data and extract information from datasets by applying sophisticated statistical methods. Thus, annotating data sets and finding relations can benefit from this to some extent. The data analysis can range from text mining and natural language processing to advanced image recognition of features in aerial images. Common patterns and correlations can be analysed and contribute to building assumptions or assumptions can be checked on real data. It is yet not clear to what extend the analysis can be automated, thus also aided operation or crowd sourcing can be used to verify results of such analysis.

4.4 Database Systems

Since open data is often published on distributed systems it is necessary to create an index referring to the available data. Since geospatial data is usually considered big data there are different advantages and disadvantages for the different types of databases.

SQL Databases

Even though new database concepts and systems were developed recently most data is still stored in SQL databases. This fact is not astonishing since it is false to assume SQL database lack the ability to scale. Facebook for example release Presto, a SQL Database that interacts with petabytes of data.[11] Since a system

[9] http://manu.sporny.org/2014/json-ld-origins-2/
[10] EU Parliament Directive 2007/2/EC
[11] https://www.facebook.com/notes/facebook-engineering/presto-interacting-with-petabytes-of-data-at-facebook/10151786197628920

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providing big geospatial data is a very heterogeneous database environment it is important how queries can perform across different database systems. User queries might need information from different databases which requires a well performing read-operation.

No-SQL Databases

Currently there are many different No-SQL Databases. This is explained by Brewer's Theorem (CAP-theorem). According to this theorem a distributed system can only provide two out of three characteristics: consistency, availability and partition tolerance. Different No-SQL Databases focus on different trade-offs and the provider of data has to choose the best database solution for his data. Since No-SQL Databases have a better performance on average they are usually the first choice if there are no critical transactional or consistency requirements. However there are huge differences between the different systems.[12]

NewSQL Databases

NewSQL Databases are a new type of database system. They support relational data model and use SQL but they target systems that need a large number of transactions. Especially when providing open data this will be the case. Not only a large number of transactions but the transactions will target only a small subset of the available data which is a strength of NewSQL Databases.

Besides the type of database system, the provider has to evaluate what system will be the most beneficial for the requirements of his system. The most important requirements are the ability to search quickly and on multiple, distributed databases at the same time and a fast reading mechanism.

4.5 Cloud technology

Geospatial data and open data are often used in the context of big data. Therefor the usage of cloud technology is almost mandatory. To evaluate the importance of cloud technology we use the definition of the National Institute of Standards and Technology.[13] According to this definition there are five characteristics of a cloud computing system.

On-demand self-service

The computing abilities have to be scalable in real time to match the requirements of the environment. This is very important for a provider of open data since some events (e.g. Olympic Games) can trigger a rapid increase of open data usage.

Broad network access

The data has to be available for different client platforms (e.g. mobile phones, tablets, laptops and workstations). This is critical as well because most applications based on open data demand a noteworthy part of the available open data. Especially mobile applications depend on a fast transfer of the required data since they usually don't provide the necessary memory to store this data.

Resource pooling

The available resources of a cloud will be shared among the different users. This can be a critical characteristic since the user of a cloud has no information where the data is stored or where the data is processed. In case of the appropriation of open data this aspect accentuates the importance of cloud technology. Resource pooling is one of the main reason why cloud resources are low priced.

Rapid elasticity

Even an unexpected increase of user queries can be handled by the cloud computing system. Ideally the scaling of the used resources will be fully automatic. In this case the provider of open data does not have to be available at all times to scale the resources himself.

Measured service

[12] https://www.google.de/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&ved=0ahUKEwjwi__nktnLAhUHVBQKHY6UDfAQFgg7MAE&url=http%3A%2F%2Fwww.datastax.com%2Fwp-content%2Fuploads%2F2013%2F02%2FWP-Benchmarking-Top-NoSQL-Databases.pdf&usg=AFQjCNEdcXHWXW78i5J5CL4Frzk1VdykBw&sig2=bP33uyudgh-CSp72cl2_Hw&cad=rja

[13] http://dx.doi.org/10.6028/NIST.SP.800-146

Especially with an automatic system that handles unexpected increase of user queries it is important to have some kind of cost control. Typically this is done on a pay-per-use or charge-per-use basis. Even though this is the least important characteristics of a cloud computing system for providing open data it is mandatory to avoid cost spikes.

4.6 Methods of interaction: Domain Specific Languages

Users that analyse geospatial data sets are confronted with a lot of GIS technology driven terminology and also computing terminology, which is mostly reflected in the language they could use for this (e.g. Python for ArcGIS). On the other hand, they naturally have a different vocabulary driven by the need of their working domain. Even each city or department can have different definitions of seemingly common terms. These deviations in definitions stem from the fact that as each organisation only needs to cover aspects they deal with and ignore others which are not relevant to their work. In many cases every department in an administration has different definitions for the same entity: Customer Relationship Management systems for example define addresses as immutable entities denoting a location. Billing systems often see addresses as a person and a location where a bill can be sent. In short, such definitions depend on the context they are used in and this is not a drawback since the focus is put on the aspects necessary. This is a common principle in IT systems, which can be paraphrased as: Do only one thing – but do it right. At second glance there are some implications when users need to understand another person’s vocabulary and they encounter conflicts of definitions of terms. So a mapping between both domains is vital to get a common understanding.

For GIS expert users’ analysis tasks on geospatial data are common and easy but they also need to deal with a lot of technology issues, which they need to resolve in order to get the results demanded. They are fluent with both the technology driven vocabulary (which uses terms like Feature, TerrainGrid, Layer, etc.) and the domain vocabulary (which may use terms like Street, Quarter, River, etc.) What would happen if we decouple the user vocabulary from the technology vocabulary by using semantic annotation and mapping? As a consequence of the mapping the domain vocabulary can be flexible and highly adapted to special circumstances. How we approach this is detailed in the following chapter. For useful interaction just a vocabulary is not sufficient – syntax for example is also required. Such a language is constructed based on the concept of Domain Specific Languages - DSL (Fowler 2010). Such DSLs have already been applied successfully within the urbanAPI project for data preparation and policy modelling (Krämer, Ludlow, Khan 2013). Most of this was done with classical desktop-GIS software (Krämer and Stein 2014). In UrbanAPI we did show how we extended the DSL concept to a web-based analysis tool which enables users to work in their language level without the need to have strong geodata and technology domain knowledge.

Our prototype is inspired by the paper of Janowicz and Hitzler (2013) and elaborates an alternative approach to using Semantic Web technologies and related generic ontologies, which is driven by the idea of simple-to-the-point models and not a normative semantic world model.

5 THE SMARTICIPATE PROJECT

The driver of the smarticipate project is the need to publish open data which is clearly understandable, serves a defined purpose and is trustable and authoritative. This data should enable people and business organisations to build up new public information services to participate and understand what is going on in their city.

The envisioned software is a data-rich citizen dialogue system, transforming public data into useful information. Tools will be developed and implemented to make data trustworthy, by using state-of-the-art web and GIS technology.

New services provided with smarticipate can put people and non- governmental organisations in charge of several tasks selected by and under the supervision of municipalities, thus transforming the administration processes and turning the administration into a partner. Within the municipal departments smarticipate will facilitate collaboration, as city administrations will work on the same data basis, which as well can be shared with business and citizens on the smarticipate platform. Data security and trust in data is responsibility of the city government and therefore is considered as legitimate.

5.1 Concept

smarticipate fosters a bottom-up approach of local governance. All citizens like entrepreneurs, students, workers, members of NGO's, estate owners and investors have the chance thanks to open government and access to open data to propose technically qualified ideas/initiatives on an expert/professional level. Increased connectivity leads to new coalitions between different citizens and produces new, unexpected and innovative ideas for new public services. Initiative can be taken by the inhabitants of the city, such as city officials, entrepreneurs and regular citizens who have issues and ideas of how to solve them. The initiators create their own applications available for everyone using their interface. To achieve the concept described above, smarticipate has the following principles of development:

- Interdisciplinary – participatory stakeholder involvement, focussing on innovation processes
- iterative development – the observation that a planning process is evolutionary is to be taken into account when discussing with citizens and stakeholders.
- development for openness – existing frameworks and technologies will be reused, standards examined and applied where suitable and useful
- extensive piloting – the platform is developed in an open environment with direct feedback options for stakeholders

See also Fröhlich and Vogt (2016) for further details on engaging people.

5.2 Tech approach

In order to enable wide distribution and technological readiness, existing software frameworks will be used as a basis for all developments. To facilitate this approach, the Service Platform is the central data hub and data processing component providing methods to build services using several proven technologies. The services will provide information in a suitable way, which will be used in the user interface and apps. On the other hand, the services can be used to gather feedback from users, file issues or report like in open311 or propose completely new things. The core of this is a component that enables semantic integration and enrichment of various datasets as shown in Figure 2 below. Based on the experiences with past research projects such as urbanAPI and Plan4Business we identified the need for more interoperability, exchange of data between stakeholders and the municipality and especially a holistic view on data to consider side effects and impact on others.

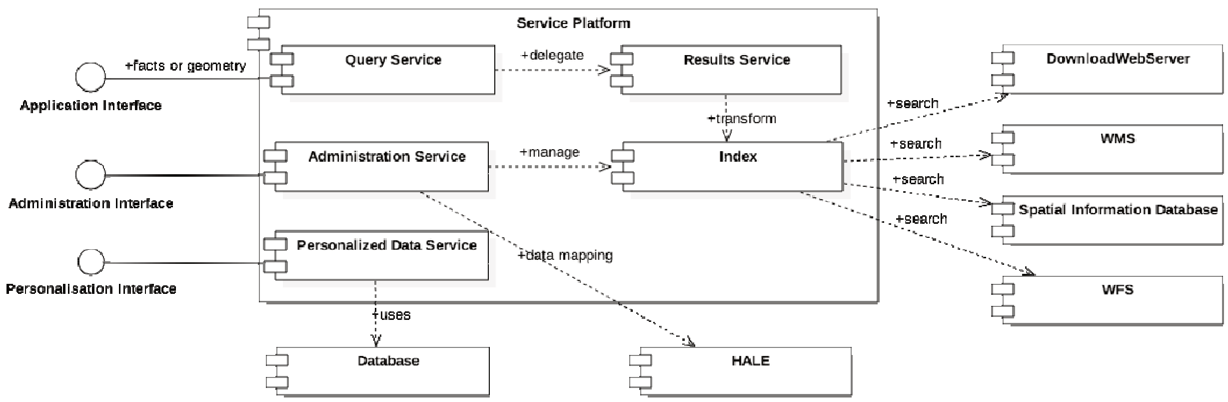

Fig. 2: Smarticipate Data Service Platform components.

The Service Platform is made up of the following parts: Technical interfaces for users and applications

- Application Interface – An interface to data for apps, providing linked data as facts or geometry data. This is the main interface for the aforementioned user interaction
- Administration Interface – An interface for users which maintain contents on the platform or also for integration of new data
- Personalisation Interface – Stores user related personalized data, can also contribute to analysis

On a functional level the platform will be made up by the following parts to be developed

- Query Service – the core to semantically enriched an integrated, holistic data, served in standardised formats like JSON-LD. Different data sets use different vocabularies for describing objects and circumstances. If these should be integrated, a common scheme needs to be developed and described. Technologies based on the Semantic Web initiative will be explored and a fit gap analysis will be carried out matching to requirements of real users.
- Results Service – Can analyse data, can draw conclusions and can check violations of conditions. A rule based query technology enables users to phrase a holistic question to the system. Also users can interact with such rules to work or change data. Which rule based systems are suitable is a question to be answered in the analysis and design phase. Also can enrich the result data set with a context, e.g. provide a complete 3D scenario with buildings related.
- Administration Service – Used to maintain data elements, import of new data and aids in semantically annotating data
- Personalized Data Service – Captures personalised context of users, preferences and settings. Every person has a different set of experiences and therefore a different approach to problems. An integrated semantically enriched system allows to connect different views on the same problems and provides methods to bridge the gap between different understandings or, at least opens up appreciation for the different view of people.
- HALE – Humboldt Alignment Editor is a tool for defining and evaluating conceptual schema mappings. With HALE domain experts will create logically and semantically consistent mappings and consequently harmonize geodata in the smarticipate platform.
- Databases, WMS, WFS, webservers for file downloads and other spatial information databases – The actual data sources for the platform. Contains the raw data, which is processed by the results service.

5.3 Piloting Cities

Three major European cities are committed to the project during the whole runtime: London - the borough of Kensington and Chelsea; Rome and Hamburg. At the beginning several workshops take place in each city gathering the requirements and use cases of each city and thus defining the scope of the developments. When the first usable software is available, an extensive joint piloting phase is started together with citizens, urban planners, stakeholders and the smarticipate team to work with the software under realistic conditions. The experiences made will directly feedback to development and assure the relevance of the software. To have a broad perspective of application each city has a different focus on the piloting use cases. However, the cases of the three cities fulfil common criteria such as:

- The selected used cases support citizens in taking over services from government, or in developing entirely new public services
- smarticipate users will receive direct, instant digital feedback that is customized to his or her own proposal. Used cases will provide the possibility for this kind of interactive relationship.
- smarticipate will provide continuous support and feedback to citizen initiatives; The used cases will not be single or periodic events, but ongoing activities.

Through the pilots and their transfer potential to other European cities, smarticipate will stimulate the creation, delivery and use of new services on a variety of devices, utilizing new web technologies, coupled with open public data.

6 CONCLUSION

Open data portals for spatial data are usually of low usability which is caused by the lack of semantic web technologies. Semantic web technologies could help to improve the usability but also improve the value of open data itself.

But the classical top-down approach imposed by many standardisation organisations and governmental agencies to normative semantics in geoinformation is a barrier for technologies such as the semantic web to be applied in its original sense. Apart from this the technology is very complex and not easy to use. Bottom-up initiatives need freedom of choice what is appropriate in their use case and heterogeneity is what people have to deal with. Easy to use approaches and simple access to data using existing technologies and concepts as search engines, folksonomies, tagging and automated annotation via machine learning should be applied in research projects to cater the needs of the public. Otherwise geodata solutions development will continue to be driven by data or commercial technology, which is a barrier for wide application, thus foiling the intention of any open data initiative on an European level. The goal of the smarticipate project is to find adequate software solutions to publish open data, make the data more visible and searchable and improve the user experience to some extent. In the scope of the smarticipate project the key technology aspects will be included and evaluated with piloting cities in real life scenarios given by citizens and cities.

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Integrative Secondary Education Programmes and Research in Smart Cities Context

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1 ABSTRACT

A smart city can be considered as a specific form of modern city that emphasizes the efficiency of infrastructures by using ICT: many early models equate a smart city with the systemic integration of ICT in e.g. the energy or the mobility sectors – while not considering societal aspects. Innovation is recognized as a key driver in smart city, and thus people, education, learning, research and knowledge gain central importance. This paper sums up the relevant national smart cities activities in Austria and provides an indepth insight into the smart cities activities at the University of Applied Sciences (UAS) Technikum Wien, focusing on gender, diversity and citizen integration in the smart city decision processes. Current steps towards integration of smart cities into research and teaching include recently established smart cities competence team, endowed professorship and the planed smart cities conference in Vienna. Furthermore, the paper is summarizes elaborated educational programs at the UAS Technikum Wien with smart cities focus. Initial base for the smart cities integration in educational and research activities at UAS Technikum Wien has been built within the framework of the European Academic Smart Cities Network (EU-ASCIN) project, with the main goal to establish an Academic Smart Cities Network in cooperation with national and international universities and research institutes. Furthermore, the project allowed to build up professional competence in the area of smart cities oriented education and to expand the training opportunities at the UAS Technikum Wien with smart cities tailored Bachelor's and Master's degree programs. This paper summarizes the project results of the EU-ASCIN project and in particular describes exemplary integration of the proposed educational programs based on practice- and professional field-oriented, diversity-fair approach. Along with the educational approach, UAS Technikum Wien also supports with research and demonstration projects, to guerantee sustainable integration of the smart cities topic at the UAS Technikum Wien. This paper provides information concerning selected, demonstration project "Korneuburg WAY2Smart". The project "Way2Smart" is driven by the intention to live up to its 2036 Vision Statement and Master Plan. The municipality of Korneuburg intends to rehabilitate two municipality-owned residential buildings, densify them by way of superstructures and annexes and equip them with energy-generating areas, and thus at the same time contribute to covering young tenants' demand for affordable small apartments. This paper shows the endeavors to achieve the ambitious objectives in terms of energy and CO_2 saving in Korneuburg by 2036 and concentration on "social togetherness".

Keywords: Smart Cities Master, Smart Cities Education, Smart Cities Research , Smart Energy, Smart Mobility

2 INTRODUCTION SMART CITIES TRENDS

The importance of smart city topic has been stated by the European Energy Research Alliance (EERA) project, Joint Programme on Smart Cities: "As urbanization is progressing worldwide and due to the fact that almost two thirds of our energy is consumed in urban environments, intelligent cities will play a significant role for the complete and successful implementation of the EU Strategic Energy Technology Plan" (Bach, et al., 2014). The subject of smart cities is being broadly discussed not only in the domain-specific mobility, energy and ICT context but also in the educational and research-related fields. Simultaneously in Austria much attention is devoted to the smart cities topic. Cities in Austria are constantly evolving and need to reinvent themselves continuously to maintain the high quality of living. The European framework strategy Europe 2020 defines a roadmap for the economic development across the region, in order to a create smart, sustainable and inclusive economy (Manville, et al., 2014). Since 2010, Austria has been focusing on the support of comprehensive urban demonstration and implementation projects related to the smart city. The Austrian Climate and Energy Fund and the Federal Ministry of Transport, Innovation and Technology (BMVIT) published the technology program "City of the Future", which is striving for the development of new technologies, technological subsystems and urban services for the city of the future (Climate and Energy Fund 2011). In the last few years, the importance of citizen participation and social inclusion has increased. With a clear message: cities can only be smart if all residents have access to the same degree of participation. This is a key factor playing a central role for urban development. Austria is a leading country with a high degree of social participation, which is endorsed by international rankings and studies in the past. As a smart city, Vienna, the capital of Austria, takes account of the different urban living environments and realities of women and men. Comprehensive equality of a political, social and economic kind is a key element to ensure quality of living. The University of Applied Sciences (UAS) Technikum Wien Austria's largest purely technical university of applied sciences contributes to these goals. UAS Technikum Wien has not only an obligation towards society, industry and business to provide innovative and pioneering instruction, but it also needs to deal with the diversity of the people who work and study at the institution in a responsible manner and must make the resulting potential and opportunities available to all those involved. The UAS Technikum Wien is an educational institution for men and women of different ages, of different origins, nationalities and native languages; with a variety of social backgrounds, family compositions and commitments; with individual needs and opinions, capabilities, skills and potential. In March 2013, UAS Technikum Wien decided to define Gender and Diversity guidelines for research and education activities. In order to derive the greatest possible benefit for students and instructors, everyone who works or studies at the university of applied sciences needs to be familiar with these topics. For this reason, UAS Technikum Wien integrates gender and diversity aspects in the contents and processes of instruction and learning (UAS Technikum Wien, 2015)

2.1 Endowed professorship

Described aspects are also considered in the research projects of the UAS Technikum Wien. One example is the endowed professorship. Relating to the subject of Energy Performance of Buildings Directive (EPBD) which requires that all new buildings to be nearly zero-energy by the end of 2020 (EPBD 2014), the user's behaviour and diversity are the main foci, which are not yet integrated in the daily building planning process. A fundamental re-orientation of teaching in the area of buildings and building blocks is required. UAS Technikum Wien has the aim to implement new teaching methods for building and building blocks in the current Master's and Bachelor's degree programmes. Users comfort, user friendliness and internal gender mainstreaming are understood as central features of sustainable buildings. Especially in the areas of comfort-elasticity, usability, dynamic simulation of buildings, facilities and neighbourhoods and life cycle analyses of neighbourhoods run application-oriented research and the results are processed and embedded in teaching.

2.2 Smart Cities Competence Team

To support the smart city activities at the UAS Technikum Wien and to support the gender and diversity concepts in education, a proposal for its own smart cities competence team has been submitted and successfully funded by the municipal government of the City of Vienna. The main objective of the competence team for Intelligent Technologies in Smart Cities (KiTSmart) is to develop smart cities related courses and support scientific dissemination in the research community (UAS Technikum Wien 2016) and considering the gender and diversity aspects.

3 SMART CITIES IN EDUCATION AT THE UAS TECHNIKUM WIEN

The initial attempt to develop competence at the UAS Technikum Wien in the area of the smart cities was started as the research project, funded by the municipal government of the city of Vienna. The European Academic Smart Cities Network (EU-ASCIN) project had several goals. On one hand to support implementation of the Smart City Wien Framework Strategy through design of the new study programmes and educational concepts, which fill the gap in the area of the citizen activation. On the other hand, to encourage and support the development of sn academic dimension of smart cities in central Europe. Within the framework of the project first attempts for integration of the smart cities subject into the existing study programmes has been performed.

In the first step it was decided to build up smart cities using the synergies between existing mobility and energy specific educational programmes (Bululukova und Wahl 2015). However, while the previous approaches e.g. existing Bachelor's degree programmes Transportation and Environment or Renewable Energy Technologies are strongly domain specific, the proposed smart cities educational focus is built on the intersection of these disciplines, providing inter-domain knowledge. The teaching concepts, subjects as well as lecturers from both mobility and energy domains are strongly involved in the design and implementation of the smart cities specialisation. After choosing the smart cities module within the Bachelor study, the students gain some insight into more general concepts of smart cities. Subsequentlt, the Master's degree programme in smart cities provides more specific subjects on technical, social and economic aspects of smart cities.

3.1 Transport and Environment

The integration of the smart cities topics into the existing Transport and Environment Bachelor Programme is performed as one of the 4 selectable specialisations, which include Smart Cities, Intelligent Transport Systems, Electric Vehicles Technology and Transportation Planning. The smart cities specialisation was designed to meet the requirements of the City of Vienna strategy concerning interdisciplinary education (shown in Table 1).

Specialization Courses	**Learning Outcomes**
Socio-Technical Aspects of Smart Cities (3 ECTS)	Students are able to point out impacts and benefits of considering gender and diversity aspects within crossover of mobility, energy, and ICT in smart cities
Smart City Influencing Factors (3 ECTS)	Students are able to describe smart cities as a concept, to compare different implementations of smart cities in an international context and to define the interactions between urban planning, mobility, building, industry and energy planning
Big Data in Smart Cities (3 ECTS)	Students are able to analyse and explain challenges posed by Big Data, its sources and its potential impact for specific domain of smart cities, makes use of suitable tools for basic Big Data tools and frameworks
Urban Energy Supply Systems (3 ECTS)	Students are able to define influencing factors on the urban energy demand, to compare energy systems used in urban environments and to work with modelling and scenario development tools

Table 1: Specialization courses and the learning outcomes

3.2 Urban Renewable Energy Technologies

The Urban Renewable Energy Technologies provides smart cities specific topics within the 4th and the 5th semester as one of the three specialisation tracks: building energy design, large-scale plants and integrated energy technologies. The subjects within the smart cities specialisation start with a more general overview in the 4th semester, with such topics as integrated design of urban technological energy projects, energy networks design in urban areas and the user behaviour with strong emphasis on diversity. The continuation of the smart cities topic in the 5th semester provides more complex insight into technological concepts, urban administrative frameworks and area specific planning concepts. The courses offer the possibility of hands on learning, including the planning process for small smart city projects, e.g. such as building refurbishment.

3.3 Integrative Urban Development - Smart City

The new smart city Master's degree programme is the main step for smart cities integration at the UAS Technikum Wien. Prior to the implementation of the curriculum, an extensive feasibility study of the smart cities domain has been performed. Considering the prospective employment possibilities, several key areas could be identified, including i) infrastructure planning implementation and maintenance ii) management and urban planning such as city administration iii) industry such as technology in mobility and energy domains iv) services such as education and consulting.

Based on the identified employment sectors, the requirements on the educational programme could be elaborated.

According to the UAS Technikum Wien strategy of outcome-oriented learning concepts, several relevant outcome oriented goals have been defined for the new Master's degree programme. After the completion of the Master's programme students should be able:

- To develop inter-domain urban services and business models based on the intersection of mobility, energy, and ICT
- To design integrative urban development objectives in a socio-technical context, to perform current state analysis and to implement required measures
- To analyse urban systems under consideration of social aspects

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Editors: Manfred SCHRENK, Vasily V. POPOVICH, Peter ZEILE, Pietro ELISEI, Clemens BEYER

- To specify and simulate overarching use cases in smart cities
- To develop and implement participatory planning concepts
- To assess regulatory and interface-specific, such as standards and norms at regional, national and EU-wide level.

The technical skills within the new Master's curriculum can be subdivided into introductory modules and selectable tracks (shown in Table 2). The purpose of the introductory modules is to compensate the missing basics for students with few to no smart cities related background, since it is planned to diversify the student groups. To support the inter-domain approach students have the possibility to deepen their interest in one or several hands on projects. The economic and social skills courses round up the curriculum with innovative trends and business models within smart cities context.

The general split in ECTS between the areas of expertise, can be summed up into following core subject clusters: i) smart cities related project work (12 ECTS), ii) scientific Methodology and Tools (36 ECTS), iii) Smart Cities Domain Basics (introductory courses) (6 ECTS), iv) Smart Cities Core Competences (48 ECTS), v) Socio-Technical skills (12 ECTS) vi) Economic, management and legal foundations (6 ECTS).

Selectable Track	**Contents**
Urban Housing	Densification in urban areas, energy-based renovation
Trends in urban energy supply	Technological trends in the energy supply of modern cities
Physical Measurement-Methods	Measurement technology of physical smart cities characteristics
Embedded Systems	Internet of things, sensor data
Human factors in modern transportation	The human factors and transportation safety
Greenhouse emission reduction	Methods and concepts for reduction of the CHG
Urban logistic systems	Technology in urban logistics and fleet management
Electric vehicles	State of the art in battery technology and electric vehicles
Sensors and Control Theory	Sensor data measurement and usage in control theory, control engineering technology
Distributed and dependable systems	Sensor networks and distributed computing
Urban lighting technology	Lightning technologies for urban lighting
Image-processing	Applied image processing
IT Security in Energy and Mobility	IT security concepts in energy and mobility domains
eHealth	Integration and usage of connected medical IT infrastructures, crowed-sources healthcare
Big Data	Technical concepts in Big Data, semantic knowledge and linked data
Autonomous Driving	Technology for autonomous vehicles and navigation
Cooperative Systems	Car to car, car to infrastructure communication

Table 2: Selectable Track and contents

The described smart cities Master's programme has been approved by the official governmental body and will take place for the first time in winter semester 2016/2017 as part-time Master's Programme in German.

Smart Cities Conference

As major outcomes, the results will be continuously presented at the "International Research Conference on New Urban Smart Energy and Mobility Concepts - First User Experiences" which is organised by EU-ASCIN. This conference is aiming to bring together the research community of European smart city experts with focus on already realised concepts in energy and mobility. Researchers from universities and research centres, who are involved in smart city developments and demonstrations, will discuss the experiences of users, the acceptance of the citizens, and further developments. The two days conference will be supported by the City of Vienna and will take place at the Vienna City Hall in winter 2017. The UAS Technikum Wien takes over the scientific lead of the conference. The conference will be completed by an on-site visit to the Aspern Vienna's Urban Lakeside.

4 SMART CITIES IN RESEARCH AT THE UAS TECHNIKUM WIEN

In addition to the implementation of the new study programmes UAS Technikum Wien is also working on demonstration projects. One of these projects is in a small town Korneuburg near Vienna, with about 12,000 inhabitants. Until 2036 the forecasts predict at least 50 % increase in population of Korneuburg. To meet the needs of a growing city - citizens, politicians and administration - planned Korneuburg's path to 2036: with ambitious objectives in terms of energy and CO2-saving and concentration on "social togetherness". The municipality of the town decided to start a big participation-project in the year 2011 to define a Vision Statement and a Master Plan for its urban development. Driven by the intention to live up to its 2036 Vision Statement and Master Plan, the municipality of Korneuburg intends to rehabilitate two municipality-owned residential buildings (shown in Figure 1), densify them by way of superstructures and annexes and equip them with energy-generating areas, and thus at the same time contribute to covering young tenants' demand for affordable small apartments. Many people, mainly from Vienna, like to come and live here because of the high quality of lifestyle – the "green area" next to Austrian's capital. But the community area is rather small, densification is the only way to increase housing - so that the small town will become a small city. Ambitious goals need smart people to reach them – „Korneuburgs Way2Smart" is the first step to a smart city. To reach the ambitious goals concerning energy efficiency, carbon-neutrality and affordable housing and living space, as well as eco-efficient mobility Korneuburg needs to inspire the citizens to join that „Way2Smart" as a step to fossil fuel independence. As accompanying measures, they offer a communications programmes involving the existing and new tenants of the building, as well as further development – because neighbourhood is a big factor for quality of lifestyle. Last, but not least, mobility measures like e-car sharing, a hitch-hiking-station, good cycle-parking etc. create the possibility to be mobile without a private car. Ultimately, the endeavours to achieve the ambitious objectives in terms of energy and CO2 saving in Korneuburg by 2036 are to be documented in a database in such a way as to make the individual measures available as models and stimuli for comparable projects in the town.

Figure 1: The two municipality-owned residential buildings to be rehabilitate (HuB architekten ZT KG 2013)

The three years project is funded by the Austrian Climate and Energy Fund, with a strong consortium composed by grid operators, energy planners, mobility planners and architects, but also the municipality of Korneuburg. The specific goals of the project are the rehabilitation of two municipality-owned residential buildings and the creation of a mobility hub in the area of the rehabilitated objects and thus create alternatives to the use of private cars. In this prototype housing scheme, affordable small apartments are to be provided to young tenants in a targeted manner. In this context, the state-of-the-art of what is currently technically feasible shall be demonstrated. As accompanying measures, (i) communications programmes are to reconcile measures and needs of existing and new tenants on a level-playing field with experts. The main goal here is to achieve acceptance for rehabilitation measures as well as self-organisation. (ii) Tenants and other citizens will be informed of and mobilised for the objective of the energy-self-sufficiency of Korneuburg. (iii) Property developers are involved in the process which is monitored by social scientists. With regard to the town's ambitious objectives in terms of energy and CO2-saving, these exemplary measures will ultimately be prepared and documented in a database in such a way as to make the individual measures available to Korneuburg and other towns and cities as models and stimuli for comparable projects.

5 CONCLUSION

This paper provides a deeper insight into the design of the new study programmes and educational concepts of the first smart cities specific practice-oriented education at UAS Technikum Wien. It sums up current status quo of the project with already accomplished milestones, including integration of smart cities into Bachelor degree programmes and development of an independent smart cities oriented Master's programme. Detailed insights into occupation research, as well as gender and diversity sensitive topics are provided. Furthermore, the paper presents the demonstration project "Korneuburgs way2Smart". The goal of the projects to provide an exemplary fashion of the two buildings that are to be rehabilitated and offer housing for young people, informed and motivated existing and new tenants, enhanced local traffic, documented progress towards achieving the Korneuburg 2036 Vision Statement and Master Plan. In addition guidance will be prepared with the cooperation of property developers, which is to serve as a tangible example for further projects. The next step at the UAS Technikum Wien may be to develop an "Open Energy City Database", which combines the data from the surrounding infrastructure environment with energy data in a standardised web-based interface. Another goal is also to demonstrate possibilities for urban planning and urban neigbourhood development with a view to creating a path to a low carbon city with a high quality of life and good resilience, while taking into account existing and proposed buildings, infrastructures and uses. In additional the development of a future-oriented overall concept for housing and mobility near the train stations is also a focus of the UAS Technikum Wien.

6 ACKNOWLEDGEMENTS

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reviewed paper

Intelligent Development Research on Job-Housing Space in Chinese Metropolitan Area under the Background of Rapid Urbanization

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1 ABSTRACT

Under the impact of regional integration and rapid urbanization, Chinese metropolitan area is confronted with the pressure brought by further massiveness, high density and continuous development. The existing layout of job-housing space balance in cities has been further spread and aggravated, which leads to a series of problems including traffic jams and air pollution, etc. This thesis excavates, analyzes and integrates the city residents' action trajectory data in various heterogeneous cities through the intelligent transportation data platform of metropolitan area. Furthermore, the research also extracts the intelligent knowledge on the aspect of urban job-housing space, identifies and analyzes its characteristics effectively.

This thesis takes Beijing-Tianjin-Hebei metropolitan area as the research object to carry out intelligent analysis on working and residential space in main cities. We can identify residents' commuting behaviors with multi-source location perception data. Firstly, the GPS trajectory data of large-scale taxi will be utilized, and the transportation behaviors and characteristics of taxi will be assumed as the urban residents' trip behaviors. Then the research of urban space-time structure and residents' activities hot spots will be carried out from the macro perspective. Secondly, a residents' trip survey method combining mobile phone location and internet feedback will be put forward. Aiming at the location Microblog data, the characteristics of residents' workplaces and residences could be identified with fuzzy mathematical method. During the identification process, the individual behavior patterns obtained from the resident trip survey data will be used as the recognition feature.

Through the analysis, We discovered that the data mining method of the residents' action trajectory is feasible for the study of job-housing space. The study shows that the key factor influencing the job-housing balance in metropolitan area is the improvement of disperse urbanization life-style which takes family as a single unit. It also puts forwards the future ternary development mode of "employment-residence-public service" of job-housing balance in Chinese metropolitan area. The research also discovers a measurement method of excess commuting to develop the commuting efficiency in job-housing space. Furthermore, through the research on excess commuting degree of main cities in Beijing-Tianjin-Hebei metropolitan area by utilizing the commuting behaviors extraction result of Microsoft data, the correlation factor of characteristic attributes and job-housing separation phenomenon in urban community could be found. Finally, the intelligent development characteristics of job-housing space in metropolitan area will be discussed by combining the geographical visualization method and taxi trajectory mining result.

Keywords: development research, intelligent, job-housing space, metropolitan area, rapid urbanization

2 WISDOM DEVELOPMENT: A NEW CHALLENGE FOR JOB-HOUSING BALANCE IN METROPOLITAN AREAS OF CHINA

2.1 Rapid evolution of spatial form in metropolitan areas

China's urbanization is entering a period of rapid development, and it took only 30 years to increase the urbanization rate from 17.8% in 1978 to 56.1% in 2016. The significant increase of the population size in metropolitan areas has brought about rapid expansion of urban space. Figure 1 shows the increasing trend of urban built-up areas and the changed situation of population density in China. During the period from 2001 to 2011, the area of urban built-up area in China has increased year by year. However, the change of population density is opposite to the outward development tendency of urban form. More employed population are flocking to the core area of the metropolis, which reflects the gap of population job-housing balance between the peripheral city clusters and the core areas in the metropolis.

Continuous and rapid urbanization results in China's urban Agglomeration region, especailly Beijing-Tianjin-Hebei metropolitan area centered on Beijing and Tianjin, facing tremendous pressures of mega-development, high density and continuous development (Fig.2). With the horizontal or vertical division of labour focusing on different links between different industries or the same industry in various cities within the area, the spatial agglomerations of the emerging functional areas have become the dominant form of the social and economic factors of spatial movements in the metropolitan areas. The second industry and the third industry are developing in the areas with superior location conditions, high level of productivity and resource conditions, which promote continuous generation of new urban areas, and attract a large number of workers to concentrate here. With the increase of employed population, employment and living spaces are rapidly expanded. However, the construction level of the regional transportation infrastructure is relatively backward, resulting in the increase of residents' job-housing commuting distance. They have to shorten the job-housing commuting time by relying on operation efficiency improvements of the regional traffic network. Energy consumption of a large number of commuting tools leads to the deterioration of the ecological quality of the environment in the metropolitan area, such as the high haze index, excessive water pollutant content and frequent traffic safety accidents. Therefore, the path choice of China's new urbanization must rely on solving the unbalanced relationship between job and housing, in terms of defining the spatial development priority of metropolitan areas and guiding the layout of urban functions.

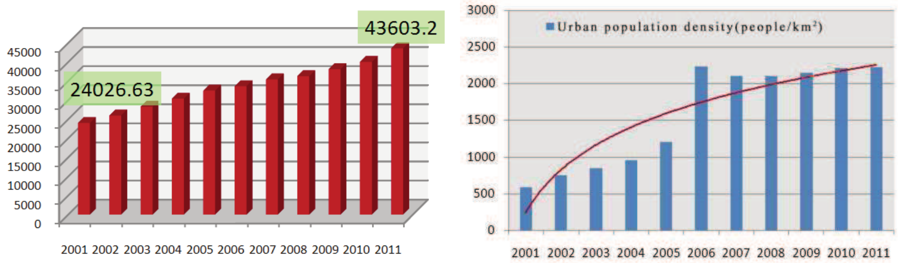

Fig. 1: China's urban area and the density of urban population growth (2001-2011).

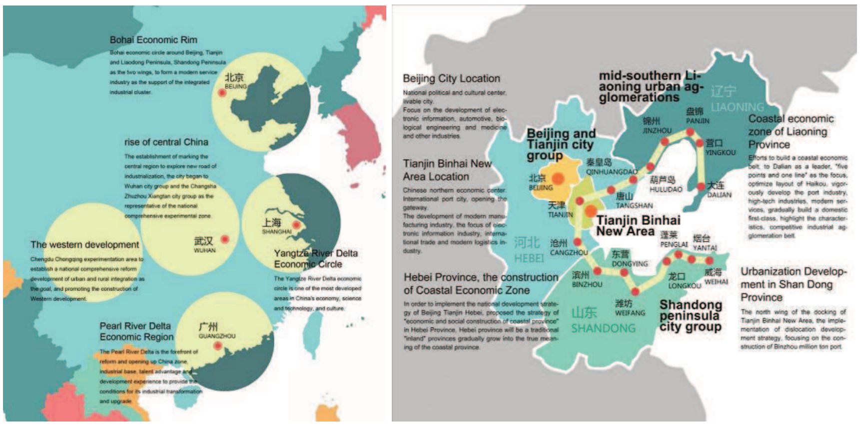

Fig. 2: China's high density city cluster distribution and link bohai sea three urban agglomerations.

2.2 New urbanization and job-housing imbalance

In 2014, the Chinese government issued the National New Urbanization Plan (2014 - 2020) to define and guide the path of new urbanization. In future, China will reduce the large-scale "population migration of migratory birds", and advocate "the nearest urbanization". However, considering Chinese society which emphasizes family ethics and clan etiquette, research of new urbanization is expressed more as a problem of job-housing imbalance based on the core unit of the Chinese family. In the process of urbanization of China's metropolitan areas, and taking into account the daily living activities in urban and rural areas of family members, unreasonable separation emerged between family members in urban and rural areas, city and city, or within the core areas of metropolis, with the result that they could only meet with each other once a week, a month, or even a year. Alternatively, although family members live together every day, the spatial locations of their employment, living and public service activity are highly scattered, which is leading to overlength commuting distances. Two types of dissociated families have arisen in the process of urbanization which could be classified from the perspective of spatial scale of the job-housing imbalance in the metropolitan area, as urban- rural dissociated and Inter-city dissociated. This spatial separation formed during the process of urbanization at the micro level led to imbalance between employment, living and public services. Serious job-housing imbalance resulting in multiple land source occupations, frequent travel consumption or the absence of family love, will affect the urbanization process and family quality of life.

2.3 Smart city: the interpretation of job-housing balance

Urban traffic congestion in Chinese metropolitan areas has increased average commuting distance and time of residents. An intelligent method must be developed to study the structure and characteristics of the job-housing space. For example, the average commuting distance of the personnel who work in the centre of Beijing has been lengthened from 9.7km/time in 2004, to 17.1km/time in 2015, and the average commuting time has been extended from 36.5 minutes in 20014 to 58.2 minutes in 2015. With the improvement of China's urban information infrastructure, it is possible to collect and process the data of urban residents' behaviour on a large scale. Internet of things, GPS terminals, smart phones, municipal information and other urban data collection facilities are gradually applied to the study of smart city. On the basis of obtaining abundant spatial data of urban job-housing space, the overall information contained in the city perceived big data is utilised to interpret the spatial structural characteristics of the city, which is conductive to quickly grasping the inner mechanism between residents' commuting behaviours and urban job-housing spatial characteristics, so as to optimize the urban and rural spatial planning layout within the metropolitan area.

Therefore, this paper utilizes the intelligent data technology to obtain the multi-source perceived data of residents in metropolitan area on the basis of semantic trajectory data model, such as the typical passive group perceived data including taxi vehicle-mounted GPS data as well as the spatial and temporal social media data. The activity behaviour and the characteristics of the taxis will be assumed as the residents' travel behaviour to carry out the studies on urban job-housing spatial and temporal structures and residents' travelling spatial and temporal hot spots from the macro perspective.

3 MULTI-SOURCE TRAJECTORY DATA ACQUISITION AND PROCESSING OF RESIDENTS' COMMUTING BEHAVIOURS

Data acquisition path of residents' commuting behaviour

3.1.1 Taxi-mounted GPS data

There are two types of significant information in the taxi GPS data: One is the origin destination (0D) information extracted from the boarding and alighting record of extraction, the other is the movement trajectory information of taxi in road network. 0D information only records the starting point and end point of passengers' travel, while ignoring the path information in the travel process. From the perspective of the study on passengers' behaviour, 0D information represents the relation between people's behaviour and its location. Conversely, the movement trajectory records the continuous positions of the moving vehicle. It includes the places of both departure and destination, and also objectively reflects the road traffic conditions, such as distance and congestion. This paper studies the Beijing-Tianjin metropolitan area (Fig. 3), which mainly contains the two major cities of Beijing and Tianjin. The permanent resident population size in this metropolitan area is 41,205,900, among which 21,516,000 in Beijing and 15,168,100 in Tianjin. There are 83,917 taxis in Beijing and Tianjin, and the average daily passenger trips are 2,730,000. At present, the taxis in this area are generally equipped with GPS and taximeter, which will transfer the data including the vehicle number, time, latitude and longitude and operational status to the dispatching centre to form massive data sources. The data formats are shown in Table 1.

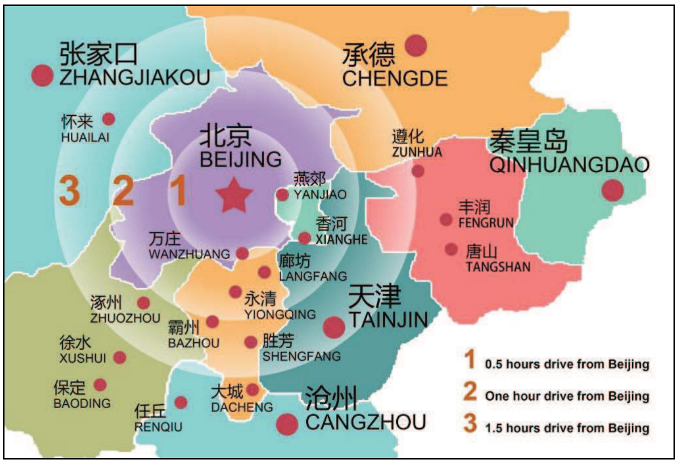

Fig. 3: The composition of beijing-tianjin-hebei metropolitan area.

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Space scale	Urban- rural discrete	Inter-city discrete
Taxi-id	Character varying(10)	The vehicle's only logo
GPS time	Timestamp	The quantitative data set time
Location	Geometry(Point, 4326)	Data point location
Flag	Integer	With the direction of the geographic North Pole Angle, which is divided into eight direction
State	Integer	0 means no load, 1 means passenger, 2 means status is unknown

Table 1: The taxi data table structure.

Field name	Type	Note	Sample
Id	Serial	The only number of record	1
Taxi_id	Character varying(10)	The only number of vehicle	523938
Trajectory	Geometry (LineString,4326)	Vehicle trajectory	LINESTRING(121.51215 31.2304,⋯)
Time_o	Timestamp	Zero hour	2015-12-09 01:11:03
Location_o	Geometry (Point,4326)	Zero point location	POINT(121.51215 31.2304)
Time_d	Timestamp	D some moment	2015-12-23 01:18:59
Location_d	Geometry (Point,4326)	D point location	POINT(121.48077 31.2217)

Table 2: OD table structure.

The data acquisition time periods utilised in this study are the whole days of two operation weeks from December, 9th, 2015 to December 23rd 2015. The original GPS data is generated and provided by 32,258 taxis. The taxi-mounted GPS collects the current location every 20 seconds to generate 84,896,382 location records. After the preprocessing of the problem data that can be used, the taxi samples available for the analysis are 14,839, and 48,758,408 records in total. Then the taxi OD is extracted by combining PostgreSQL/PostGI database environment and the Net. programming environment to form the travel OD Table (Table 2). Finally, the visual matching will be carried out between the taxi trajectory data and the figure of road vector data, township boundary data and the current land application situation in the metropolitan area. After a preliminary statistical analysis on the OD point data of taxis in the villages, towns and districts, OD quantitative classification statistical diagram (Fig. 4) is obtained, which could intuitively understand the spatial distribution of passengers' boarding/alighting.

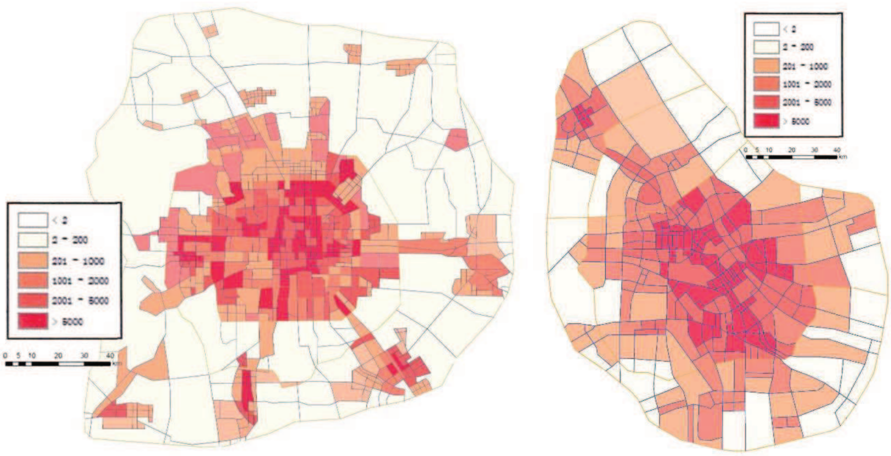

Fig. 4: The OD quantitative classification statistical diagram (Beijing and Tianjin).

3.1.2 Space-time social media data

There are 6,320,000,000 netizens in China in 2014, and the coverage rate of Micro-blog among the netizens has reached 43.6%. Many micro-blogs are posted from the users' intelligent terminals. The locations of an individual or a good could be obtained by means of built-in GPS and other location awareness support equipment of mobile devices, which allows the micro-blog data with the location awareness function. This provides an excellent opportunity for researchers to extract the information for micro-blog social data. This study takes the API interface provided by the Sina Micro-blog open platform as the core means of data crawling and utilizes the location service interface and the users' reading interface to write the crawling program. The program flow is shown as Fig. 5. Through the above-mentioned micro-blog crawling program, the data collection space is set as Beijing-Tianjin-Hebei metropolitan area, and the time horizon is set as the period from August 1st, 2015 to January 1st, 2016. 4,174,518 Micro-blog data from 104,715 Micro-blog users is grasped. Then the statistics on the number of individual users to publish the location micro-blog is carried out to discover the characteristic conforming to power-law distribution. Conduct the data with visualization technology to obtain the spatial and temporal distribution characteristics of micro-blog location data. The classic density clustering algorithm DBSCAN is utilized to cluster the position micro-blog, so as to study the commuting travel and job-housing spatial pattern contained in the data.

3.2 Commuting behaviour information mining based on multisource trajectory data

3.2.1 The job-housing space analysis based on the taxi movement pattern

Taxi trajectory has natural temporal and spatial attributes. The analysis could be carried out from the spatial and temporal patterns for the clustering results obtained from the clustering method. Firstly, some statistical indicators could be utilized to mine the spatial and temporal patterns related to the taxi traffic in each cluster. And then conduct the related features with spatial and temporal visualization so as to evaluate the residents' travel characteristics in relevant regional and urban areas. Secondly, the movement trajectories of taxis of each cluster are utilized to evaluate the connectivity and connection degree of the regions. This study takes the commuting behaviour as an example to mine the related temporal and spatial patterns. The characteristics of the taxi origin destination are utilised to describe the job-housing situation in an area so as to put forward the concept of job-housing factor, which is as follow:

$$JRF = \frac{\text{inflow}_m \times \text{outflow}_e - \text{inflow}_e \times \text{outflow}_m}{\text{totalflow}_m \times \text{totalflow}_e}$$

In the formula,

$$\text{totalflow}_m = \text{inflow}_m + \text{outflow}_m$$

$$\text{totalflow}_e - \text{inflow}_e + \text{outflow}_e$$

Where, inflowm represents the flow of the taxis entering into this area in the morning, inflowe represents the flow of the taxis entering into this area in the evening, outflowm represents the flow of the taxis driving out from this area in the morning, outflowe represents the flow of the taxis driving out from this area in the evening. When the taxis driving out from this area dominate in the morning, whereas driving into this area dominates in the evening the job-housing factor in the interval of [-1,0), which indicates that this area has the characteristics of residential area. When the factor is closer to -1, its characteristics of residential area is more obvious. On the contrary, if the taxis driving in this area dominates in the morning, whereas driving out from this area dominates in the evening, the job-housing factor(JRF) in the interval of (0,1], which indicates that this area has the characteristics of job area. When the factor is closer to 1, its characteristics of job area is more obvious.

According to the trip survey data of residents' in Beijing-Tianjin-Hebei metropolitan area by statistics department, the single commuting time by taxi is about 30 minutes. The on duty period of this survey is from 5:30 to 9:30, and the off duty period is from 15:30 to 19:30. Taxi trajectories in the two periods accounte for 43% of the total number of the whole day. Then the inflow, outflow, and totalflow of each cluster are calculated, based on which job-housing factor of each cluster could be obtained. According to the statistical histogram of the calculated results, concluded that the job-housing factors in the study area present a significant normal distribution. Its mean=0.05, and standard deviation SD=0.2. If the area of which the job-housing factor is bigger than 0.2 is set as the job area, smaller than 0.2 is set as residential area, in the interval of [0.1,0.2] as job area to be, in the interval of [-0.2,0.1] as residential area to be, in the interval of (-0.1,0.1) as balance area, the job-housing area distribution figure could be obtained. (Fig. 6)

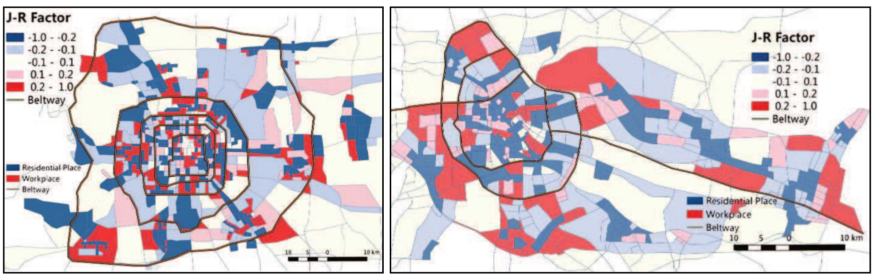

Fig. 6: Job-housing factor classification statistics and regional distribution.

3.2.2 Identification of job-housing space based on social network data

According to the residents' space-time social micro-blog data obtained in 3.1.2, the job and housing sites in this area could be calculated. Take the centre of gravity of each site as the midpoint, which is taken as the centere of a circle. Take 500 meters as the radius to make a buffer to record the land-use type and area in each buffer. Match each resident's residence and job to the street scale so as to form a commuting network (Fig. 7). Each vertex in the network represents the street scale of each resident's housing and job areas, and each edge represents the connection of each resident's housing and job areas. V represents the vertex, and E represents the edge to regard the commuting network as the concept of Figure (G) in a mathematical sense, which could be expressed as G(V,E) with mathematical symbols. There are 417 vertexes and 9211 edges, and the figure density is 0.473 in Network G. This shows that the commuting behaviors don't exist in all areas between two streets. In fact, most commuting behaviors occur in the area of several streets and form internal commuting subsystem (the node of the same color in Fig. 7). The commuting flow between the nodes is different. How the important commuting nodes in the network can be found in the network is through the control of flow, so as to further identify the the job-housing space characteristics of the area.

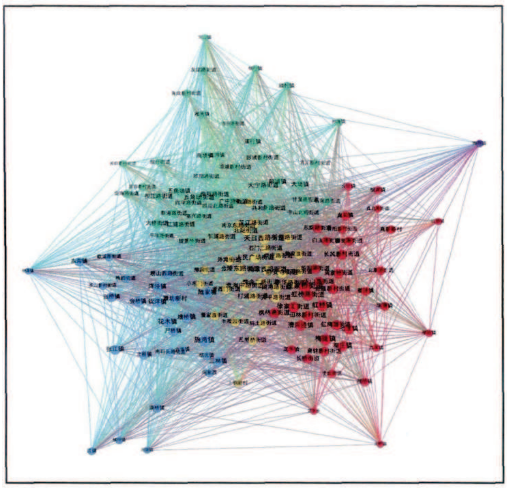

Fig. 7: Commuting and main node distribution network.

4 A STUDY ON THE CHARACTERISTICS OF THE JOB-HOUSING SPACE IN BEIJING-TIANJIN-HEBEI METROPOLITAN AREA BASED ON COMMUTING BEHAVIOUR

4.1 Study on commuting efficiency of Beijing-Tianjin-Hebei metropolitan area

Since the data acquisition process of Chinese commuting efficiency study is seriously affected by the administrative units and organizations, the survey scale always adopts the administrative division of villages, towns, streets, districts and counties. The areas are mostly above 10km2, and the scale is large. This paper adopts two spatial analysis units of the real estate plate (REP) and traffic zone (TZ). The scale of the real estate plate size is relatively large, and the area is usually in the interval of 10 and 100km2. Traffic zone is the results obtained through the taxi OD cluster. The scales of each area could be controlled by changing the parameter of the clustering algorithm, which are usually in the interval of 1 and 10 km2. In this paper, the real estate plates are 297, and the traffic zones are 1649.

Set two conditions: (1)Residents' jobs and housing units are homogeneous and same. (2)Residents can freely exchange job and housing locations. For all the residents of this city or area, there should be a minimum required commute (MRC) in theory, which is an optimal value in job-housing balance. The value of MRC is generally smaller than minimum required commute (MRC). At the same time, there should be a difference value between the maximum required commute (MaxRC) and MRC under the established spatial distribution, which is called excess commute (EC) to represent the job-housing imbalance degree in a city. After confirmation of the minimum spatial analysis unit on the basis of the two concepts of ARC and MRC, The following formulas are utilized to measure the commuting efficiency and job-housing balance condition:

$$E = \left(\frac{ARC - MRC}{ARC}\right) \times 100\%$$

$$C_u = \left(\frac{ARC - MRC}{MaxRC - ARC}\right) \times 100\%$$

Where E is the excess commuting efficiency, which is used to represents the proportion of excess commuting in actual commuting of the metropolitan areas. It shows the theoretical minimum required commute provided by the job-housing imbalance degree relative to the existing job-housing distribution. Cu is the commuting capacity usage rate, which reflects the commuting proportion of excess commuting and job-housing separation in the worst case of the metropolitan area. The smaller the value of Cu, the higher commuting efficiency will be, and the job-housing balance will be better. In the unified evaluation standard, the balance situation of various cities in the metropolitan area could be evaluated and compared. This paper establishes a OD spatial distribution matrix and a shortest spatial commuting matrix on the basis of actual data in two scales of REP and TZ respectively. The former identifies the commuting population in arbitrary two areas, and the latter identifies the shortest commuting distance in arbitrary two areas.

REP_h	REP_j					
	1	2	3	4	…	297
1	272	0	73			0
2	26	221	0	0		0
3	0	1	50	0		0
4	5	0	0	32		0
…	…	…	…	…	…	…
297	0	0	0	5		12

Table 3: The start-end point spatial distribution matrix in REP scale.

TZ_h	TZ_j					
	1	2	3	4	…	1649
1	11	0	27	7		0
2	0	8	0	1		5
3	6	13	7	3		0
4	3	0	4	6		8
…	…	…	…	…	…	…
1649	0	9	0	0		5

Table 4: The start-end point spatial distribution matrix in TZ scale.

REP_h	REP_j					
	1	2	3	4	…	297
1	2.7	4.95	7.11	8.81		17.81
2	3.66	1.73	0.69	4.96		13.51
3	7.18	0.96	3.31	6.65		9.92
4	6.48	12.81	2.73	1.77		6.53
…	…	…	…	…	…	…
297	16.31	17.47	10.11	5.38		13

Table 5: The shortest commuting matrix in REP scale.

TZ_h	TZ_j					
	1	2	3	4	…	1649
1	0.68	1.15	1.37	1.49		0.94
2	1.17	0.93	1.19	2.07		2.77
3	1.44	1.86	0.71	1.91		3.61
4	2.15	2.32	1.58	0.81		1.79
…	…	…	…	…	…	…
1649	1.98	2.77	3.32	1.87		1.36

Table 6: The shortest commuting matrix in TZ scale.

Objects	Samples	ARC		MRC		MaxRC		E		Cu	
		REP	TZ	REP	TZ	REP	TZ	REP	TZ	REP	TZ
Beijing	216884	7.4	8.5	4.2	2.8	22.8	33.2	43.2	67.1	17.2	18.1
Shanghai	115731	8.1		3.0		37.3		64		17	
Tianjin	91680	7.5		3.0		10.5		71		18.9	
Xian	59967	5.1		4.0		14.6		21		11	
Guangzhou	15000	5.0		2.7		13.5		44		23	

Table 7: Commuting efficiency compared with other cities.

Table 7 compares the commuting efficiency in Beijing and Tianjin with other cities. It is found that the job-housing balance and commuting in Beijing-Tianjin-Hebei metropolitan area possess the following characteristics: (1) On the perspective of the actual required commute, the job-housing balance under TZ scale in Beijing is the worst, which is higher than Tianjin, however it is lower than Guangzhou and flats within Shanghai. (2) As for the commuting efficiency index E, the job-housing balance under the scale of TZ in Beijing is similar to Beijing and Tianjin, and higher than Xi'an and Guangzhou. It shows that the excess commuting rate is higher in the metropolitan area, and the job-housing space represents the imbalance status. And the excess commuting rate under the scale of TZ is the same with Guangzhou. The commuting capacity usage rates of both Beijng and Tianjin are between 17 and 18 under each scale. This proves that there is still deterioration space on the aspect of job-housing balance.

4.2 The regional space characteristics and the job-housing separation

4.2.1 Housing estate characteristics and job-housing separation

The paper summarizes and compares the differences of the four community types on the aspect of residents' job-housing commuting distance (Table 8). It is found that the job-housing balance degrees in old public housing community and high-end community are much better than that of economically affordable housing community, residents' commuting distance of which are all shorter than 6km. However, the residents in economically affordable housing community need to bear the maximum commuting cost. The mean value of 17.3km of commuting distance is much higher than other community type. This proves that the government pays more attention to the construction amount, coverage and the construction cost, rather than the integrality of job-housing space distribution. Due to the increase in the employment population and housing prices rising pressure as well as the trend of suburban areas development, Beijing-Tianjin-Hebei metropolitan area will face more severe phenomenon of job-housing spatial mismatch.

Community types	Average house prices (10000￥)	Samples	Commuting distance(km)			S	P
			mean value	median	standard deviation		
Old government house	4.4	248	5.8	6.2	6.4	6.3	18
High-end community	8.5	42	5.1	5.2	3.1	5.0	19
General house	3.3	1232	10.8	9.3	8.4	8.2	25
Low-cost housing	1.5	96	18.3	15.2	9.1	17.3	38

Table 8: Commuter comparison of different types of community.

4.2.2 The relation of professional industry characteristics and job-housing balance

This paper summarizes the employee proportion of the second and the third industry in Beijing-Tianjin-Hebei metropolitan area respectively, and compares it will the job-housing separation characteristics. (Fig. 8) It is found that the employee proportion of the second industry presents significant positive correlation property with the job-housing balance (the correlation coefficient is 0.72 under the confidence level of 0.01.) However, the employee proportion of the third industry presents significant negative correlation property with the job-housing balance (the correlation coefficient is -0.57 under the confidence level of 0.05.). The data shows that most employees in the second industry live in the suburbs and need to work in the downtown, whereas the residents working in the third industry could choose to live nearby. This indicates that development of the third industry is conducive to improving regional commuting balance to a certain extent.

4.2.3 The relation between regional housing price and job-housing balance

This paper summarizes the average house price in the core cities of Beijing-Tianjin-Hebei metropolitan area, and compares it will the job-housing separation characteristics. (Fig. 9) It is found that the regional house price presents significant negative correlation property with the job-housing balance (the correlation coefficient is -0.59 under the confidence level of 0.05.). Real estate developers consider the job-housing balance when they price the house. The traffic is more developed in the areas closer to the downtown. And there are more employment posts in the area where the house price is more expensive. This indicates that residents are willing to pay a higher price for housing in favorable job-housing balance areas.

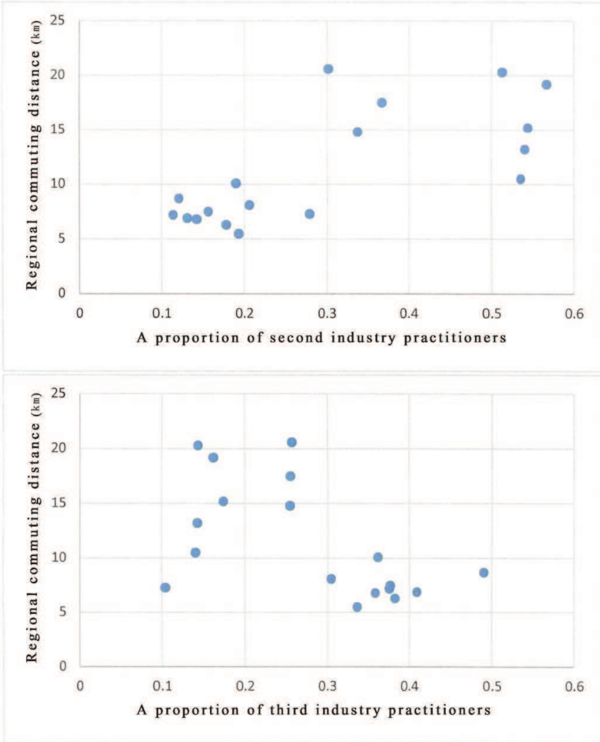

Fig. 8: Professional industry characteristics and job-housing balance.

Fig. 9: Regional average house prices and job-housing balance.

5 CONCLUSION AND DISCUSSIONS

Based on the above analysis, the taxi travel commuting network figure of Beijing-Tianjin-Hebei metropolitan area is obtained (Fig. 10). In the figure, the red points represent the working area, and the blue points represent the residence zone. The sizes of the points represent the travel density (namely the ratio of travel times and the regional area). The line between the regions represents the corresponding travel behaviour. The frequent travel behaviours will generate the line with darker colour. The travel connectivity and commuting characteristics of each job-housing space in the metropolitan area can be directly observed in the figure, and the following conclusions are obtained:

The taxi traffic mode can better show the job-housing space structure in the new and old city. High intensity taxi flows often occur in large urban areas with special features and complementary functions, which mainly concentrate in the new urban districts composed of large-scale working areas and the residence zones. For example, there are several large-scale residence zones and important working area in the Tianjin Binhai New Area. Thus, it is a relatively independent job-housing area (The yellow boxes in Fig. 10). However, the job-housing commuting flow of the old urban area in the core city is significantly decreased. The developed urban public transport system in this area provides adequate transport capacity, more short distances commuting. Therefore, the travel could be dependent on bicycles even on foot, rather than taxis. In addition, Fig. 10 shows that there are few commuting travel across the whole city except for the trip to the airport or the railway station.

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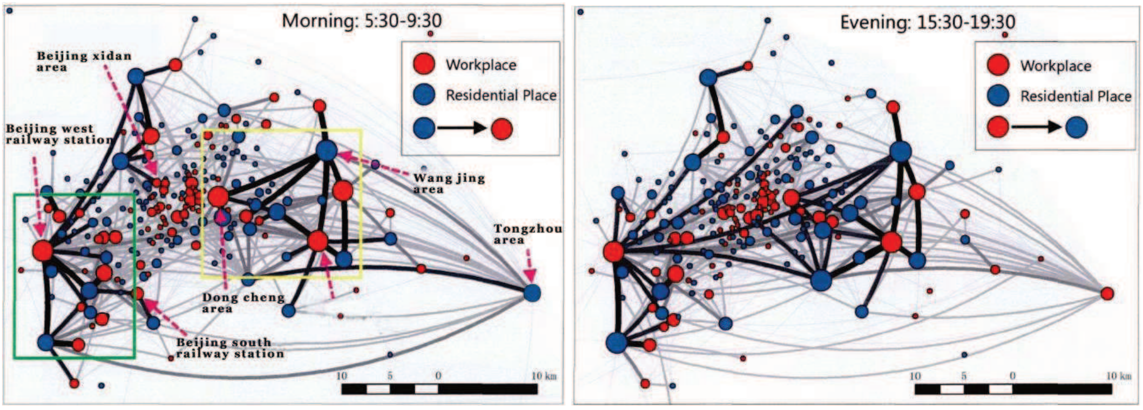

Fig. 10: The taxi commuter density and job-housing space connectivity

Residents' job-housing commuting travel flows are asymmetric in morning and evening. The travel flow from the residence to the working area in the morning is more concentrated and direct. However, the travel flow from the working area to the residence in the evening represents the characteristics of diversification and circuity. This mode indicates that residents are limited to the fixed working time in the morning, and directly departure to the working area. However, they have more free travel modes and purpose in the evening, and the more diversified taxi travel traffic space-time modes are presented.

As the most important transportation junction in the city, railway station and airport should have presented a neutral job-housing characteristic. That is to say, the passenger flow volume should be roughly equivalent in any time. However, the obvious working area characteristics are presented actually. This phenomenon is mainly caused by the behaviour mode of the passenger's choice of transportation means. Since it is pressed for time for departure in morning or return at night, the passengers are more inclined to take taxis. However, the time is quite ample if the passengers depart at night and return in morning, and they are inclined to choose other public transport modes.

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Interaction with Interconnected Data in Participatory Processes

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1 ABSTRACT

This paper proposes a conceptual graphical user interface for the interaction with interconnected data in participatory processes that play an important role for future smart cities. The presented idea is based on identifying important tasks for data exploration and data editing. The data to consider is structured, semi-structured or unstructured and of different facets. For example, participatory processes like planning and decision processes involve text, time and spatial data. In other words, the handling of the data is a complex endeavor in terms of representation and interaction. In this respect, we utilize and describe a graph-based data model that properly reflects the connected data.

Keywords: Smart city, Data processing, Data visualization, E-participation, Interaction

2 INTRODUCTION

Online civic participation is one major element of future smart cities. Even now, people engage individually or together in participatory processes, e. g., formal and informal planning and decision processes (cf. DANIELZYK 2005), and social communities, e. g., groups in different social media applications (BBSR 2015). People want to characterize their social environment and make contributions to the public. People develop ideas and discuss past or future events. In this regard, they use different information and communication channels. Any smart city can benefit from the knowledge of the masses and continuously adjust its future development, if it provides the proper software tools tailored to their own specific needs. These services must enable different user groups to participate independently from space and time constraints while lowering the barriers for getting started (SCHÜTZ et al. 2015). Although this thought is very promising, it immediately leads to three main challenges.

Firstly, participatory processes produce data of various data types, e. g., text, image, time and geographical data. Consequently, future software applications and services of smart cities in the area of e-participation need to deal with structured, semi-structured and unstructured data. This is a complex undertaking in terms of storing and processing the heterogeneous data that is additionally interconnected on multiple hierarchy levels, e. g., consider comments of comments. Secondly, we must understand the users' needs during participation in order to design and implement interaction methods. We need to allow the users to accomplish their tasks. But for this purpose, typical and clearly distinguishable tasks have to be identified at first. Thirdly, the user requires an interface to participate. Thereby, the collected data needs to be visualized properly without suffering from information overload. Furthermore, the user interface must provide ways to work with the data, e. g., for adding new content or searching existing information.

This paper briefly examines related work (see Section 3) and proposes a system to interact with the interconnected data of participatory processes. Thus, it addresses the aforementioned challenges by presenting 1) a graph-based data model, 2) main tasks from a user's point of view and 3) a graphical user interface (GUI) for exploring and creating content during participation. Firstly, the graph-based data model (see Section 4) best reflects the data's nature in terms of interconnected and multi-faceted entities. It easily represents the relations between participatory contributions while storing several related data attributes of various data types. Secondly, it is important to understand the users' needs. In general terms and from a user's perspective, participatory processes are all about finding, understanding and providing information. Thus, common and fine-grained tasks for working with the data are identified as well as categorized (see Section 5). These tasks build the foundation for the design of specific interaction mechanisms. Thirdly, the collected information, e. g., documents, comments and geographical data, is visualized in a two-panel-based main view that allows interactions. Therefore, a user can keep track of different content, compare it or relate it to each other at the same time. In contrast to many visualization techniques that display the graph's structure, i. e., its nodes and edges, in combination with multiple facets (cf. HADLAK et al. 2015), we propose a user interface (see Section 6) for exploring paths of the graph, i. e., the relations between entities, without explicitly displaying the graph's components in a main view. The overall goal is to display the sophisticated data in a clear and simple interface that also provides ways for creating new content based on related and already existing data. In this regard, corresponding conclusions and possible future work (see Section 7) are explained as well.

3 RELATED WORK

Plenty of individual software applications for the realization of participatory processes in the digital space do exist. This applies likewise to informal and formal planning and decision processes. So, information and communications technologies play a growing important role (MEDAGLIA 2011). There are systems that mainly present and deliver information like city-related information portals, e. g., of the city of Köthen[1] in Saxony-Anhalt, Germany. Their interfaces focus on displaying texts and lists of downloadable documents that can be explored only in an incoherent fashion. There are also more interactive applications for exploring the planning material and participation contents like "BOB-SH"[2], a platform listing current planning procedures of the state Schleswig-Holstein, Germany, or "Rechne mit Halle"[3], a platform for discussing the budget of the city of Halle, Saxony-Anhalt, Germany. Their interfaces support the exploration by search and filter elements and integrate possibilities to participate via online forms or by the integration of discussion boards. But overall, it is difficult to understand the relations and connections within the data, because the included information is presented separately. Often, transparency and insight are hard to acquire. To the best of our knowledge, there is no description or concept available of how a Web-based GUI for the exploration and editing of data in participatory processes can look like that focuses on the interconnections.

Graph visualization and interaction is an interesting and promising research area when it comes to the representation of the interconnected data. This field incorporates a lot of methods and interactive systems for the data exploration (cf. BECK et al. 2014, HADLAK et al. 2015, VEHLOW et al. 2015). But these systems and their GUIs commonly deal with different abstract graph representations, typically affect experts only and neglect the data editing. There are also many text visualization techniques (cf. KUCHER et al. 2015) for the deduction of insights from multi-faceted data with the focus on natural language text that plays a major role in participatory processes. These methods are promising as well but normaly show results of analytical tasks only, e. g. topic modeling. Such methods do not support the user during the participation process itself.

4 GRAPH-BASED DATA MODEL

Online participatory processes deal with data of different types. In the case of formal and informal planning and decision processes we need to consider a wide spectrum. In formal processes, involved participants, e. g., citizens or public agencies, typically produce natural language text data, e. g., when they write official statements in relation to specific parts of the planning material like binding site plans. These materials themselves comprise of text data but can additionally contain more useful information on a deeper level. In this respect, we noticeably point to textual references, e. g., references to external legislative texts or references within a document itself. In informal processes, the situation is similar to the already described one but often allows more degrees of freedom regarding the communication among each other, i. e., users are encouraged to discuss and develop ideas or opinions collaboratively, so that we might gain a deeper and denser net of interconnected data. Additionally, there is no restriction to natural language text. Each online contribution might contain other data like images or videos. More importantly, we need to consider more facets like time-oriented and spatial data, because all participatory contributions are made at a specific point in time and planning and decision processes involve geographic information systems (GIS) for further interactions, e. g., placing markers or defining regions on a map. Generally, details about the described data depend on the specific application, i. e., not every participatory process needs to consider all possible kinds

[1] See www.koethen-anhalt.de/de/stadtplanung.html, last access: March 31th, 2016
[2] See www.bob-sh.de, last access: March 31th, 2016
[3] http://www.rechne-mit-halle.de, last access: March 31th, 2016

of data. But in relation to multiple data facets the challenges for software systems in the area of e-participation stay the same: How can we represent and obtain the interconnected data?

4.1 Data Representation

The previously described situation leads to a complex endeavor regarding data representation. We consider a mathematical graph for describing the data. A graph $G = (N, E)$ basically comprises of a set of nodes N and a set of edges E. In our approach, each node $n \in N$ represents a specific entity or contribution, e. g., a comment referring to a text passage or a marker on a map. Such an entity is described by a number of attributes, e. g., the author's name or the date of submission. Each node of our graph model is able to store a different number of attributes. This flexibility is motivated by the fact that online civic participation can not only involve one but various types of participatory entities as previously described. Consequently, we have a single graph that is allowed to contain different types of nodes. Furthermore, an edge $e = (n_1, n_2) \in E$ is a directed connection between two nodes n_1 and n_2, i. e., n_1 refers to n_2, while $n_1, n_2 \in N$. Hence, an edge represents a relationship. It is additionally possible to weight an edge, e. g., to emphasize its importance in comparison to other edges, but we currently do not consider any special edge weighting, i. e., each relationship is equally important. But generally, this aspect depends on the use case in practice and needs further investigation.

An example for a very simple model is depicted in Figure 1. It shows various types of nodes (map, map marker, document, comment, image and rating information in form of a "heart", "like" or "thumbs up") indicated by different symbols. The example includes three text documents (nodes 3, 4, 5) and a map (node 2) of a GIS. Some markers (nodes 1, 6, 7, 8) are present on the map. There are also some comments (nodes 9, 11) on text documents as well as a comment (node 14) on a map marker. And even comments (nodes 10, 13) on comments exist. One comment (node 9) refers to a text document and to the map at the same time. Even an image (node 16) is attached to one specific comment. Last but not least, some comments and the image are liked or rated (nodes 12, 15, 17) by some participants. In the end, we see different levels of complexity. Table 1 shows typical attributes and some values corresponding to the presented node types of the previously described graph-based data model.

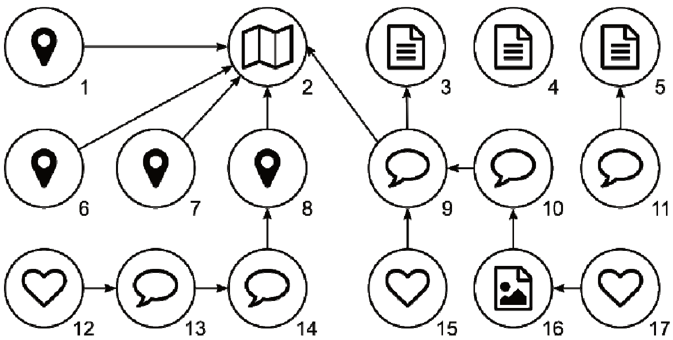

Fig. 1: Exemplary graph-based data model showing different node types and some interconnections.

Type	**Attribute**	**Value**
Document	Author	John Doe
	Name	goals.pdf
	Title	Planning Goals
Map	Dataset name	saxony_anhalt12
Map marker	Label	M3
	(x, y)	(51.746071, 11.983459)
Comment	Author	Jana Doe
	Content	I don't agree with the idea! That would be too expensive.
	Timestamp	20160308 T 07:59:01 UTC
Image	Size	88 KB
	Dimensions	1363 × 667

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	Name	sketch_3.png
Rating ♡	Author	Joe Blow

Table 1: Exemplary attributes and their values for different types of nodes.

4.2 Graph Creation

There are two main mechanisms that create the data graph of a particaptory process. As a starting point, an initial graph is needed that describes the available material given through the planning or decision process itself. This is done through a (semi-)automated approach. Secondly, each contribution made during participation is added to the graph by a manual, interface-supported interaction. This means the graph grows over time during the whole process.

A (semi-)automated method creates the initial graph, because it is not always possible to manually maintain all conceivable references. Otherwise, this would lead to an extra amount of work that might not be desirable. Therefore, we need automated methods that extract the interconnected information and create nodes and edges. For example, planning material like expert reports might contain textual references to legislative texts, e. g., "§ 437 BGB (German Civil Code)", commonly prefaced by the section sign "§" or by the strings "Sec." or "Section". Such information can be extracted computationally via specific rules, e. g., by the integration of a set of regular expressions. But natural language text is more complex when we generally consider its unstructured form and the information contained within. In this context, a different example is the mention of other available documents in phrasings like "I received your letter from last Monday". Algorithms in information extraction (cf. JIANG 2012) and specifically named entity recognition (cf. GRISHMAN et al. 1996, RATINOV et al. 2009) or coreference resolution (cf. DURRETT et al. 2013) deal with these problems. However, this is out of the scope of this paper and will be described elsewhere. For this paper, we assume the availability of a suitable algorithm. On the downside, these approaches are prone to errors. Absolute correctness and completeness are sophisticated goals and commonly utopistic. Because of that, a user-driven control mechanism to check and modify computed suggestions is added, bringing the manual effort to a minimum.

During participation, each new contribution is added to the graph as a new node, e. g., when a user submits an official statement. Often, a contribution relates to a specific part of the available data and hence a specific part of the graph, like a specific chapter of a planning document, a specific region on the map or a specific participation contribution of someone. To improve follow up work with the contribution, like the analysis of all made contributions or the exploration of contributions by other participants, it is important to connect the new node to the most related nodes in the graph, either manually through the contributor, or automatically supported by the interface or the same analysis methods mentioned above. This is described in Section 6.3.

5 TASKS

Each participant of participatory processes has certain goals and wants to accomplish specific tasks respectively. Here, we want to characterize basic tasks for users of an online e-participation system. We distinguish between two main perspectives: tasks for data exploration and tasks for data editing. Therefore, we cover two major objectives from a user's point of view, which are exploring the space of available process information and contributions made by every participant as well as taking part in the participatory process by making own contributions. These tasks build the foundation for the software system and are based on an established task categorization for interaction in information visualization (YI et al. 2007) and for graph exploration and graph editing (GLADISCH et al. 2015).

5.1 Data Exploration

In the following, we describe basic tasks for exploring the complex and interconnected data of participatory processes. They allow interaction with the underlying components of the data model, i. e., the nodes, the nodes' attributes and the edges.

Explore tasks: Exploration tasks allow a user to examine different parts of the given data.

- *Inspect online:* This task allows a user to read or view the provided information material in an online and direct way without the need of additional software.

- *Scroll content:* Scrolling changes the view and shows previous or subsequent content of the current view. For example, a user scrolls documents in order to read different sections or scrolls a list of comments in order to browse their contents that relate to one specific posted idea.
- *Directly navigate:* Performing this task, the user can directly jump to another view of the current content or exchange the displayed content at all. Considering the table of contents of a document, clicking on a hyperlink that links to the related section is one imaginable example as well as the selection of a document in a list of downloadable or online readable files.
- *Pan view in GIS:* Geographical map data plays an important role for self-positioning in the environment of interest. Panning allows to move the current view. Panning also extends scrolling by allowing not only one- but two-dimensional translations of the related view at the same time.
- *Zoom view in GIS:* This task enables a user to zoom in or out of the current content shown in the view in order to reveal different information.
- Download data: Performing this task, a user wants to consume parts of the data later or in a different context. For example, participants might want to download individual chapters of planning documents for offline use.

Select tasks: These tasks focus on marking data items as interesting and keeping track of them.

- *Select / deselect content*: When selecting / deselecting content, the user marks the affected data item as interesting / uninteresting. This task is often a starting point in a chain of further tasks.
- Select / deselect multiple content*:* This task is similarily performed to the previous one but takes multiple concurrent selections into account.

Reconfigure tasks: Reconfigure tasks lead users to a different perspective on the data.

- *Sort items:* This task changes the spatial arrangement of the data representation. For example, a user sorts all comments that relate to one specific text paragraph by their date of submission.
- *Enable / disable layers in GIS:* GIS incorporate several layers of data. By performing this task, users can toggle the list of displayed layers. This might show different relationships between geographical data facets.

Abstract & elaborate tasks: These tasks enable the user to adjust the level of abstraction of data representation and consequently provide more or less detail.

- *Examine details:* This task can represent further details of one or more data items on demand. Hovering special content that reveals further information is an example.
- *Hide details:* When hiding details, the user suppresses a specific amount of information, e. g., in order to overcome information overload. For example, this task might undo a previous request for more details but can also be independent.

Connect tasks: These tasks highlight relationships that are already presented and show previously hidden data items that are relevant to a given data item.

- *Combine information:* This task aims at visually connecting data from different contexts. For example, a user wants to write a comment to a specific document section and at the same time see the related or involved geographical area highlighted on the provided map in a GIS.

Filter tasks: When performing filter tasks, the set of displayed data items is changed based on conditions. So, this generic task reduces or extends the set of visible data, but the perspective on the data persists. Direct search queries, e. g., for document titles, that alter the number of displayed items are an example. We do not subdivide tasks of this category any further.

Encode tasks: Encode tasks alter the visual representation or encoding of the data in terms of visual appearance. In participatory processes, we currently do not consider encoding tasks for exploraty purposes.

5.2 Data Editing

This section is about the basic tasks for data editing in participatory processes.

Compose: Composing is about the creation of new own data.

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- Write text: This basic task allows a user to write text which is a fundamental part in participatory processes.
- *Style text:* This task allows to emphasize specific parts of the text, e. g., by changing the color of a word or by setting the font of a sentence in “bold”.
- Attach data: This task focuses on the data source that originates from outside of the system, i. e., the data usually comes from other applications. For example, a user might want to attach photos or scanned documents from hard disk.

Add: These tasks allow the graph-based model to evolve by adding new data.

- Send data: Submitting data describes the process of transfering and storing the composed data as a contribution to the related participatory process.
- Save draft: This task temporarily adds new contributions to the graph-based model. This new information can be interpreted as a preliminary version of a final submitted version of the data.

6 GRAPHICAL USER INTERFACE

In this section, we propose a conceptual idea of a GUI for data exploration and data editing in the environment of participatory processes. The GUI reflects the previously described tasks. The concept is currently optimized for the use on large screens with keyboard and mouse interactions. The interface basically comprises of three main components: direct navigation area, two-panel view area and editor area (see Figure 2). They are arranged vertically from top to bottom.

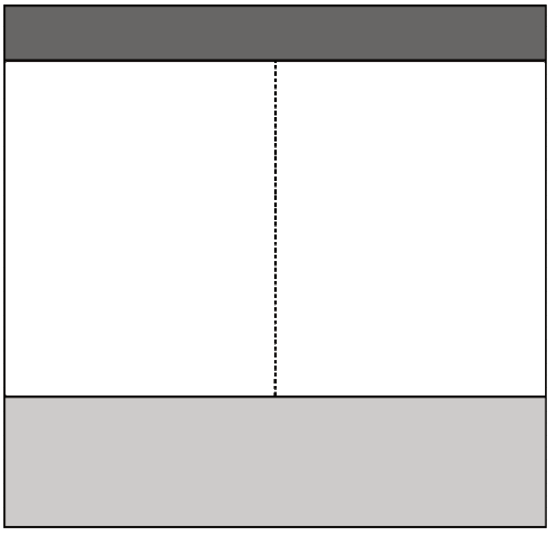

Fig 2: Main components: direct navigation area (top), two-panel view area (center) and editor area (bottom).

6.1 Two-panel View Area

We start with the two-panel view area that features a side-by-side arrangement as the name might already suggest. The simple layout is motivated by dual-pane file managers of operating systems, e. g., Vifm or Midnight Commander, as well as centuries-old printed books. With this choice, we enable the exploration of maximal two different contexts simultaneously.

Each panel can hold different content reflecting certain nodes in the data graph during exploration. For example, a document can be displayed on the left side for further reading (*inspect online task*), while the map is displayed on the right side. Therefore, at least two distinct types of data can be mentally combined and viewed in context (*combine task*) which can lead to more transparency and insight. Depending on the shown data, further interactions with the content are possible. For example, when we consider text documents, scrolling (*scroll content task*) can be achieved, text can be selected (*select / deselect content task*) and tooltips that explain technical terms can be shown (*examine details task*) or hidden (*hide details task*). In case of a geographical map, panning (*pan view in GIS task*), zooming (*zoom view in GIS task*) as well as selecting different map layers (*enable / disable layers in GIS task*) is allowed. In this regard, we understand that GIS can be complex systems and provide their own individual interaction methods possibly based on different and more advanced tasks. Therefore, map data will be displayed through an integrated GIS client inside the panels.

In case people want to inspect planning material at a later time and maybe in an offline scenario, they can download data via a button (*download data task*), e. g., by downloading a whole document or a screenshot of the current map's viewport.

A panel can also show a group of information items of same type that might be hierarchically structured like lists or trees of comments and subcomments. Additionally, such structures can be filtered via text queries (*filter task*) and sorted by different aspects (*sort items task*), e. g., date or author of the contribution. Each item itself can be visualized by using a short form respectively snippet of the item's content. This whole idea is shown by Figure 3.

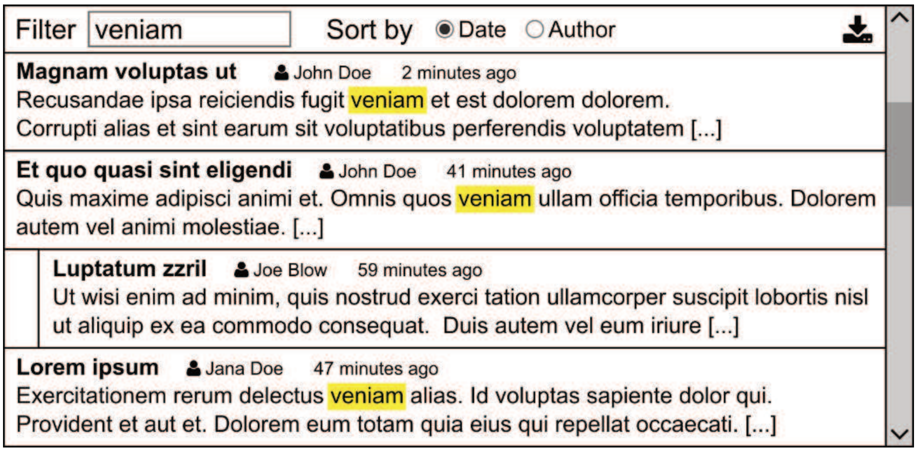

Fig. 3: List of comments including one sub-comment in one panel with filter and sorting functionalities.

In addition to showing any two information items simultaneously, a two-panel-based view is nicely suited for exploring paths of the graph in context. For this purpose, the graph edges are visualized as part of the content visualization like hyperlinks are visualized in a Web document. Clicking such a visualized edge or reference will then show the original content in the left panel and the related content in the right panel. For example, if the user is reading an expert report which refers to a specific section of the planning document, this reference is highlighted in the report on the left side. Clicking on the reference, i. e., following a graph's edge, will then show the section of the planning document on the right side. Such a visualized edge can also summarize several edges at once, e. g., all comments to a section of a document, that will be displayed in the previously described list view.

6.2 Direct Navigation Area

Reflecting different cases of application, we allow different methods for changing the content of each panel (*directly navigate task*). Most important for the exploration in context is the previously described following of edges that is directly realized in the panel view. This can lead to a navigation sequence, in which the user explores several edges. To trace back such a route and for getting back to the original starting point, the navigation area provides back navigation through the panels' history similar to back navigation on the Web.

Additionally, the navigation area also allows for direct selection of content to be displayed in each panel via single selection dropdown boxes with maximally two navigation levels. The first level distinguishes between available main entities like planning documents, maps or the collection of participation content. The optional second level dynamically adjusts its content based on the first level. For example, if a document contains several sections, typically listed in the document's table of contents, the second navigation level lists these direct links to the sections. Figure 4 shows the navigation area.

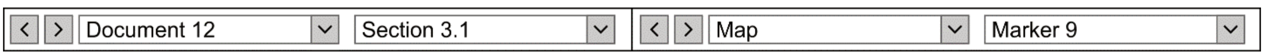

Fig. 4: Dropdown boxes for direct navigation and buttons to browse each panel's history.

6.3 Editor Area

An interface is needed to compose the ideas and opinions of the participants (see Figure 5). An important part is the possibility to create text with at least minimal features known from operating system text editors

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or online forms (*write text task*). We consider basic methods for highlighting text like setting font in “bold” or “italic” in order to allow each user to emphasize specific content (*style text task*). Also, we allow the user to upload data that gets attached to or directly integrated into the written content (*attach data task*). The last part of the editor area enables a user to save the composed content as a preliminary version (*save draft task*). People can be interrupted or run out of ideas while they participate. Consequently, it is necessary to come back to the current state of the contribution. Draft versions can be managed separately in the personal user area of the system. Of course, the composed content can finally be submitted (*send data task*), too.

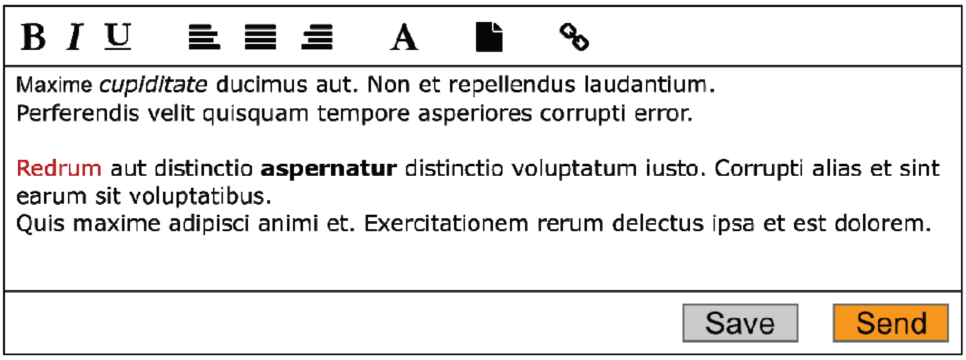

Fig. 5: Editor area for composing, saving and submitting content.

But the pure content composing is only one necessary part. Another important aspect is the creation of connections that originate from the new content and relate to other nodes of the graph. In this regard, we look at two basic approaches. On the one hand, we use (semi-)automated methods of information extraction and coreference resolution for adding new parts to the graph as described earlier. In the contribution submission process, an automated procedure searches for possible new connections which the user must refuse or accept before submitting. This idea can even possibly be realized during content composing, i. e., in realtime. On the other hand, a manual, user-controlled method is provided. It can start from two different areas:

- The first way starts from the contents of the panels and ends in the editor. As an example, let us consider documents. A context-aware menu can be displayed after a user successfully selected a text of interest (*select / deselect content task*) (see Figure 6). By clicking the displayed chain symbol of the menu, the user links the current content of the editor window to the selected text or can start composing new content. So, while the user is reading the document, he can start making his contribution.
- The second way starts from the editor and ends in a panel’s content. By clicking the chain symbol in the editor window, already shown by Figure 5, the user enables a selection mode. During this mode, the user can select single items, e. g., text paragraph, or even a set of items, e. g., several comments, in both panels at once (*select / deselect multiple content task*). This mode is left when the chain symbol is clicked again. Figure 7 shows these steps in the complete concept of the GUI as an example.

These ways can be repeated and chained individually so that multiple targets might got specified in the end. Existing interconnections are highlighted by a specific background color similar to the visualization of text selections as shown in Figure 6. By clicking this existing connection, the context-aware menu pops up and contains an additional icon that might trigger the deletion of the selected connection.

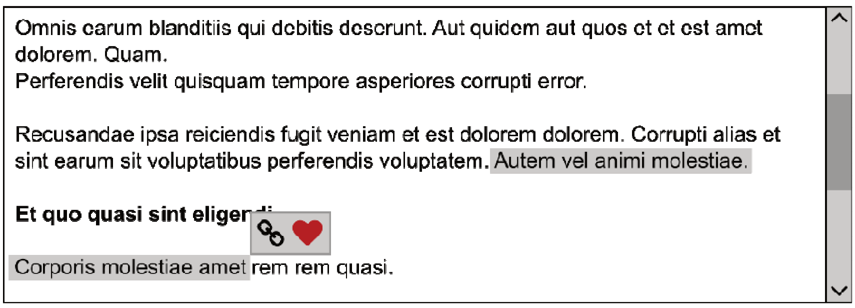

Fig. 6: Selected text and context-aware popup menu for adding another comment or rating.

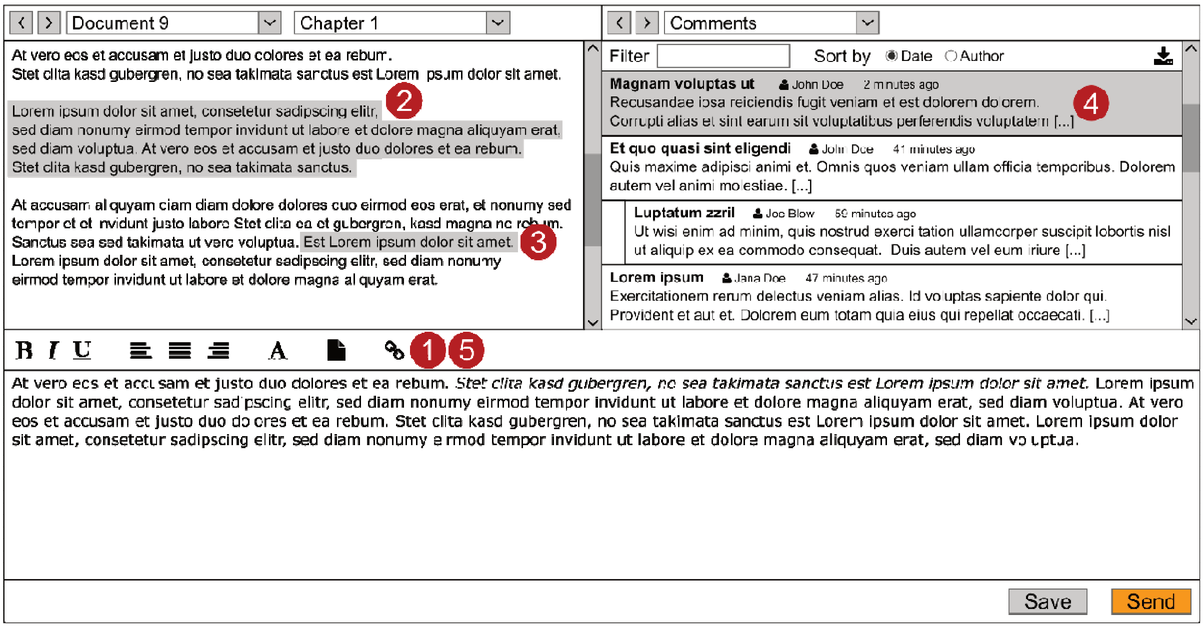

Fig. 7: Exemplary steps for creating interconnections: (1) Start process by clicking the chain symbol, (2, 3) select some text targets by clicking, holding, dragging and leaving the mouse, (4) select a comment by clicking the mouse and (5) click to end the process.

7 CONCLUSION AND FUTURE WORK

E-participation is one major aspect of smart cities. Complex and potentially a lot of data arise during the progress of participatory processes depending on the number of participants and their activities. If more and more people participate, a flexible and expendable data model is needed. Our described graph-based model is able to represent data of different types with a varying number of attributes. Especially when it comes to the relationships between several data items, the graph easily describes the interconnections due to its inherent incorporation of edges.

We described basic tasks for data exploration and data editing. It is sometimes not easy to identify the matching category of a task and the boundaries seem to blur. But this approach helps in finding the needed and atomic tasks. Therefore, redundant complexity can be avoided before it comes to mapping these tasks to interaction elements in a GUI.

The presented conceptual idea for a GUI of an interactive software system for data exploration and data editing picks up on the described tasks. We currently implement and integrate this idea in a Web-based software prototype for formal or informal planning and decision processes. In a next step, we will conduct user studies to evaluate the presented concept. A key challenge is the achievement of simplicity, i. e., different user groups of various ages need to be able to efficiently work with the system. This concerns experts as well as amateurs. Another challenge for the future is the adaptation of our concept to different devices, especially tablets and smartphones with smaller screens and other interaction mechanisms.

8 ACKNOWLEDGEMENT

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Korneuburg 2036 – eine Stadt plant sich selbst. Die Frage nach Langfristigkeit und Verlässlichkeit in der kooperativen Stadtentwicklung

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1 ABSTRACT

Cities are complex systems and face various internal and external challenges on their path towards sustainability and resilience. These are characterized by ambiguous problem definitions or unclear, conflicting and dynamically changing goals. Hence, long-term thinking and forward-looking action as well as flexibility and adaptability are indispensable in urban planning and development. In order to elaborate broadly accepted strategies for future, especially the involvement of citizen's perspectives and needs is a core concern for actors in urban planning. While case-related citizen participation already has a longer tradition, long-term collaboration agreements with citizens in terms of strategic and forward-looking planning is at an early stage.

Korneuburg, a medium scale district capital next-door to the metropolis of Vienna, grappled with identity finding between the poles of urbanity and village quality of living, while low municipal budget, considerable population increase, heterogeneous interests and perceptions of its self-image challenged the city. Within a broad participatory process a mission statement for urban planning and a master-plan, containing guidelines for implementation of the desired vision for the next twenty years were elaborated. Finally also an obligation for further collaborative urban decision making – the Charter for citizen participation – emerged as an unexpected spin-off product. This contribution discusses the integrative approach within the project, the dynamics and novelty of the process and associated challenges of long-term oriented collaborative urban development. It is shown that the city not only commits itself to a broadly accepted framework for future urban development in the upcoming decades, but also points the way ahead for a cultural change regarding communication and decision making with citizens. This development calls for new perspectives in thinking, reshaping of cooperation designs and for flexibility, creativity and mutual trust.

Keywords: Smart City, kooperative Stadtentwicklung, Langfristigkeit, Masterplan, Partizipation

2 EINLEITUNG

Akteurinnen und Akteure der Stadtplanung und -entwicklung sind täglich gefordert, Entscheidungen auf Basis unvollständigen Wissens, unterschiedlicher Problemdefinitionen und Bedürfnisse zu treffen (Schauppenlehner-Kloyber und Penker, 2015). Sie stehen dabei vor der Herausforderung, vergangene und gegenwärtige Entwicklungsprozesse zu analysieren und interpretieren sowie auch sozial-räumliche Veränderungen zu antizipieren und in ihre Planungen zu integrieren (Kegler, 2014). Die Fähigkeit einer Stadt, vorausschauend zu denken und auf Veränderungen flexibel reagieren zu können, ohne dabei Struktur und Funktionsfähigkeit zu verlieren (Walker et al., 2012), gewinnt unter dem Schlagwort der Resilienz zunehmend an Bedeutung in der Debatte um nachhaltige und zukunftsfähige urbane Räume. Naturkatastrophen als Folgen des Klimawandels, Terroranschläge oder Finanz- und Wirtschaftskrisen haben die Verletzlichkeit der Städte spürbar gemacht und den Fokus auf die Widerstandsfähigkeit urbaner Systeme gerichtet (Jakubowski, 2013). Resilienz bezeichnet dabei die Fähigkeit einer Stadt, mit Herausforderungen und Krisen umzugehen und sich gegebenenfalls neu zu organisieren, Lernprozesse zu nutzen, um widerstandsfähiger zu werden und sich weiterzuentwickeln (z.B. Birkmann et al., 2012; Deppisch, 2016; Kegler, 2014). Nicht ein Zustand, den es zu erreichen gilt, sondern der Vorgang des Suchens, des vorausschauenden Lernens und der Innovation stehen dabei im Vordergrund (Kegler, 2014). Dem „Einfallsreichstum" kommt dabei eine besondere Bedeutung zu: Eine Stadt gilt demnach dann als besonders resilient, wenn sie auch „in Verwaltung, Bürgerschaft und anderen relevanten Akteursgruppen über ausreichend Know-how und Kreativität verfügt, um mit außergewöhnlichen Lagen umgehen zu können" (Jakubowski, 2013; siehe auch WEF, 2013). Die zentrale Rolle der Interaktion der städtischen Akteure, ihrer Kooperations- und Lernfähigkeit und der Flexibilität und Entwicklungsfähigkeit organisatorischer Strukturen wird daraus deutlich: „Resilienz kann nur durch gezielte und langfristige Kommunikation und Kooperation der relevanten Stadtakteure erreicht werden." (Jakubowski, 2013). Dieser Trend zur akteurszentrierten Perspektive findet sich nicht nur in der Resilienzforschung, sondern auch in den Smart City-Strategien. Dabei wird unter dem Leitbild einer „intelligenten Stadtentwicklung", das Zusammenspiel aus dem Einsatz moderner Technologien um städtische Ressourcen besser und effizienter zu verwalten und zu nutzen, und dem Humankapital und der Organisationsfähigkeit städtischer Akteure bzw. des Systems Stadt selbst hervorgehoben. Denn nicht nur technische, sondern auch soziale Innovationen und Lösungen, wie neue Wege der Kommunikation und Kollaboration zwischen Bürgerinnen und Bürgern und Stadtgemeinden, sind zentral für zukunftsfähige und lebenswerte Städte. Vor dem Hintergrund der Fähigkeit zur Resilienz wird im vorliegenden Beitrag bewusst das Augenmerk auf die Bedeutung kollaborativer Strukturen gelegt. Kollaboration beschreibt einen ergebnisoffenen Prozess kollektiver Wissensaneignung, eine enge, auf geringer Arbeitsteilung basierende Zusammenarbeit, in der „selbst gesteuerte interaktive Austauschprozesse zwischen den beteiligten Gruppenmitgliedern" überwiegen. Eine kollaborative Vorgehensweise ist vor allem dort angebracht, wo „noch keine Lösung im Wissenskanon der jeweiligen Domäne vorhanden ist bzw. wenn die Aufgabe eine sehr starke Adaption vorhandener Lösungswege erfordert" (Bornemann, 2012), wo es also darum geht, neue Problemstellungen und bislang unbekannte Herausforderungen gemeinsam zu definieren und entsprechende neu zu erprobende Handlungsoptionen zu entwickeln.

Eine zentrale Herausforderung für Städte liegt demnach darin - im Sinne einer nicht dem Zufall überlassenen Stadtentwicklung - den nachhaltigen Umgang mit den städtischen Ressourcen vorausschauend zu planen und anzustrebende Entwicklungsziele zu setzen, gleichzeitig jedoch Planungsinstrumente dynamisch und anpassungsfähig zu gestalten. Um diesen Spagat zu bewältigen, braucht es Innovations- und Kollaborationsstrukturen, die städtischen Aktuerinnen und Akteuren ermöglichen, dynamisch auf Veränderungen zu reagieren, sich weiterzuentwickeln und an Änderungen der Rahmenbedingungen anzupassen. Ein großes Risiko im Umgang mit Planungssicherheit und Langfristigkeit liegt daher darin, einmal formulierte Entwicklungsziele und Planungsinstrumente als starre Rahmengebung zu interpretieren, anstatt Mechanismen zu installieren, die eine Evaluierung und Anpassung der (längerfristig) gesetzten Ziele und Maßnahmen erlauben, ohne bei Pfadänderungen das übergeordnete Entwicklungsziel aus den Augen zu verlieren.

Der vorliegende Beitrag diskutiert zunächst die Relevanz vorausschauender Stadtentwicklung und beleuchtet dabei einerseits die Rolle langfristig orientierter Planungsinstrumente, sowie andererseits den Status und die Bedeutung verlässlicher Kollaboration städtischer Akteurinnen und Akteure in diesem Kontext. Am Beispiel eines umfassenden, partizipativen Stadtentwicklungsprozesses in der niederösterreichischen Stadt Korneuburg wird gezeigt, welchen Weg eine Stadtgemeinde beschreiten kann, um in enger Zusammenarbeit mit den Bürgerinnen und Bürgern vorausschauende Lösungen zu erarbeiten. Basierend auf den Erkenntnissen aus Literatur und Anwendungskontext werden abschließend die entstehenden Herausforderungen langfristig orientierter kollaborativer Stadtplanung diskutiert.

2.1 Status quo und Relevanz langfristig orientierter Planungsinstrumente

Stadtentwicklungspläne mit einem längerfristigen Planungshorizont waren in Österreich lange Zeit nur wenigen großen Städten vorbehalten, der überwiegende Teil der Klein- und Mittelstädte verfügte, wenn überhaupt, über ein, dem jeweiligen Raumordnungsgesetz entsprechendes, „örtliches Entwicklungskonzept", das je nach Bundesland zumeist auf einen bestimmten Zeitraum beschränkt war. Bedingt durch den Umstand, dass die Raumordnung in Österreich in den Kompetenzbereich der jeweiligen Bundesländer fällt, gibt es in einigen Bundesländern keine Vorgaben bzw. unterschiedliche Definitionen zu längerfristigen Planungsinstrumenten. Dennoch zeigt die Zunahme an Beispielen, bei denen sich Bürgerinnen und Bürger durch städtische Planungen negativ betroffen sehen, wie notwendig eine langfristige und gemeinsame Entwicklungsplanung ist. Im Positionspapier des Deutschen Städtetages (2013) wird einmal mehr die Etablierung von integrierten Stadtentwicklungskonzepten gefordert, um zum einen die Vorgaben der „Leipziger Charta zur nachhaltigen europäischen Stadt" (Europäische Union, 2007) umzusetzen, zum anderen mit dem Ziel der Verankerung von langfristig angelegten Leitbildern als Orientierungsrahmen für alle Akteurinnen und Akteure. So soll die Definition von Leitprojekten, Handlungsräumen und Zielgebieten in der städtischen Entwicklungsplanung einen langfristigen Rahmen bilden. Dennoch stellen diese Entwicklungskonzepte eine informelle Planung dar und sind im Gegensatz zum Flächenwidmungs- und Bebauungsplan keine verbindlichen Rechtsgrundlagen. Dadurch besteht die Gefahr, dass diese Konzepte von den jeweiligen kommunalen Entscheidungsträgern nur angewandt werden, wenn diese zur Legitimierung von Argumentationen und Entscheidungen benötigt werden und daher oft Papiere mit geringer Aussagekraft und Wirkung bleiben (Kühn, 2008).

Gleichzeitig sehen sich besonders Städte mit hoher Entwicklungsdynamik (z.B. Bevölkerungs- und Siedlungswachstum) mit einem großen Bedarf an vorausschauender Planung konfrontiert. Fehlt diese, so werden relevante Entscheidungen wie Flächenumwidmungen, Neuausweisungen von Siedlungsgebieten oder die Errichtung von Verkehrswegen allzu oft anlassbezogen und kurzfristig getroffen, ohne dabei ein übergeordnetes Entwicklungsziel bzw. „die Stadt als Ganzes" im Blick zu haben. Solch ein Mangel an Orientierung und Steuerung führt zu einer unkoordinierten Stadtentwicklung mit unerwünschten Folgeeffekten (inkompaktes Stadt- und Siedlungswachstum, große Flächeninanspruchnahme, hohe Infrastrukturkosten, verödende Stadtkerne, Segregation, Bürgerinnen- und Bürgerinitiativen etc.) und hohen Folgekosten. Es überrascht daher wenig, dass Städte und Regionen vor allem im Punkte Steuerung der Siedlungstätigkeit in der Regel die Ziele nachhaltiger Entwicklung oftmalig verfehlen (Einig, 2005; Weith, 2003).

Damit sich das Bild und die Entwicklungsrichtung einer Stadt langfristig und nachhaltig festigen oder auch verändern können, ist daher einerseits die Formulierung eines anzustrebenden Zustands als auch die schrittweise Umsetzung zur Zielerreichung für städtische Akteurinnen und Akteure von Vorteil. Zugleich stellt ein langfristiges Planungsinstrumentarium eine Argumentationsgrundlage dar, auf die sich die kommunalen Entscheidungsträgerinnen und Entscheidungsträger bei neuen Projekten beziehen und damit mögliche Konfliktfelder im Vorhinein bereits vermieden werden können. Solche Planungsinstrumente dienen daher auch der Vermittlung von Grundsatzentscheidungen und können somit eine Begründung für die Art und Weise der städtischen Entwicklung liefern. Gleichzeitig erscheint die Einbeziehung der Perspektiven und Anliegen der Bürgerinnen und Bürger in die Formulierung von Leitbildern, zukünftigen Entwicklungsszenarien etc. als zentraler Erfolgsfaktor – da durch die Teilnahme am Entstehungsprozess eine Identifikation der Akteurinnen und Akteure mit dem Zukünftigen zu erreichen versucht wird und daher die Beteiligten eher verstehen werden, wie die städtische Entwicklung und bestimmte Projekte ablaufen.

2.2 Von der anlassbezogenen Bürgerinnen- und Bürgerbeteiligung zur verlässlichen Kollaboration

Partizipative Elemente in der Stadtplanung – die zumeist punktuelle informative oder konsultative, aber auch kooperative Einbeziehung von Bürgerinnen und Bürgern– sind schon heute vielerorts Standard. Zentrale Basis von Partizipations-Theorie und Praxis ist bis heute Arnsteins Pionierarbeit – the ladder of citizen participation - aus dem Jahr 1969 (Arnstein, 1969). Partizipation wird dabei als die anlassbezogene Verteilung von Entscheidungsmacht beschrieben – das heißt, im Rahmen konkreter Problemstellungen und Projekte gibt die öffentliche Hand einen Teil ihrer Entscheidungsmacht an Bürgerinnen und Bürgern ab. Das Ausmaß des Einflusses der Bürgerinnen und Bürger auf das Endprodukt wird in hierarchischen Stufen (von „Nicht-Partizipation" bis „Entscheidungsmacht") dargestellt. Gleichwohl dieser Zugang vielfach kritisiert wird, partizipative Prozesse in Bezug auf Offenheit in der Problemdefinition, den tatsächlichen Bewegungs- und Aushandlungsspielraum und die Chance auf eine Veränderung bestehender Entscheidungs- und Kooperationskulturen einzuschränken (z.B. Tritter und McCallum, 2006; Turnhout et al., 2010), prägt er nach wie vor das Denken über Partizipation (Collins und Ison, 2009).

Die in Veränderung begriffene Beziehung zwischen Staat und Gesellschaft bleibt in Arnsteins Modell und dem darauf aufbauenden Verständnis von Partizipation weitgehend unberücksicht (Bovaird, 2007; Collins und Ison, 2009; Ross et al., 2002; Tritter und McCallum, 2006). Der Fokus auf die Verteilung von Entscheidungsmacht erzeugt eine Konkurrenzsituation zwischen zwei Parteien: den Bürgerinnen und Bürgern einerseits, die höhere Treppen der Leiter und damit mehr Mitgestaltung zu erreichen versuchen und der öffentlichen Hand andererseits, die bestrebt ist, ihre Entscheidungsmacht zu halten (Tritter und McCallum, 2006, Collins und Ison, 2009, Boonstra und Boelens, 2011). In der Regel verbleiben die politischen und administrativen Akteurinnen und Akteuren in einer dominierenden und kontrollierenden Rolle und definieren a priori Ausgangsproblem, Rahmen und Spielraum für partizipatorische Prozesse und behalten die Entscheidungsmacht am Ende. Das Potenzial der Bürgerinnen und Bürger in puncto Problemdefinition und –identifikation sowie Prozessgestaltung bleibt damit ungenutzt, der Spielraum ist in der Regel auf das Entwickeln von Lösungen beschränkt (Boonstra und Boelens, 2011, Tritter und McCallum, 2006). Die traditionelle Dichotomie zwischen Staat und Gesellschaft (Regierenden und Regierten) wird dadurch verstärkt, Möglichkeiten und Freiräume für vertrauensvolle Zusammenarbeit, Wissens- und Erfahrungsaustausch und gemeinsame Entscheidungsfindung bleiben ungenutzt (Gardesse, 2014; Tritter und McCallum, 2006). Bürgerinnen und Bürger selbst sind in der Regel weder ermächtigt, ihrerseits partizipative Prozesse einzufordern (es sei denn über den Weg des Protests), noch sind sie in Aushandlungsprozesse in Bezug auf Problemdefinition, Prozessgestaltung oder als aktive Akteurinnen und Akteure einer institutionellen Transformation einbezogen. Seit Arnstein ihre Theorie in den 1960er Jahren entwickelte, hat sich das Verständnis über die Steuerung und Entwicklung einer Stadt fundamental und spürbar verändert. Diese Veränderungen umfassen vor allem den Übergang von Government (hierarchische, zentrale Steuerung, „top down") zu Governance (interaktive, kooperative Politikgestaltung, Netzwerkperspektive, „bottom up"). Dennoch bleibt Bürgerinnen- und Bürgerbeteiligung auch heute nach wie vor „good will" und Angebot der öffentlichen Hand, deren Entscheidungsträgerinnen und Entscheidungsträger darüber bestimmen, ob und wann Bürgerinnen und Bürger an anlassbezogenen Entscheidungsfindungsprozessen beteiligt werden und in welchem Ausmaß Macht auf diese übertragen wird. Bürgerinnen- und Bürgerbeteiligung findet daher bis dato weitgehend projektbezogen und eingebettet in die bestehenden Steuerungsstrukturen statt (Klages und Vetter, 2013).

Will eine Stadt nun im Sinne einer Fähigkeit zur Resilienz - und des in der Einleitung genannten Einfallsreichtums - die Potenziale aus der Zuammenarbeit und gemeinsamen Lernprozessen zwischen Politik, Verwaltung und Bürgerinnen und Bürgern nutzbar machen, ergibt sich ein Bedarf der Neugestaltung von Rollen, Verantwortlichkeiten und Aufgaben/Zweck der Beteiligten. Nicht in Bezug auf die Frage der Verteilung von Macht, sondern im Sinne sozialer Lernprozesse, die bereits bei der gemeinsamen Auseinandersetzung über Wesen und Charakter der zu bewältigenden Probleme beginnen und in denen die Beteiligten miteinander nach Lösungen suchen, wie man diesen begegnen könnte (Collins und Ison, 2009). Gemeinsame Problemidentifikation und –lösung bedeutet nicht, Macht, sondern vielmehr Wissen und Erfahrung auszutauschen, und ist damit eine soziale Angelegenheit, die eine Integration und Mobilisierung unterschiedlichster Wissensquellen im Rahmen eines sozialen Lernprozesses erfordert (Hurlbert und Gupta, 2015). Zentrale Gelingensfaktoren sozialer Lernprozesse sind Kontinuität, Offenheit, Vertrauen und Prozessorientierung, die im Rahmen punktueller Beteiligungsformate schwierig aufzubauen sind (Tritter und McCallum, 2006; Wondolleck et al., 1996). Die kontinuierliche und prozessorientierte Einbeziehung der Bürgerinnen und Bürger in die Belange der Stadtentwicklung – nicht nur anlassbezogen, sondern vor allem auch auf strategischer Ebene - könnte daher einen Beitrag dazu leisten, bislang ungenutze Potenziale partizipatorischer Praxis zu heben und die Beziehung zwischen Staat und Gesellschaft neu zu gestalten. Dabei spielt insbesondere der Faktor der Verlässlichkeit und der Transparenz der Spielregeln für beide Seiten eine zentrale Rolle (Klages und Vetter, 2013). Der Frage, wie aus projektbezogener Beteiligung eine langfristige Zusammenarbeit auf Augenhöhe im Sinne einer kollaborativen Stadtentwicklung werden kann, kommt daher in Zukunft eine zentrale Bedeutung zu.

3 FALLSTUDIE „LEITBILD UND MASTERPLAN KORNEUBURG 2036"

In den folgenden Abschnitten wird die Fallstudie Leitbild und Masterplan Korneuburg 2036 vorgestellt. Im Rahmen dieses Projektes wurde in enger Zusammenarbeit zwischen Stadt und Bürgerinnen und Bürgern ein verbindlicher Leitfaden (Masterplan) für die zukünftige, nachhaltig orientierte Stadtentwicklung erstellt, als auch auf Basis der Erfahrungen aus diesem partizipativen Prozess ein Commitment für langfristige und verlässliche Kollaboration zwischen Stadt und Bürgerinnen und Bürgern (Charta) erarbeitet.

3.1 Projektrahmen

Die niederösterreichische Bezirkshauptstadt Korneuburg (rd. 12.500 Einwohnerinnen und Einwohner, Stand 2015) erfährt aufgrund ihrer Lage in einem zukünftigen Wachstumshotspot am nördlichen Stadtrand Wiens einen relativ hohen Bevölkerungszuwachs. Die Statistik Austria (2015) hat für das Jahr 2030 ein österreichweites Bevölkerungswachstum von 9% prognostiziert, wobei der Großteil davon auf die Stadtregion Wien entfällt. Für den gesamten Verdichtungsraum ist laut einer ÖROK-Prognose (Fassmann et al., 2009; ÖROK, 2001), ein Wachstum von 146.000 Menschen errechnet worden, davon knapp 60% für den nördlichen Teil des Wiener Umlandes, zu dem auch die Stadt zählt. Betrachtet man diese Prognose etwas kleinräumiger, so ist für den Bezirk Korneuburg ein Plus von 23,3% zu erwarten. Zwar wird sich diese dynamische Entwicklung vorwiegend auf jene Orte konzentrieren, die über viele Baulandreserven sowie mögliche Bauflächen verfügen, was für die Stadt Korneuburg im Vergleich zu anderen Gemeinden weniger zutrifft, dennoch ist durch diesen generellen Trend die Entwicklungsrichtung auch für die Stadtgemeinde vorgegeben: Wachstum. Die Nachfrage nach Wohnraum, aber auch nach attraktiven Flächen für Betriebe wird in Zukunft für diese Region ansteigen; es gilt, diese auf eine möglichst nachhaltige Weise zu befriedigen. Dazu zählt unter anderem die Ausnutzung bereits vorhandener Infrastrukturen oder die (Wieder)Inwertsetzung von Leerständen und Brachflächen anstelle von Neuausweisungen.

Um einem ungesteuerten Wachstum entgegenzusetzen und einen Rahmen für die zukünftige Stadtentwicklung zu setzen, startete die Gemeinde 2012 einen partizipativen Leitbildprozess (siehe Schauppenlehner-Kloyber et al., 2013). Aufbauend auf dem Ende 2013 verabschiedeten Leitbild mit dem Titel „Korneuburg – Leben im Zusammenfluss" wurde – ebenso in partizipativer Vorgehensweise - ein umfassender Masterplan mit Handlungsempfehlungen zur Umsetzung der im Leitbild formulierten Ziele für die nächsten 20 Jahre erstellt. Das Vorhaben wurde von Beginn an von aktiven Bürgerinnen und Bürgern der Gemeinde (der Zukunftsinitiative Korneuburg (ZIK)) forciert und unterstützt, weshalb von einem Bottom-up-Prozess mit einem hohen Grad an Motivation und Identifikation einzelner Akteurinnen und Akteure gesprochen werden kann. Der Prozess wurde von einem interdisziplinären Wissenschaftlerinnen- und Wissenschaftlerteam aus Geographie, Architektur, Landschaftsplanung, Regionalentwicklung und Moderation/Facilitation begleitet.

Die breite und intensive Beteiligung der Korneuburger Bürgerinnen und Bürger in allen Prozessstufen ist als Besonderheit des Prozesses zu werten. Neben einem direktdemokratischen Element in der Phase der Leitbildentwicklung (alle Gemeindebürgerinnen und Gemeindebürger konnten aus vier partizipativ entwickelten Zukunftsszenarien ihr „Wunschbild" für die zukünftige Stadtentwicklung und damit die zentrale Ausrichtung des Leitbilds wählen), ist vor allem die Implementierung einer – zunächst auf Projektlaufzeit beschränkten – Steuerungsgruppe aus Bürgerinnen und Bürgern, politische Akteurinnen und Akteuren und Verwaltungsmitarbeiterinnen und Verwaltungsmitarbeitern in gleicher Gewichtung zentral für den Projektfortschritt zu nennen. Dieses „Steuerrad" umfasste 28 Personen (inkl. Vertretungen), die als Kernteam am Projekt arbeiteten und in gleicher Weise stimmberechtigt waren. Vertreten waren neben dem amtierenden Bürgermeister sämtliche politischen Fraktionen, die lokale Verwaltung, Zivilgesellschaft und Bürgerinnen und Bürger. Zu Beginn des Prozesses wurde gemeinschaftlich eine Geschäftsordnung erarbeitet, die das Zusammenarbeiten und die damit verbundenen Rechte und Pflichten regelt. Im Schnitt kam das Steuerrad über eine Laufzeit von knapp drei Jahren einmal pro Monat zu Sitzungen zusammen, was eine beachtliche Summe an ehrenamtlich erbrachten Arbeitsstunden ergab.

3.2 Prozessstufen und –dynamik, Arbeitsschritte

Sämtliche Prozess- und Arbeitsschritte des Projektes wurden in enger Zusammenarbeit zwischen städtischen Akteurinnen und Akteuren, Bürgerinnen und Bürgern und wissenschaftlicher Begleitung vorgenommen.

Zu Projektbeginn stand eine wissenschaftsgeleitete Struktur- und Entwicklungsanalyse, deren Ergebnisse mit qualitativen Erfahrungen der lokalen Wissensträgerinnen und Wissensträger (qualitatives Systemwissen) abgeglichen wurden. Die Struktur- und Entwicklungsanalyse fokussierte vor allem auf eine Analyse und Bestandsaufnahme der Siedlungsstruktur und Bevölkerungsentwicklung und hatte zum Ziel, die komplexen Zusammenhänge aufzuzeigen, von denen eine weitere Entwicklung abhängen kann und die auf ganz unterschiedlichen Maßstabsebenen wirken. Neben Siedlungs- und Bevölkerungsentwicklung wurden auch die Bereiche „Wirtschaft ", „Verkehr" und „Umwelt" und deren Wechselwirkungen analysiert. Die Ergebnisse versuchten Antworten zu geben auf Fragen wie beispielsweise „Welche Spiel- und Gestaltungsräume stehen der Stadt zur Verfügung?", um zukünftige Entwicklungsmöglichkeiten der Stadt hinsichtlich ihrer Machbarkeit zu beleuchten. In einem nächsten Schritt wurden durch die Kombination der Ergebnisse aus der Strukturanalyse und der Einschätzung der Steuerradmitglieder zentrale Handlungsfelder definiert, die Berücksichtigung in der Szenarienerstellung fanden und schließlich zum ausformulierten Leitbild führten. (siehe Schauppenlehner-Kloyber et al., 2013).

Die darauf aufbauende Erstellung des Masterplans Korneuburg 2036 wurde weiterhin von externer Seite fachlich betreut und in enger Abstimmung mit Politik, Verwaltung und Bürgerinnen und Bürgern erarbeitet. In einer ersten Erhebungsphase wurden der IST-Stand aktueller Planungen und Projekte sowie ein möglicher Handlungsbedarf der Stadtgemeinde Korneuburg in den verschiedenen im Leitbild definierten Lebensbereichen erhoben.

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Um eine entsprechende Datengrundlage für die Ausarbeitung der konkreten Themenfelder und Maßnahmen zu erhalten, war es zudem notwendig, Basisanalysen in den Bereichen Demographie und Innenentwicklung bzw. Nachverdichtung durchzuführen. Genauere Erkenntnisse über die Bevölkerungsentwicklung und die Bevölkerungsstruktur der Stadtgemeinde Korneuburg brachte eine demographische Analyse. Dieser „Demographie-Check" analysiert die Stadt in drei Ebenen: Zunächst wird die Stadt als Ganzes betrachtet und dabei werden unterschiedlichste statistische Daten wie Bevölkerungsentwicklung, Wanderungs- und Geburtenbilanz, Wanderungssaldo nach Alter, Bevölkerungsstruktur usw. auf Gemeindeebene ausgewertet. In einem weiteren Detaillierungsschritt wird die Stadt in ihre statistischen Zähleinheiten (Zählbezirke) untergliedert. Dadurch können wesentlich genauere Aussagen zu den auf Gemeindeebene erhobenen Daten getroffen werden wie beispielsweise, in welchen Teilen der Stadt ein Bevölkerungswachstum oder rückgang vorliegt. Als dritte Ebene und die damit kleinstmögliche Untersuchungsebene bei der Auswertung statistischer Daten wurde die sogenannte Rasterdatenanalyse durchgeführt. Bei der Analyse der Bevölkerungsentwicklung auf Rasterdatenebene wurde ein 250 mal 250 Meter Raster (ca. vier Fußballfelder) herangezogen. Die Analyse der Innentwicklungspotenziale erfolgte auf Basis von Luftbildern und Begehungen. Dadurch konnten parzellenscharf Nachverdichtungs- und Innenentwicklungspotenzialflächen für das gesamte Stadtgebiet Korneuburg erhoben werden.

Den 9 im Leitbild formulierten Lebensbereichen entsprechend wurden als weiteres partizipatives Element 9 Lebensbereichsteams gegründet, die sich - jeweils von einer/m Bürgerin oder Bürger und einem/einer politisch Verantwortlichen bzw. einem/einer Verwaltungsmitarbeiterin oder Verwaltungsmitarbeiter geleitet – intensiv mit den Inhalten der einzelnen Themen auseinandersetzten, um die im Leitbild formulierten Bedürfnisse und Entwicklungsziele für die Einarbeitung in den Masterplan und die spätere Umsetzung zu konkretisieren. Die Verantwortlichen für die Lebensbereiche waren angehalten, sich mit lokalen Expertinnen und Experten bzw. für die jeweiligen Handlungsfelder relevanten Personen auszutauschen und an einer Konkretisierung des Leitbilds in Richtung Masterplan zu arbeiten.

Unter der Mitarbeit der Steuerrad-Mitglieder wurde im September 2014 eine nach Lebensbereichen gegliederte Stärken-Schwächen-Liste erarbeitet, die als inhaltliche Basis für das weitere Vorgehen diente. Die Arbeitsergebnisse aus den Lebensbereichsteams wurden ebenso wie die vom externen Beraterinnen- und Beraterteam erhobenen Grundlagen und Daten regelmäßig in das Steuerrad getragen, dort präsentiert und anschließend diskutiert. In der abschließenden Ergebnisphase wurden die vorhandenen Informationen, Ideen und Vorschläge synthetisiert und verräumlicht. Für jeden Lebensbereich kristallisierten sich so 4-7 Handlungsfelder heraus. Unter Berücksichtigung von kommunalen und regionalen Konzepten und der vorangegangenen Basisanalysen wurden nach Themenschwerpunkten gegliedert insgesamt knapp 120 Maßnahmen ausgearbeitet. In mehreren Feedbackschleifen wurden die vom Beraterinnen- und Beraterteam vorgestellten Handlungsfelder und Maßnahmenvorschläge gemeinsam mit dem Steuerrad und den Lebensbereichsteams überarbeitet und ergänzt und schließlich dem Gemeinderat in Form einer Endpräsentation vorgestellt.

4 „ERGEBNISSE"

4.1 Leitbild

Das Leitbild „Korneuburg – Leben im Zusammen:Fluss" wurde im März 2014 der Bevölkerung präsentiert und anschließend im Gemeinderat beschlossen. Es legt die grundlegende Wertehaltung dar, die der zukünftigen Entwicklung der Stadtgemeinde als Orientierungsrahmen dienen soll. Zentrale Säulen sind hierbei eine „Kultur des sozialen Miteinanders", „Kompetenz am Wasser" sowie „Konzentration auf Bildung". Der inhaltliche Aufbau und die Struktur des Leitbilds orientieren sich an 9 Handlungsfeldern, wie z.B. Siedlungsentwicklung, Gesundheit & Soziales, Kommunikation & Beteiligung oder Mobilität (Details zum Leitbildprozess und den Ergebnissen siehe Schauppenlehner-Kloyber et al., 2013). Darüber hinaus sind im Leitbild bereits Kriterien enthalten, anhand derer die Umsetzung des Leitbilds laufend überprüft werden kann. Das Leitbild dient dabei als Grundlage für das nächste, wesentlich detailliertere Planungsinstrument Masterplan.

4.2 Masterplan

Der Masterplan „Korneuburg 2036“ ist das finale Dokument, in dem die zentralen Ergebnisse der mehr als dreijährigen Arbeit wiedergegeben werden. Er stellt ein übergeordnetes strategisches Planungsdokument dar, das in den kommenden 20 Jahren die Weichen für die Stadtentwicklung Korneuburgs stellen wird. Dabei handelt es sich um ein informelles Planungsinstrument, das trotz inhaltlicher Konkretisierung und Verbindlichkeit dynamisch bleiben soll. Bis zum Jahr 2036 können sich mit wandelnden Rahmenbedingungen auch die Anforderungen an die Stadtentwicklung verändern. Um darauf reagieren zu können, handelt es sich beim Masterplan Korneuburg 2036 um ein evaluations- und fortschreibungsfähiges Zukunftskonzept. Vordergründig verantwortlich für die Evaluierung und Weiterentwicklung des Dokuments ist das partizipative Steuerungsgremium. Der Masterplan berücksichtigt vorhandene stadtentwicklungspolitische Leitlinien und kommunale Konzepte ebenso wie (klein-)regionale Rahmenkonzepte oder überregionale Festlegungen z.B. des Landes Niederösterreich. Er integriert parallel erstellte fachliche Grundlagen wie den Demographie-Check oder die Innenentwicklungsanalyse und gibt den Rahmen für künftige Fachkonzepte wie das bereits beauftragte Verkehrskonzept oder das beabsichtigte Grünraumkonzept vor.

Damit bietet der Masterplan einen Orientierungsrahmen für die baulich-räumliche, gesellschaftliche, wirtschaftliche, kulturelle und ökologische Entwicklung Korneuburgs. Die bestehenden Rahmenbedingungen und Herausforderungen wurden dabei einerseits inhaltlich nachhaltig interpretiert, andererseits zeigt der Masterplan aber auch Raum für Visionen auf. Die drei im Leitbild definierten Schwerpunkte – Kultur des sozialen Miteinanders, Kompetenz am Wasser und Konzentration auf Bildung – stellen die Grundpfeiler der inhaltlichen Ausarbeitung des Planungsdokuments dar. Die gemeinsam mit dem Steuerrad und in den jeweiligen Lebensbereichen erarbeiteten Themenfelder und Maßnahmen bilden die Bausteine, die notwendig sind, um die im Leitbild definierten Ziele in eine planbare und zeitlich umsetzbare Dimension zu überführen. Strategisch sind den Maßnahmen drei integrierte Zielsetzungen bzw. Entwicklungsgrundsätze übergeordnet:

1. INTER-KOMMUNAL

Das nördliche Wiener Umland zählt zu den stärksten und dynamischsten Wachstumsräumen Österreichs. Korneuburg als Bezirkshauptstadt und Schwerpunktzentrum übernimmt eine Vorreiterrolle bei der gemeindeübergreifenden Zusammenarbeit. In bzw. bei wirtschaftlichen, sozialen und kulturellen Belangen und Herausforderungen setzt man auf regionale Kooperation. Die Entwicklung der wachsenden Stadtregion und ihrer Gemeinden erfolgt dabei nach den Grundprinzipien der Regionalen Leitplanung für den Nordraum Wien (ARGE „Regionale Leitplanung A5/S1/A22“, 2013).

2. KOMPAKT

Die Bezirkshauptstadt bekennt sich zu einem moderaten Bevölkerungswachstum. Aufbauend auf den Erfahrungen der letzten 20 Jahre geht man bis zum Jahr 2036 von einem Wachstum von derzeit 12.500 auf 18.000-20.000 Einwohnerinnen und Einwohnern aus. Die Gewährleistung der Balance zwischen Dichte, Lebensqualität und sozialem Miteinander hat dabei oberste Priorität. Das Wachstum der Stadtgemeinde erfolgt auf Basis des Grundsatzes „Innenentwicklung vor Außenentwicklung“ (innen vor außen). Unter ökologischen und ökonomischen Gesichtspunkten wird dabei auf eine nachhaltige und flächensparende Siedlungsentwicklung gesetzt. Die im Rahmen des Masterplanprozesses durchgeführte Innenentwicklungspotenzialanalyse verdeutlicht, dass das prognostizierte Bevölkerungswachstum auf den theoretisch verfügbaren und bereits wohnbaugewidmeten Flächen sowie dem künftigen Entwicklungsgebiet Werft und den daran umliegenden verfügbaren Flächen unter Berücksichtigung etwaiger Vorgaben untergebracht werden kann.

3. KOOPERATIV

Die Aufgaben und Herausforderungen, mit denen sich die Kommunen konfrontiert sehen, werden zunehmend komplexer. Eine zukunftsorientierte Stadtentwicklung erfordert daher den Austausch und ein gemeinsames Handeln von verschiedensten Akteuren. Unter Einbeziehung von Bewohnerinnen und Bewohnern, Unternehmen vor Ort, Eigentümerinnen und Eigentümern sowie Bauträgern gilt es, kooperative Lösungsansätze zu erarbeiten. Die Eigeninitiative und die Eigenkräfte der Bürgerschaft sollen auch in Zukunft in allen Handlungsfeldern der Korneuburger Stadtentwicklung unterstützt und gefördert werden. Durch geeignete Formen der Beteiligung sollen die Korneuburger Bürgerinnen und Bürger auch künftig an

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der Qualitätssicherung und Evaluation des vorliegenden Masterplans teilhaben. Aus diesem Anspruch heraus wurde als Teil des Masterplans eine Charta für Bürgerinnen- und Bürgerbeteiligung formuliert.

4.3 Charta für Bürgerinnen- und Bürgerbeteiligung

Die Zusammenarbeit zwischen Bürgerinnen und Bürgern und städtischen Vertreterinnen und Vertretern aus Politik und Verwaltung war sowohl in der Leitbild- als auch in der Masterplanphase von hoher Offenheit, Qualität (inhaltlich wie auch auf kommunikativer Ebene) und großem Vertrauen geprägt. Während die Produkte Leitbild und Masterplan von Projektbeginn an klare Ziele der Zusammenarbeit waren, entstand als „spin-off"-Produkt aufgrund der positiven Erfahrungen in der Art des gemeinsamen Erarbeitens eine Einigung über die Fortsetzung der Zusammenarbeit über die Projektlaufzeit hinaus. Mit der Korneuburger Charta für Bürgerinnen- und Bürgerbeteiligung wurden Leitlinien und Regelungen für diese langfristig orientierte Kollaboration zwischen Stadtgemeinde und Bürgerinnen und Bürgern formuliert. Die Charta befindet sich derzeit noch in der Detailausarbeitung und soll im Sommer 2016 im Gemeinderat verabschiedet werden (wobei die grundlegenden Werte und Ziele bereits als Teil des Masterplans im Herbst 2015 beschlossen wurden). Mit diesem verbindlichen Dokument bekennt sich die Stadt zu einer dauerhaften kollaborativen Stadtentwicklung auf Augenhöhe mit den Bürgerinnen und Bürgern. Die in der Charta beschriebenen Vorgehensweisen für eine gute Zusammen¬arbeit und erfolgreiche Bürgerinnen- und Bürgerbeteiligung in Korneuburg werden stufenweise realisiert, stellt schließlich für alle drei Gruppen – die politischen Entscheidungsträgerinnen und Entscheidungsträger, die Verwaltungs-Mitarbeiterinnen und Verwaltungs-Mitarbeiter und die Bürgerinnen und Bürger – die neue Zusammenarbeit ein weites Lernfeld dar.

Kernstück der Charta ist die Implementierung und Weiterführung eines permanenten Steuerungsgremiums (vormals Steuerrad des Leitbild- und Masterplanprojektes), in dem Bürgerinnen und Bürger sowie Vertreterinnen und Vertreter aus Politik und Verwaltung auch in Zukunft zusammenarbeiten, um einerseits die Umsetzung der in Leitbild und Masterplan festgelegten Ziele und Maßnahmen voranzutreiben und zu überwachen (Monitoring), sowie andererseits sämtliche Belange rund um das Thema Bürgerinnen- und Bürgerbeteiligung in der Gemeinde zu koordinieren und zu steuern.

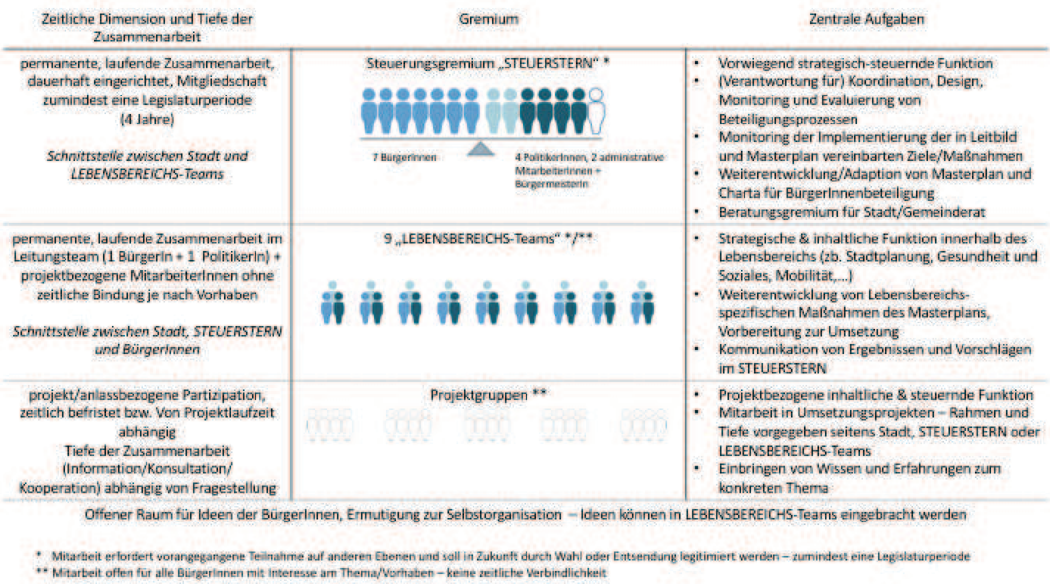

Abbildung 1: Gremien der Bürgerinnen- und Bürgerbeteiligung in Korneuburg, zentrale Aufgaben und Verbindlichkeit

Auch die in den 9 Lebensbereichen eingerichteten Teams, geleitet jeweils von einer/m Bürgerin oder Bürger und einer/m Politikerin oder Politiker, arbeiten langfristig orientiert an der Vertiefung und Konkretisierung der Handlungsfelder und Maßnahmen im jeweiligen Themenbereich bzw. fungieren als Anlaufstelle für neue Vorhaben, die in diesen Feldern in Zukunft entstehen. Die Arbeit in den Lebensbereichsteams erfordert ein hohes Maß an Abstimmung mit den zuständigen Abteilungen und Ausschüssen der Gemeinde. Zugleich dienen die Teams als Kontaktstelle für interessierte Bürgerinnen und Bürger, die sich in der Stadt engagieren und beteiligen wollen. In der Regel findet dieses Interesse themen- oder projektbezogen statt, weshalb die Lebensbereichsteams einen niedrigschwelligeren Zugang darstellen, als das Gremium des Steuersterns.

Gleichzeitig ist der Zugang über Bürgerinnen und Bürger (und nicht ausschließlich über Vertreterinnen und Vertreter der Gemeinde) vermutlich als niedrigere Hürde zu betrachten.

Die Charta für Bürgerinnen- und Bürgerbeteiligung umfasst darüber hinaus – neben allgemeinen Qualitätskriterien und Werten als Grundlage der Beteiligungskultur - Richtlinien zur Initiierung von Bürgerinnen- und Bürgerbeteiligung und regelt damit die Vorgehensweise, wie Bürgerinnen und Bürger selbst Beteiligung an (eigenen oder von der Stadtgemeinde geplanten) Projekten und Vorhaben erreichen können, für welche die Stadtgemeinde es nicht von sich aus vorsieht. Basis dafür stellt eine Vorhabensliste der Gemeinde dar, auf der in festgelegten Abständen die aktuellen und geplanten Vorhaben transparent gemacht werden, jeweils mit Basisinformation dazu versehen, sowie mit dem Hinweis, ob und in welcher Form sich Bürgerinnen und Bürger in der konkreten Projektumsetzung einbringen können (hierzu liegen bereits einige Beispiele aus anderen Gemeinden vor, die Leitlinien für die Bürgerinnen- und Bürgerbeteiligung erarbeitet haben, wie z.B. Bonn, Heidelberg, Graz u.a.).

5 DISKUSSION

Zukunftsbewusste Städte sind gefordert, vorausschauend zu planen und dabei ein hohes Maß an Verbindlichkeit der formulierten Entwicklungsziele und -schritte zu erreichen und dennoch flexibel auf Veränderungen zu reagieren und kreative Wege im Umgang mit neuen Herausforderungen zu beschreiten, denn: „nur anpassungsfähige Städte können langfristig ihre gesellschaftlichen und ökonomischen Aufgaben erfüllen“ (Jakubowski, 2013). Dieser Spagat und damit der eingangs beschriebene Vorgang des Suchens, des vorausschauenden Lernens und der Innovation am Weg zur resilienten Stadt erfordert ein hohes Maß an Offenheit und Innovationsbereitschaft der handelnden Akteurinnen und Akteure.

Im Rahmen des Projektes „Korneuburg 2036“ wurden auf mehreren Ebenen neue und innovative Wege beschritten. Einerseits in Bezug auf die kollaborative Erarbeitung eines umfassenden, integrativen – informellen – Planungsdokuments, das über die Kernaufgaben klassischer Stadtplanung hinaus sämtliche Dimensionen städtischen Lebens umfasst und sowohl Stabilität, Vorhersagbarkeit und Verlässlichkeit in der Stadtentwicklung ermöglichen soll, als auch durch Evaluierung und Weiterentwicklung dynamisch und anpassungsfähig bleiben soll. Andererseits verlangte die experimentelle Form der Zusammenarbeit im Rahmen des Steuerungsgremiums, das als dauerhafte Institution in der Gemeinde verankert wird, allen Beteiligten – Politik, Verwaltung, Bürgerinnen und Bürger und externe wissenschaftliche Beraterinnen und Berater – ein hohes Maß an Vertrauen, Flexibilität und Geduld ab sowie die Bereitschaft, sich gemeinsam auf diesen intensiven sozialen Lernprozess einzulassen. Sowohl inhaltlich als auch prozessbezogen bestand laufend die Notwendigkeit, spontan Lösungen und Vorgehensweisen für anstehende Fragen zu entwickeln oder bekannte Verfahren an die neue Situation anzupassen. Rahmen und Vorgehensweise waren zu keinem Zeitpunkt durch städtische Akteurinnen und Akteure vordefiniert, sondern wurden im Sinne der eingangs erwähnten Definition von Kollaboration (Bornemann, 2012) in enger Zusammenarbeit miteinander entwickelt.

Was zunächst als „klassischer Beteiligungsprozess“ begann, gewann bereits im Zuge der Leitbilderstellung an beachtlicher Eigendynamik. Der Erfolg der Zusammenarbeit war maßgeblich von der Offenheit und Kommunikations- und Kooperationsfähigkeit der handelnden Akteurinnen und Akteure abhängig. Sämtliche Entscheidungen wurden konsensuell getroffen, auch im Gemeinderat konnte man alle Beschlüsse in Bezug auf das Projekt einstimmig fassen. Da nicht immer von einer solchen Konstellation ausgegangen werden kann und sich durch Veränderung der Zusammensetzung auch Kultur und Atmosphäre der Zusammenarbeit verändern, entstand mit der dauerhaften Institutionalisierung der Bedarf, Regeln für die Zusammenarbeit zu erarbeiten und dabei vor allem die grundlegenden Werte herauszuarbeiten. Erfahrungen aus bisherigen Beteiligungsprozessen und das Verständnis einer angebotsseitigen Beteiligung reichten dabei nicht aus, um die entstehenden Fragen und Herausforderungen in Bezug auf langfristig funktionsfähige und lernende Kollaborationsstrukturen zu beantworten. Der zentrale Unterschied des Korneuburger Wegs zu traditionellen Beteiligungsverfahren (anlass/projektbezogen) liegt darin, dass die Bürgerinnen und Bürger dauerhaft in strategische Entscheidungen der Stadt (schon vor Projektebene) miteinbezogen sind. Neben der Berücksichtigung zentraler Erfolgsfaktoren für Bürgerinnen- und Bürgerbeteiligung wie Fairness, Transparenz, offene Kommunikation, frühzeitige Einbindung, Repräsentativität in der Auswahl der Beteiligten, gemeinsames Erarbeiten von Kooperationsregeln oder Ergebnisoffenheit (Newig, 2007) rückte daher vor allem die Frage der Legitimität in den Vordergrund. Während die politischen Vertreterinnen und

Vertreter durch Wahlergebnisse klar legitimiert sind, stellt sich die Frage, mit welchem Prozedere eine legitimierte Entsendung der Bürgerinnen und Bürger ein langfristig wirkendes Gremium sichergestellt werden kann. Es zeigte sich, dass die relativ große Hürde zur Mitarbeit in einem permanenten Gremium zu einer gewissen gesellschaftlichen Elitenbildung führt: Es beteiligen sich hierbei jene, die in der Regel über einen höheren Bildungsstand und ausreichend Zeitreserven verfügen. Kontinuität in der Zusammenarbeit stellt sich als Potenzial und Risiko des Prozesses zugleich heraus: Einerseits erlaubt sie intensive kollektive Lernprozesse, die Entwicklung eines umfassenden gemeinsamen System- und Prozesswissens, zugleich wirkt sie immer stärker ausschließend und elitär. Die Balance zwischen intensiver Mitgestaltung einiger Weniger und der punktuellen, projektbezogenen Beteiligung Vieler wird in Zukunft im Zentrum der Bestrebungen der Gemeinde stehen müssen.

In Bezug auf die inhaltliche Erarbeitung des Masterplans stellte sich vor allem die Frage nach der Legitimität und „Gültigkeit“ des Wissens, z.B. Expertinnenwissens und Expertenwissens versus Erfahrungswissen. Auch im Übergang von der Erarbeitung von kreativen Visionen (Leitbild) versus konkrete Umsetzungsprojekte (Masterplan) lag eine besondere Herausforderung des Prozesses. Aber gerade dieses Wechselspiel zwischen „großen Plänen“ und „kleinen Schritten“, die Einheit von Orientierung und Umsetzung, ist das Wesentliche, das eine strategische Planung ausmacht (Kühn, 2008; Brake 2000).

Ein weiterer offener Diskussionspunkt ist der offensichtliche Wiederspruch von einem „ergebnisoffenen Prozess“ und einer strengen Prozessreglementierung: hier stellt sich begründeterweise die Frage, inwieweit kreative Programme und Instrumente wie beispielsweise Leitbilder in ein „Vorgaben-Korsett“ zu zwängen sind. Die „örtlichen Entwicklungskonzepte“ in Österreich zeigen zum Beispiel, dasstrenge Reglementierungen nicht immer zielführend sind. Durch die konkreten formalen Vorgaben und inhaltlichen Mindeststandards werden diese sehr oft von den Gemeinden mehr als notwendiges Übel als ein Instrument langfristiger Entwicklungsplanung angesehen.

6 SCHLUSSFOLGERUNGEN

Es hat sich gezeigt, dass die enge Zusammenarbeit von Bürgerinnen und Bürgern, Politik und Verwaltung, um gemeinsam Verantwortung für die zukünftige Stadtentwicklung zu übernehmen, durchaus ein vielversprechender Weg zur nachhaltigen und resilienten Gemeinde sein kann. Dennoch sind sowohl auf Ebene der Institutionalisierung neuer Kollaborationsstrukturen – von anlassbezogener Bürgerinnen- und Bürgerbeteiligung zu strategischer Zusammenarbeit – als auch auf Ebene der Erarbeitung und Verankerung informeller Planungsinstrumente noch zentrale Fragen offen. Dazu zählen vor allem die Frage der Legitimität der beteiligten Bürgerinnen und Bürger und mögliche Konflikte mit gegebenen Entscheidungs- und Machtstrukturen im Rahmen unseres repräsentativ-demokratischen Systems, sowie der Umgang mit nicht (rechts)verbindlichen Konzepten und Programmen seitens kommunaler Entscheidungsträgerinnen und Entscheidungsträgern

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Local Agenda 21 Plus Josefstadt: Smart Projects to Share Space, Talents, Knowledge, Objects and much more

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1 ABSTRACT

The Local Agenda 21 Plus in Vienna is based on the principle of sustainable urban development at the district and city level. The main goal is to use the creative potential of the different stakeholders for the development of innovative ideas and projects in the district. The main focus of the Local Agenda 21 Plus Josefstadt is to transform the district into a smart, sharing district to reduce to consumption of resources. The slogan used is "Josef and Josefine take part". Concepts like the Smart City/Region have a strong focus on technological solutions and newly built structures. So there is need for smart spatial concepts and smart approaches for existing structures. One possibility of smart development in the existing structures is the sharing of space and infrastructure. Car sharing is also offered by private sector as the project Sharoo (powered by Migros subsidiary m-way AG with participation of the Swiss Mobiliar Holding AG, successfully shows (sharoo AG 2013). With exchange platforms like Napster the idea of shared economy became mainstream. But the real benefit of collaborative consumption and sharing turns out to be social. In an era of individualism, the peer-to-peer sharing "involves the re-emergence of community," says Rachel Botsman (2010) and is therefore very important in bottom-up planning process, because people learn to trust each other (ibid). Therefore the sharing concept is in line with the Local Agenda 21 Plus goals and the experiences in the Josefstadt will test the practicability of the idea.

Keywords: Shared Space, Shared Knowledge, Shared Objects, Local Agenda 21, Smart Development

2 SHARED CITY = SMART CITY

2.1 Effects of Sharing

Sharing is the joint use of a resources or space and also includes in a broad sense the collaborative consumption of goods and services. By sharing instead of possessing resources are saved. The possibilities for common use (e.g. vehicles, apartments, programs, homes, gardens, services) are manifold and not new. "New" technologies e.g. smartphones, however, multiply the opportunities for sharing. The actual time spirit and lifestyle makes the "we" more attractive and pushes the need for personal ownership more and more into the background. By sharing on the one hand natural and spatial resources are saved and on the other hand personal time and financial cost are reduced. For example, the laundry room revival - historically arose from infrastructural needs, now rediscovered as a resource-saving service facility. Sharing and renting is reinvented by innovative technologies.

The so called commons refer to the cultural and natural resources accessible for everybody, including natural materials such as air, water and earth. There are freely available to all potential buyers and is therefore also used and shared together. By definition, public goods can be provided by the State or by private providers (e.g. Wikipedia). Public goods and common goods are public goods by non- excludability property. The concept of "collaborative consumption" was published in 1978 (Felson/Spaeth). With the book "What's Mine is Yours" by Botsman/Rogers (2010) it rose in popularity, especially in the US. "Sharing is ... Connectivity Connectivity is progress ... It's not how smart you are ... but how connected you are!" writes the communication scientist Dominik Haller and outlines the "post -ownership" movement, currently led by innovative thinking "digital bohemians", which focus on sustainability and are not waiting for politicians and companies to change (Haller, 2013). This new attitude of "sharing instead of owning" reflects milieu bound trends, their impact on the spatial development have hardly been explored. The main effects of sharing are described as follows:

- Resources: Sharing helps to use resources more efficient and to adapt to a world with fewer resources. Botsman (2010) points out that sharing might help to achieve sustainability goals by reducing waste and pollution as well as extending the life-cycles of products. Fewer assets bought

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and sold means that there is more value taken from the same environmental resources as well. There is no doubt that the emergent paradigm of sharing resources will expand and flourish in future, especially in the face of continuing economic recession, government austerity and environmental concerns.

- Social innovation and trust: Various forms of sharing amongst residents, neighbours and colleagues can strengthen communities and builds trust into the society which leads to greater resilience in times of economic and environmental stress. Even with the growing individualisation of lifestyles sharing helps to keep society values be strengthening of neighbourhood community relationships in both urban and suburban areas.
- Economy: Sharing leads to lower sales and in the long run possibly to a shift in production and employment structures. Some worry that sharing creates an informal economy, which lacks the safety nets of social security, health insurance, anti-discrimination, and taxation. These are aspects to be tackled with this “new” economy and sharing also creates new kinds of demand.
- Technical Innovation: The introduction of new technologies (smartphones, apps and websites) in the past years enables more opportunities for sharing and renting. A lot of innovation and development made the sharing-coordination possible through modern technology.
- Urban development: At the moment cities and agglomerations are the hubs of sharing economy. The impact of “space” sharing and sharing in general on the spatial development have hardly been research.

2.2 Smart City and Sharing

The Smart City / Region is defined by the City of Vienna as an “intelligent, sustainable city – responding to the challenges of a changing energy , mobility and economic system that aims to ensure the quality of life of citizens in the long term" (Magistrat der Stadt Wien, 2014). In recent years, numerous Smart City research projects have been carried out in Austria, a special funding programme was created (Klima- und Energiefonds, 2014), EU initiatives have been provided with substantial funds to accelerate the use of efficiency- enhancing technologies in Europe Smart Cities. As a result of this a lot of cities call themselves "Smart City" nowadays, although or because it is not clearly defined yet.

The climate scientist Boyd Cohen has developed a worldwide "Smart City Index" (Cohen, 2014), which is updated annually and is based mainly on quantitative data (Cohen, 2013). Looking at the indicators of the Smart City Index, the spatial development is not included. Most Smart Cities put technological innovations and approaches at the forefront, such as civil engineering, traffic engineering, network engineering or information and communication technology solutions. When it’s about the urban environment, the Smart City Concept appears especially in development areas, e.g. in Vienna the Car-free model housing, Bike City, Marx box or the Seestadt Aspern (Magistrat der Stadt Wien, 2014). The Smart City aims to use resources in an intelligent and sustainable way. The new construction rate of buildings in Austria as well as in Germany is less than 1% per year, most of the today and future living, working and leisure space is already built. Use the existing stock, continue to build on the stock, organizing the existing stock resource efficiently - these are key challenges for the Smart City designed for smart urban development and smart renewal processes. One possible approach is the common use and sharing of resources.

2.2.1 Sharing as a spatial development concept

Cities and regions worldwide increasingly recognize the potential of sharing. In Europe, Amsterdam wants the first European Shared City and has decided at least not to ban shared economy such as Airbnb (Share NL, 2014), Urban Gardening is funded by municipalities or at least initiatives such as Bodenfreiheit for the preservation of open spaces are less hindered. Overall, the debate in Europe is still at the beginning.

The South Korean capital Seoul has declared itself a shared city in 2012 (Johnson, 2013). As one of the global megacities Seoul is facing extraordinary challenges in terms of population and mobility development, environmental impact, etc. Seoul has begun to promote shared economy companies and sets sharing initiatives. A mission statement for the "common use" has been adopted and includes the following objectives and measures:

- A label for selected sharing services to establish trust

- To promote sharing companies to strengthen their perception in public and funding of 10 sharing companies with € 180,000 to build or improve their services and also to support 20-share-startups (counselling, subsidy and provision of office space) with innovative ideas and thinkers.
- Establishment of the "Shared Seoul Promotion Committee " consisting of actors of different sectors (e.g., science, law, media , transportation) to disseminate the Shared City idea in all policy
- International branding of Seoul as a Shared City and as a future-oriented innovation center. Organization of an international conference on the Shared City to exchange know-how.
- The communication between the administration and the economy should be improved through shared data and the Department of Social Innovation acts as a focal point for the Shared City Seoul.

In addition, Seoul offers 492 carsharing vehicles, opens the parking of governmental and municipal buildings outside of work hours to the public, supports common living of senior citizens and students, opens common tool boxes and bookshelves throughout the city and much more. With support of the city companies like Woozoo, a company that remodels the old houses into the shared living or SOCAR - a car-sharing company, children's clothes exchange or even a food sharing platform improve their services. The Creative Commons Korea (CCK) platform is the official partner of the city to share information and resources via an online platform.

The Shareable Cities Resolution was adopted by the US Conference of Mayors in June 2013 (Collaborative Consumption, 2013). This resolution, supported by 15 mayors (including San Francisco and New York City), "states that mayors resolve to make their cities more shareable, encourage better understanding of the sharing economy, and create local task forces to review and address regulations that may hinder participation in the sharing economy" (ibid).

3 SPATIAL POTENTIAL OF A SHARED CITY

3.1 Sharing goods and services

The service platform Task Rabbit (Task Rabbit, 2014), especially available in American cities, has developed a sophisticated system. Based on the principle of neighbourly help, Task Rabbit offers help for supermarket shopping, assembling of furniture or small repairs locate in the neighbourhood. Task Rabbit is based on trust between people, which is built up by background checks, personal profiles as well as ratings and reviews. Unlike traditional barthering circles, for example in a number of regions in Austria work with their own currency or time accounts, the Task Rabbit is paid after the task is fulfilled online by credit card.

This model allows easy neighbourhood assistance and inspires trust, but without dependence and fits individual lifestyles. The task rabbits develops a virtual trust value by the ratings and reviews over time - similar to online shops. The experiences of Task Rabbit show that employees with high trust levels are booked more often. According to Botsman / Rogers (2010), this trust value could be similar to the credit rating in the future and uses as an integral part of a personal portfolio, if it's provided platform independent.

In Vienna the platform "Frag nebenan - ask next door" (https://fragnebenan.com/, 30.03.3016) links interests, recommendations and neighbourhood help within the house, block and the neighbourhood. The service is for free and was invented by seven active Viennese citizens with to goal to support a community platform in a dynamically growing city. Sharing goods became also popular with shops to borrow things, exchange platforms and repair workshops.

3.2 Crowdfunding and Crowdsourcing

A small revolution in the field of software development was started by open source programs. The Internet community develops - jointly and transparently - different software applications that are available for free. Start -ups discovered the possibility of crowdfunding and crowdsourcing for innovative projects, which become financed through many small amounts. This offers a new dimension for innovations as probably these projects would not have been financed by banks.

Crowdsourcing of spatial data in planning processes - the entering, updating of data and collections of ideas – gets more and more popular. The number of applications of online-based participation tools grows increasingly. In Vienna 8,500 people discussed about – their wishes, concerns, needs and ideas - "Living together in Vienna" in 651 Charter groups. The results were put together in the "Vienna Charter" (Wiener

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Charta, 2013). On www.muenchen-mitdenken.de citizens were involved in the revision of urban development plan ("Perspektive München"). www.muenchen-mitdenken.de was viewed more than 180,000 times within the period of three months. On www.schau.auf.linz.at anyone reports on problems, deficiencies and opportunities for improvement on site using an online portal. The following information is available for everybody: when a message was delivered and how long did it take until the defect has been fixed (Stadt Linz, 2014).

Crowdfunding is also used for secure and design open spaces. The association Bodenfreiheit in Vorarlberg is looking for people who are willing to spend each month, an amount of at least 10 euros to buy open spaces which are already dedicated residential areas. When these areas are bought, the will not be built up and are made accessible by the public (Bodenfreiheit, 2014).

3.3 Sharing space

The possibilities to share space are manifold such as living space, working spaces, gardens, sports facilities, meeting halls, parking lots, garages, storage rooms, courtyards, streets and squares.

The so-called “shared space” is a planning approach to minimise demarcations between different modes of transport by removing features such as curbs, road surface markings, traffic signs and regulations (FGM, 2014). The principle behind this is quite simple: all road users feel fundamentally insecure and therefore the attention is increased massively. Experiences and surveys show that this leads to a reduction of road accidents and an increase of use as well as quality of public space.

Fig. 1: VIENNA, Mariahilfer Straße: In a citizen survey in March 2014 (with a stake of almost 80% of the voters) the inhabitants of the neighbouring districts were in favour of the traffic calming Mariahilfer Straße with 53.2%. Shared space or pedestrian zone covering a distance of 1.6 km. Picture Credits: stadtland.

Not only in the public space but also in the private space, there are numerous examples of common usage, especially for touristic use. Examples are: couchsurfing, an Internet- based guest network for the exchange of accommodation with 7 million members in more than 100,000 towns (couchsurfing, 2014) worldwide, private renting of rooms like Airbnb, founded in August 2008 with headquarters in San Francisco, another worldwide community for private accommodation (Airbnb, 2014) or houses and home exchange. One exchange of living space in Vorarlberg – announced by the exchange platform of Radio Vorarlberg - has become a pilot project in the country of Vorarlberg (ORF, 2013). A young family of five people from Wolfurt had offered their too small apartment in exchange for a house and the change was successfully completed.

Particularly in the age group 50 + there are innovative examples, when it comes to share living space. On the one hand, the costs are reduced by sharing and on the other hand it is more possible to stay in the community. Nevertheless, the focus is again projects with new constructions. However, many older people live in large flats over 100 m², the general these units could be easily converted to residential communities, corresponding individual and communal areas. This has two effects: more exchange of the inhabitants and resources saving (e.g. space, energy, heating). The combination with thermal renovation this community housing project causes higher energy efficiency than thermal renovation alone. Increasing only the higher occupation density brings an energy-saving effect (Brandl, 2012, P. 111). Moreover, mobile services are organized easier and more cost-efficient, if needed. There is variety of models possible - from small apartments including bathroom in a shared large apartment up to a family house with common areas. This ensures privacy and takes advantage of the common facilities.

Urban Gardening is a popular trend for several years where people join together for gardening. The organization forms are very different. Partially located on public or private space, organized with access restriction or simply accessible for all, such as on tree slices and green stripes in the road space or flower beds in the park. Urban Farming , also known as "City Farming", in neighbourhood gardens ("Community Gardens") in a public space, to semi-public or private green on buffer stripes and on former agricultural and fallow land (incl. Brownfields) increased the diversity of green features in the city. It allows a "Do it yourself" urban nature experience and strengthens the relation to food production. The City of Vienna promotes neighbourhood gardens. The Municipal Department 42 lists 20 supported garden projects (February 2014), more gardens are in the planning stage. Urban Gardening seems to be optimal entry into the sharing of space.

4 LOCAL AGENDA 21 PLUS JOSEFSTADT: A SHARED DISTRICT

The sustainable use of space and resources is a fundamental principle of spatial planning and legally anchored at all levels – European spatial development, the Austrian Spatial Development Perspective, spatial laws of the provinces, urban development plans and regional and local development concept. The Local Agenda 21 Plus is based on the principle of sustainable urban development at the district and city level. It's governance model fosters new forms of cooperation and communication between citizens and politicians and allows a common policy making on the district level. The results achieved show that a variety of topics are put forth and dealt with by the residents and that some of the solutions developed by agenda groups evolve into role models for solving similar situations. The participants appreciate the possibilities of working on projects within a remarkable framework, they gain new experience and expand their skills (Verein Lokale Agenda 21, 2016).

In the district concept for Local Agenda 21plus Josefstadt (2015-2019) the guiding principle is "Sharing" with diverse areas of action. The goal is to improve the quality of life and to achieve sustainable development in the district, facing major challenges like heavy traffic, conflicts between individual groups of users of public spaces, green space shortage, migration of purchasing power and vacant shops.

The Local Agenda 21 Plus is a form of participatory democracy and in line with the idea of the positive effects of sharing. Nonetheless, challenges do exist such as the difficulty in achieving a broad participation process; the lengthy periods until projects are realised due to administrative procedures; the trouble communicating the specific quality of the work of the agenda groups and of the whole process to people not involved; the fact that it is hardly possible to measure improvements of the mostly highly localized agenda projects by the usual sustainability categories.

Traditionally spatial planning attempts to minimize conflicts by the spatial separation and compatible mix of uses as well as moderate densities. Sharing as a principle for spatial planning means a paradigm shift. Space is not distributed anymore but commonly shared and used. The balancing of private interests (land ownership and individual use) and public interests (regulatory and development planning) needs participatory and negotiation-based planning processes focused on this new common perspective. Sharing is done by individuals, companies, ad-hoc groups or associations, often in variable, rapidly changing forms of organization and involved parties. Within this system the “users” of planning are a fuzzy, moving, a more or less loose community, so the participant's circle (e.g. by voting rights) is not conventionally clearly identified or defined anymore.

Sharing is facilitated and support by the hype of online tools providing more capacity of self-organization. The apps give the advantage of omnipresent access. Possessing, hoarding and collecting of space and objects are not so much in the foreground of a successful lifestyle anymore. The Local Agenda Team developed a virtual and phisical platform to collect ideas for projects in the field of sharing within the district. Everybody is invited to share her or his ideas.

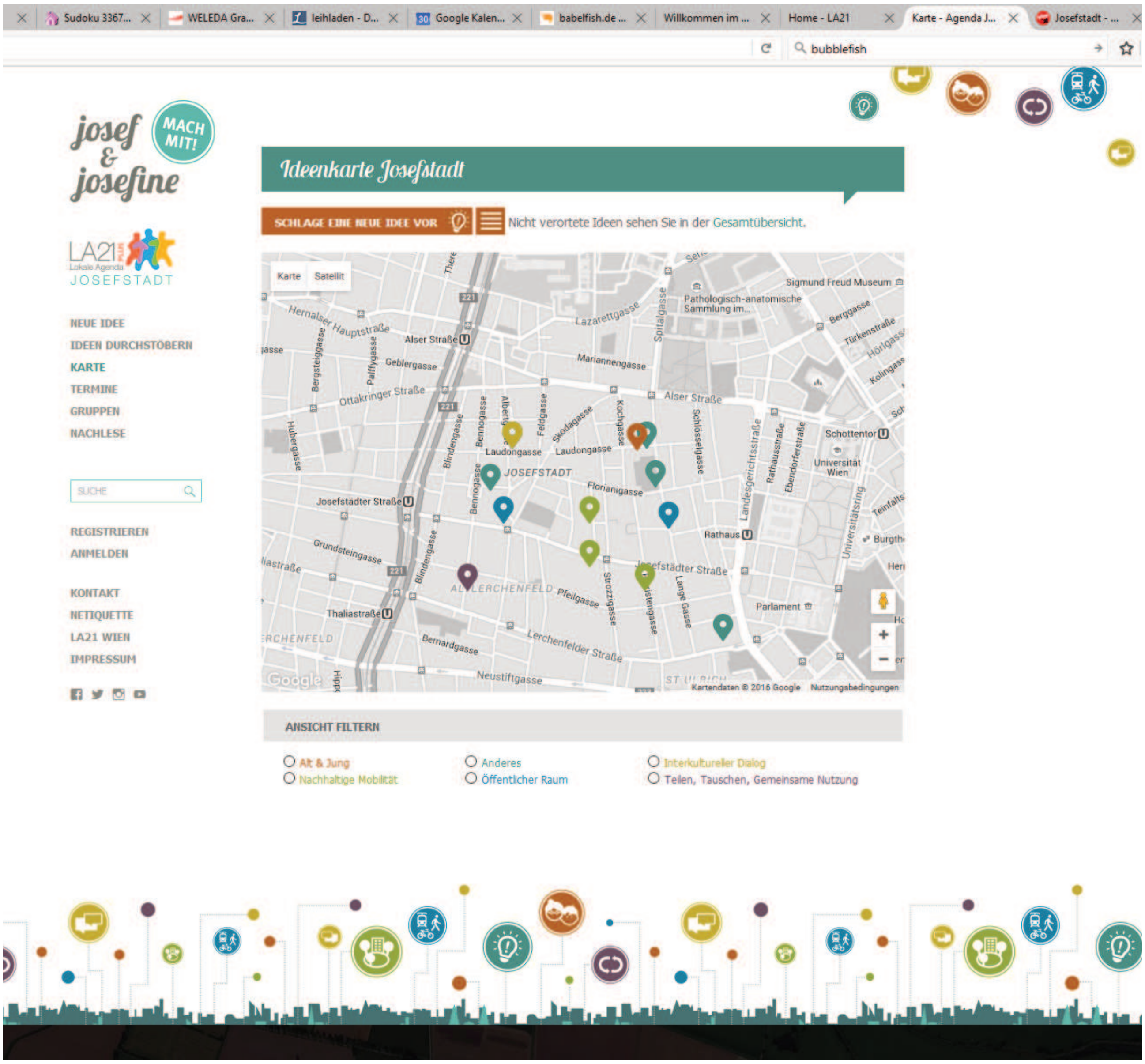

Fig. 2: Local agenda 21plus Josefstadt: Map of ideas for sharing projects within the district on the irtual platform to share ideas for development. Picture Credits: ARGE JosefStadtDialog, https://agenda-josefstadt.at/karte/ (30.03.2016)

For some people sharing seems to be antiquated and socially too romantic - it is reminiscent of commune, cooperative and clubs. Others fear "forced" sharing and therefore a limitation of personal freedom. However, experience shows that this is hardly the case. On the contrary, the social profit is in the foreground, which also coincides with the individual profit. “The reduction of ownership brings us more access: to people, to experiences and to stuff. And that makes us happy and makes us more sense, ..." explains Lena Sönnichsen, Head of PR & Social Media by Airbnb (quoted in Haller, 2013). Money loses significance, personal relationships are built up and trust strengthens the community. The environmental impact is reduced due to the lower production and disposal of goods and resources.

Far too little recognized and researched is the potential of the house and apartment sharing. Advice in social processes is needed, such as in revitalization of single family house settlements (abandoned because of the generation change), community use large apartments especially in “Gründerzeit” buildings and the reuse and conversion of commercial estates. Knowledge could be obtained from experience of building communities (see Noack, 2013) - the experience in jointly planned and built settlements and houses. Housing subsidies should be available not only for construction, but rather on the efficient use and reuse of the existing building stock.

One good pracitce example is the the project "Living for Help" was started in Erlangen (Amt für Soziales, Arbeit und Wohnen, 2014) in 2011. The basic idea is to provide assistance in everyday life for the provided living space. The project is aimed primarily at residential partnerships between seniors / families / singles and students. The additional costs of living are paid and the assistance such as help with housework, gardening, shopping, walks together, tuition for kids, babysitting are arranged individually. Only any kinds of care services are excluded. The city proposes one hour assistance per month in exchange of one m² living space (Ibid). The number of students interested in this project is very high in Erlangen, because affordable housing is hardly available. The website of the Amt für Soziales, Arbeit und Wohnen brings is the link to establish the residential partnerships (mitwohnen.org is a search engine for housing providers and housing seekers). It is particularly interesting that in this example the city itself is active in shared living. This "public" support the offer is very trustworthy and speaks out to thus users, which might not have considered such a flat model in other circumstances.

For models of the space sharing trust is an essential core value among stakeholders. In particular by sharing between strangers on the Internet through P2P platforms (peer -to-peer , such as the above-mentioned services platform Task Rabbit) as well as sharing F2F, in which the users face-to-face their immediate circle, such as a neighbourhood garden, a house or share an apartment. A master thesis at the Department of Spatial Planning at the TU Vienna developed proposals for a platform to share of vacant or under - used private garage spaces in the densely built-up urban area to enlarge public space (Stoeger , 2013).

5 CONCLUSION

To sum up sharing has great potential for an economically, socially and environmentally sustainable urban and regional development. Even if sharing has already reached a certain level of popularity and can be seen as hype for small parts of the population (about carsharing, couchsurfing, urban Gardening), it needs encouragement of civil society and economic efforts through a bunch of incentives. A successful implementation of the sharing model therefore includes the anchoring in strategy papers and planning instruments of provinces, cities and communities. The local level (the community, the village, the quarter) needs expert support, motivation and promotion as well as first-hand experiences and knowledge "on the spot", which should be integrated in the strategic approach on the higher level (Zech et al., 2011, P. 17). Sharing is promoted by smart communication as well as supported by smart technologies in construction and reconstruction of settlements, buildings, open spaces and transport infrastructure. However, the primary challenge is not the technical solution, but the smart combination of technical and social innovations. This includes planning- and process-know-how to raise awareness and participation, steering and cooperation skills within smart governance of diverse stakeholders from economy, civil society and policy.

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Low Tech Solution for Smart Cities – Optimization Tool CityCalc for Solar Urban Design

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1 ABSTRACT

Designed as an easily applicable planning and evaluation tool, CityCalc has been developed to assess the energy performance of urban planning projects at early design stages. The tool supports the development of low-tech solutions for smart cities by means of optimising the use of renewable energy on site – including passive and active solar gains.

Currently energy planning and assessment tools for early design stages do not take into account the mutual interactions of buildings such as shading and shadowing from adjoining structures as their focus is on the individual buildings. A great variety of tools for urban solar design exist nowadays, however they are not suitable for architects and early design stages (IEA SHC Task 41). In the future it will be of increasing importance to quantify the passive and active solar gains in order to fulfil ambitious legal and funding requirement and to implement future-oriented building concepts (e.g. passive house, zero energy, zero carbon or plus energy standards).

The objective was therefore to develop an easily applicable energy planning and assessment tool for urban planning projects for the early design stages. The CityCalc tool focuses on energy efficiency - that is, the reduction of energy demand - with the best possible use of site-specific energy sources (gains from solar thermal and photovoltaic plants, wind energy, combined heat and power). In order to ensure a simple, user-friendly usability for architects, a three-dimensional geometry and data acquisition and an interface with energy calculation software is developed. CityCalc is developed for urban development planning, urban design competitions and urban densification. CityCalc can be used on the one hand by architects for optimizing the conceptual design phase and on the other hand, for the energy assessment of urban planning and architectural competitions.

CityCalc combines the simplistic three-dimensional geometry input method of the freely available software SketchUp with proven evaluation algorithms of the energy performance certificate. In addition it refers to a variety of default values for details, which are not defined in detail at this stage of planning. With the assessment tool CityCalc it is possible to assess the potential of active and passive use of solar energy at a very early planning stage. For this purpose, the simplified three-dimensional input of the building and its surroundings in the free software SketchUp is required. CityCalc is available as a plugin for SketchUp.

The developed planning and assessment tool has been tested and validated in selected planning competitions and early design projects. The tool and the experiences of the validation will be presented in this paper. Conclusions are a well-adjusted applicability for an early design stage. System boundaries of the assessment have to be shaped based on the available information as well as the flexible parameters of early design stages. Further aspects of smart cities have been identified to be included in future upgrades of the tool, such as: daylight comfort of indoor and outdoor areas, costs for supply and disposal especially energy supply, embodied energy in materials. The project has been funded by the Austrian Ministry for Transport, Innovation and Technology (bmvit) within the research program ‘City of Tomorrow’ (Stadt der Zukunft).

Keywords: early design, energy efficiency, low-tech, planning tool, solar architecture

2 INTRODUCTION

In the context of Smart Cities the focus lies in the efficient and 'smart' interaction and optimisation of the different components within the city. Linking buildings, mobility, energy and industry to achieve an optimum performance in terms of quality of life, comfort, efficiency and greenhouse gas emission reduction for the overall city is considered the ultimate goal. The buildings have in this respect changed from being purely energy consumers to also energy providers by the integration of renewable energy systems into the building. Using the buildings envelope for active systems, the focus is mainly on solar powered systems, such as solar thermal collectors or photovoltaics. In addition buildings can provide a substantial load shifting potential by utilising their thermal mass capacity, building energy systems, which connect and convert thermal and electrical loads and the link to e-mobility in order to store energy and release it when it is needed.

In urban planning aspects for both new built as well as refurbishment projects the objective in terms of energy performance is therefore twofold: Buildings should exploit passive design principles by the utilisation of solar heat radiation and daylighting to reduce the overall energy consumption to a logical minimum. Reducing the thermal loads – in non-residential buildings mostly cooling and in residential buildings mostly heating - represents one of the main aspects of passive design. The location, orientation, size, angle and material properties of the glazed as well as opaque elements of the building skin together with shading elements, compactness and overall area to volume ratio provide the framework conditions for the thermal behaviour of the building. The transparent elements allow for daylighting as well as solar gains and must therefore be carefully designed to balance wanted and unwanted solar gains. On the other hand, the building skin provides ample area for the integration of active systems. The radiation potential can be exploited on all unshaded areas on the building envelope. The choice of thermal or electrical system (or a combination of both) depends mostly on the requirements of the building.

Balancing these requirements on passive as well as active design principles in a quantitative manner provides a significant challenge at an early design stage for large-scale urban planning projects. Shading and overshadowing of building structures can be easily done in almost any standard 3d CAD software. However this provides mostly only a qualitative assessment. To quantify solar radiation on a larger scale for urban planning projects a more accurate analysis is required in order to make design decisions at an early planning stage. Currently there is a lack of assessment tools available, which can quickly compare and evaluate different designs (Horvath 2011).

The project CityCalc is trying to fill that gap by providing an easy to use planning and assessment tool, which can in a simple 3d model quantify the shading effects of building structures on the energy performance of the design. With the tool the passive and active design aspects can be assessed at an early design stage and different design scenarios can be rapidly compared. The tool can also be used for design competitions, providing quantifiable key performance indicators, which can be used to rate the various designs in a quick and efficient manner.

3 METHODOLOGY

3.1 First step

The first step in the project CityCalc was to provide an overview on current urban planning practices at an early design stage and merge the findings in a state-of-the-art-report. Literature research, experience with urban planning projects and stakeholder feedback have been used to develop the framework for the CityCalc tool. The software program is based on a simplistic three-dimensional geometry input method of the freely available software SketchUp. In order to shape the functionality of the tool and to validate the prototypes in practice, several architectural competitions and similar urban planning procedures have been accompanied during the early design stages. State of the art – Integration of energy efficiency aspects in architectural competitions

The task was to survey current urban planning approaches in Austria, Germany and Switzerland with focus on forms of procedures, involved stakeholders and applicable 3d software tools for energy efficiency assessments. In addition to the literature survey, the project partners delivered substantial contributions based on their experience with conducted architectural competitions:

- 'First design building according to climate, then design HVAC according to the building' (Gertis et al., 2008) has proved its worth as guiding principle for low-tech energy efficient solutions. That means primarily to optimize the geometry and shell of the building regarding minimization of the energy demand for heating, cooling, lighting, ventilation and humidification. The second step, to optimize the HVAC-system according to the building, can be conducted during later planning stages. The principle helps to reduce the amount and costs of technical building equipment and therefore supports low-tech solutions.
- Comparing heating with cooling, in most cases the energy demand for cooling has a higher influence on the energy efficiency of non-residential buildings. This applies as well for the optimization potential and therefore it is important to take window area (especially in roofs) and shadings (of construction and other buildings) into special consideration.
- There is a lack of 3d assessment tools for early planning stages, which can quickly compare and evaluate the energy performance of different designs. Some participants of architectural competitions already perform detailed energy simulations but there are no appropriate tools available which allow fast assessments.
- In many cases the infrastructure of urban development projects causes higher costs than the buildings. Therefore there is a demand for low-tech and cost-efficient urban solutions.
- Architectural competitions are usually very specific regarding scope and objectives. Extensive criteria sets for sustainable building cause a high effort for architects and primary examiners and are hard to comprehend for the jury. Furthermore many of those criteria are not relevant for early planning stages.
- Assessment tools are necessary to integrate energy efficiency criteria in architectural competitions. But prerequisite to that is the technical competence of jury members and their affinity to the topic energy efficiency.

3.2 Urban planning in Vienna – concept and practice of cooperative procedures

A cooperative procedure is an urban planning methodology that has been used since several years in Vienna as an alternative to architectural competitions for urban planning projects. Cooperative procedures are urban planning processes with several planning teams which at least partly cooperate. There exist two basic types of cooperative procedures: Either all participants work together on a project or participants work competitively on different projects but have also a cooperative exchange during planning colloquia, workshops, presentations and discussions. In contrast to common architectural competitions there is no anonymity but usually there exists an anonymous selection procedure before the cooperative procedures starts. Cooperation partners are as well public authorities, selected departments of the municipality and developers. In several cases specific experts (e.g. for wind comfort) are integrated and public participation was realised. (Temel, 2014)

Advantages	Drawbacks
Learning procedures: Involvement of many stakeholders with continuous feedback to objectives, tasks and concepts. Combination of knowhow instead of selection of the best concept. Public participation and transparency. Diversity of procedures. Improved process: higher chances for implementation by higher acceptance of results; reduced revisions; speed. Flexibility: wide scope for stakeholders to change and adjust objectives and tasks. Variety of planners due to relatively easy access.	Risk of results with low quality due to short planning time or due to unclear starting conditions. Compared to competitions the results have no responsible author and the further development has usually no public control. Risk that a partial interest gains too much importance. A high social competence is required by participants. Partly very low fees for planners. Follow-up orders are unclear. Competence of organizer and steering committee.

Table 1: Advantages and drawbacks of cooperative procedures (Temel, 2014)

3.3 Stakeholder opinions

Interviews and workshops with stakeholders produced a critical feedback and a detailed wish list for the tool:

- The chamber of architects raised high concerns regarding the reasonability and effectiveness of an assessment tool for the energy efficiency in architectural competitions. Reasons were the fear of higher efforts for architects, primary examiner and jury as well as bad experiences of previous attempts to integrate this topic into competitions.
- Primary examiners in architectural competitions had some experiences with 3d modelling from special competitions with the task to optimise the shading of skyscrapers on surrounding buildings: The 3d models of the participants varied in quality. Some models were too complex with too much elements and complicated the interpretation. Other models were too sketchy and had to be completed or re-drawn. There is a lack of framework for the content and structure of 3d models in architectural competitions.
- Several architects showed interest in the development of a planning support tool for early planning stages, which should be web based, open source and compatible with other software. Additional information created by 3d planning should be used e.g. to determine construction volume and surfaces, excavation volume, daylight quality of public spaces, ground sealing, infrastructure demand, embodied energy etc.

3.4 Framework for the CityCalc tool

The most important requests of the stakeholders were integrated in the development of the tool but others had to be omitted in order not to lose the focus of the initiative. Nevertheless, a modular structure was aimed at, to integrate further aspects at a later date. By means of the state of the art research the scope of the CityCalc tool was elaborated. The target applications are not only urban architectural competitions but also general urban planning processes and the aim is to generate a support tool for planners. This should expand the target group and help to disseminate the tool. Furthermore the tool should be open source and based on SketchUp. The calculation methodology refers to the Austrian building code (OIB, 2015), which is based on the European Energy Performance of Buildings Directive (EPBD). The assessment results should be presented with easily understandable figures e.g. on a coloured scale (green to red). Further results (e.g. construction volume, floor areas, etc.) should be produced in order to generate additional value and reduce effort for participants and primary examiners.

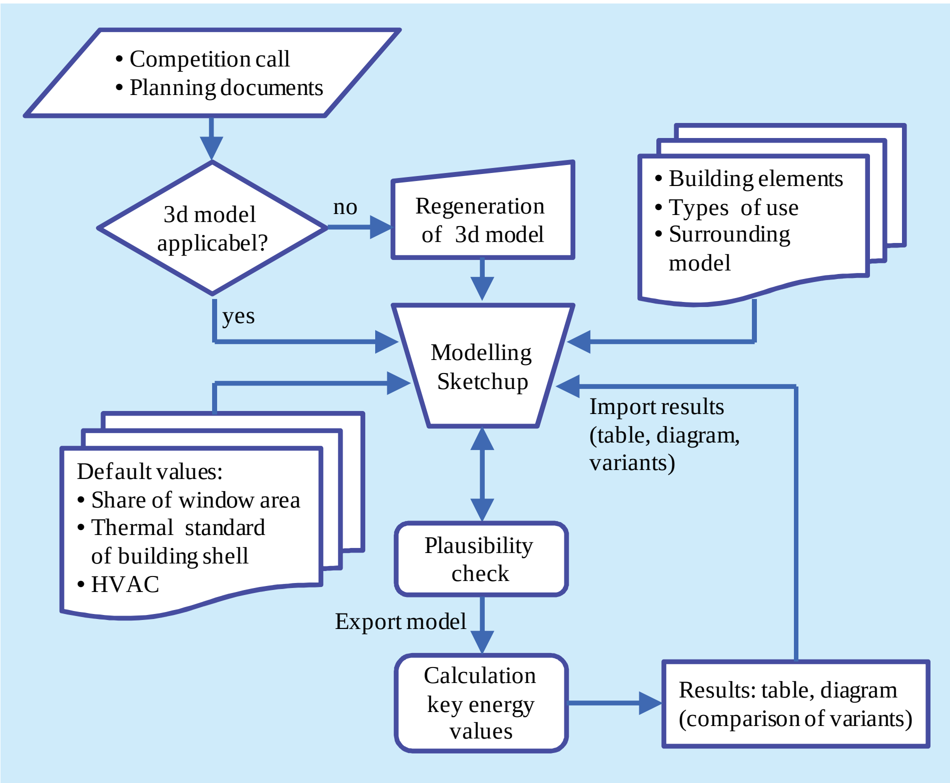

Fig. 1: CityCalc structure. Flow chart of the modelling and assessment process.

4 RESULTS

CityCalc was programmed as a SketchUp plugin with a modular structure. The model was reduced to the most necessary elements that are relevant for early planning stages. Several parameters were pre-set as default values: heat transfer values (thermal protection standard) of the building shell, HVAC system, energy supply system and share of window area. These default values can be adjusted according to the scope of specific urban development projects.

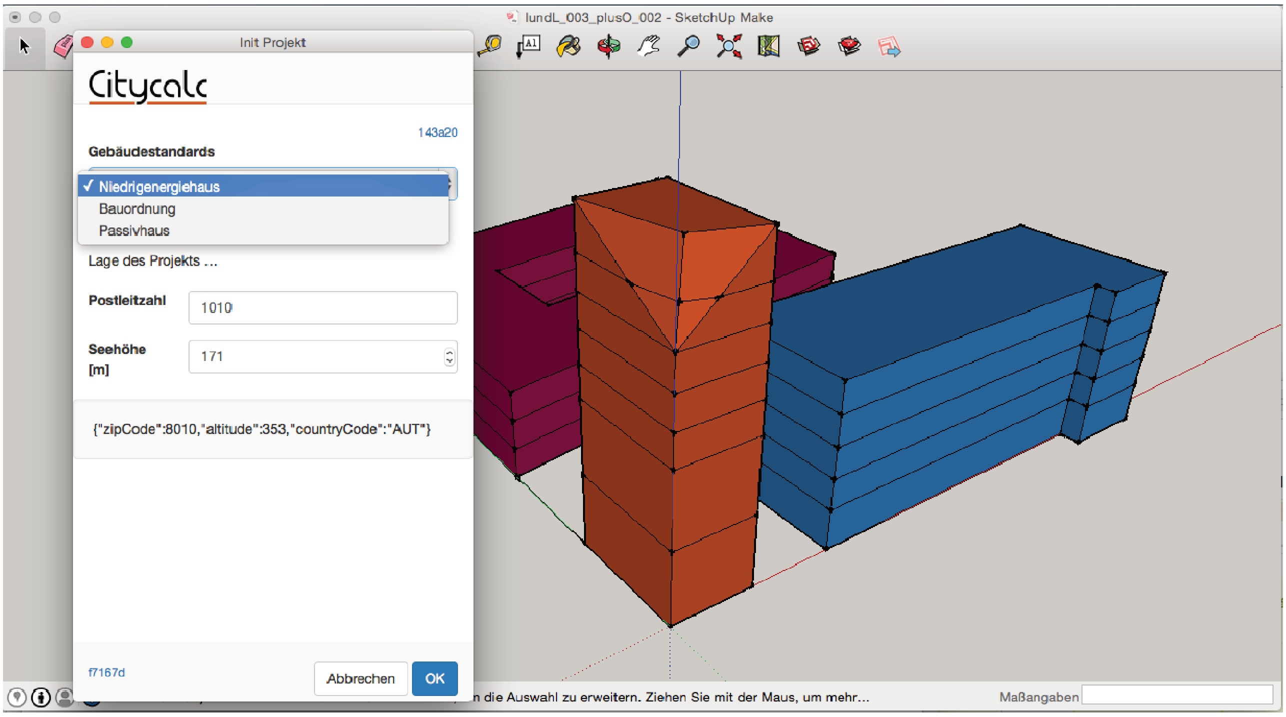

Fig. 2: CityCalc prototype. Modelling a simple urban test area: Setting location, orientation and thermal protection standard

Different types of use can be modelled and shown by different colours. The CityCalc tool automatically calculates floor areas and volumes for each use area.

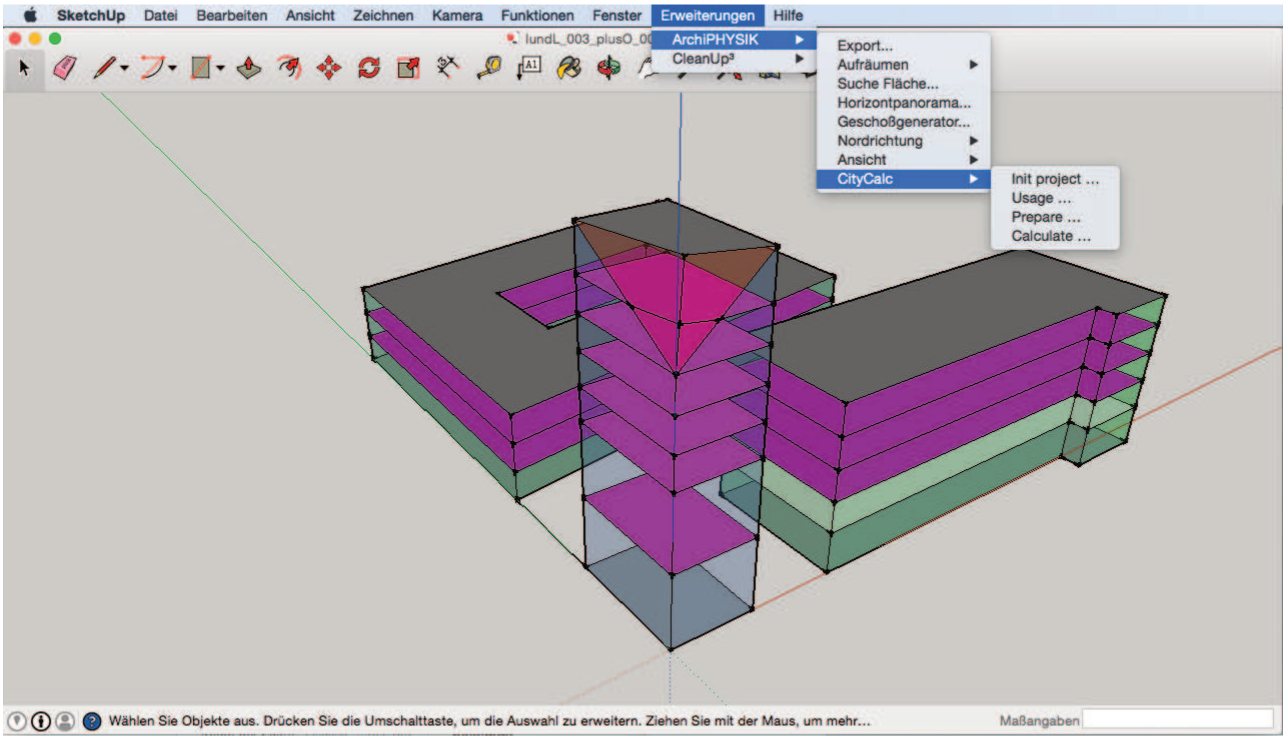

Fig. 3: CitaCalc prototype. Automated calculation for floor areas and volumes for different use areas

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Editors: Manfred SCHRENK, Vasily V. POPOVICH, Peter ZEILE, Pietro ELISEI, Clemens BEYER

For the calculation of energy efficiency figures the model is exported to the Archiphysik server and the calculation results are automatically re-imported for each building. In the CityCalc prototype the results for useful energy, primary energy, greenhouse gas emissions and solar potential are shown in a table and it is possible to compare the effect of variants.

5 CONCLUSION

The CityCalc tool provides with a plugin for the well-known software SketchUp an easy to use and readily available assessment platform to analyse, compare, rate and visualize different urban planning scenarios during the initial design stages. Solar radiation, shading effects as well as energy performance indicators as used in energy certificates can be easily calculated and visualised in a virtual 3d model.

At an early design stage of urban planning projects there is usually not enough information available to assess the energy demand of individual buildings in detail. The urban morphology of districts is nevertheless largely energy relevant as the structure, compactness, orientation and material of the building skin influence the energy performance of the buildings. In the context of urban environments the shading from adjoining structures and thus the context of each building within its urban environment impacts on the overall energy performance of the district and city. Being able to quantify on a large scale shading effects of building structures and solar radiation in urban planning projects is therefore imperative in order to maximise the benefits of active and passive solar design. At an early design stage, adaptions in terms of orientation, context and compactness can still be more easily undertaken. Quantification and the visualisation of the performance indicators can thus contribute to positively influence the decision process.

From the cooperative planning project ‘Oberes Hausfeld’ in Vienna learnings have been derived how to adjust and implement CityCalc in cooperative procedures. The presentation and interpretation of the energy performance indicators should be visualized directly on the virtual 3d models of the buildings. This provides an important support in discussions and consultations and helps the planners to make informed decisions on their design. Energy related results, which are displayed in graphs and charts detached from the 3d visualisations are harder to read and relate to the respective designs by the planners. Being able to see the impact of shading and overshadowing effects directly on the 3d surfaces can accelerate and positively influence the planning process.

CityCalc has thus been developed to be a successful accompanying tool for the early design stages where the comparison of different scenarios is imperative in order to arrive at an energy optimised design scenario. Further urban planning projects will be accompanied in order to validate and adjust the tool. Following the initial implementation phase of CityCalc it is envisaged to add other aspects such as life-cycle and eco-analysis to the capabilities of the tool.

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Mapping Conflicts in the Development of Smart Cities: the Experience of Using Q Methodology for Smart Gusu Project, Suzhou, China

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1 ABSTRACT

The concept of smart cities is now firmly on the current urbanisation agenda around the world. Although such ideas are now widely accepted, the planning practice has experienced operational difficulties in supporting the development of smart cities in the real-life context. While great emphasis has been laid on the importance of collaboration in the development of smart cities, there has been little analysis on how to develop an empirical framework to evaluate different opinions and potential conflicts in smart cities. This paper aims to investigate the stakeholder's perspective and attitude in the smart city development, and highlight lessons from their experience. For this purpose, the research uses Q methodology to measure attitudes and subjective opinions of smart city stakeholders. The research shows that stakeholders have expressed different priorities in the development of smart cities based on the particular standing point of the observed participants based on their work and social backgrounds. This subjective landscape on smart cities can be valuable to understand the existing debates in practice and implement projects more efficiently by mapping possible conflicts in advance.

Keywords: Conflict Management, Participatory Approach, Planning Practice, Q Methodology, Smart Cities

2 ISSUES IN THE DEVELOPMENT OF SMART CITES

2.1 Three Views on Smart Cities

It has been evident that the ideas of smart cities can play a positive role in achieving benefits for the efficiency of city operations and the quality of living environments by engaging urban planning practice with ICT (information and communication technology). Over the last two decades, there have been various interpretations and definitions regarding the concept of smart cities (see Dutton, 1987; Ishida, 2002; Komninos, 2002; Aurigi, 2005; Hollands, 2008; Yigitcanlar et al., 2008; Shin, 2009; Tranos and Gertner, 2012; Kim 2015). In recent years, the term of smart cities has become a 'buzzword', and been used for the financial and political marketing purposes (Hollands, 2008; Chourabi et al., 2012; Dameri, 2013). Due to terminological confusion and definitional problems around smart cities, Kim (2015) argues that the term 'smart' is employed in a variety of ways in urban planning practice, for example, some use the term to highlight the technological and engineering features, whilst others relate this to social and cultural perspectives. Those different views on smart cities may be summarised in three categories: smart cities as engineering; smart cities as science; and, smart cities as studies.

2.1.1 Smart Cities as ENGINEERING

The first view on smart cities is to understand the innovative technologies that matter in contemporary urban environments. The concept of smart cities can be differentiated from earlier practices of technological transformation by emphasising two new innovations: 'Internet of Things' and 'System of System'. The radical technology advances not only allow a form of intelligent communication between the city's physical assets, such as facilities, buildings and inhabitants, but also enable correspondent actions to be taken more systematically in responding to the sustainability issues. This led to expanded research in cloud computing, wireless communication, wearable computing, human-computer interaction, sensor networking, computational intelligence, energy optimisation, and so on.

2.1.2 Smart Cities as SCIENCE

The second view is to investigate how our cities can use emerging technologies smartly. There are wider acknowledgements that smart cities can add value to urban environments and improve the quality of life of the city's inhabitants by improving the way people live, learn, work, and play. Innovative technologies have been recognised as a potential tool to tackle urban problems and resilience, which might differ from the

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traditional methods of the city's planning, development and management. The smart city model has been increasingly applied in order to optimise and improve urban services, such as urban infrastructure, water, transport, energy, healthcare, commerce, education, logistics, home and building automations, to name a few.

2.1.3 Smart Cities as STUDIES

The third view is to investigate what smart cities mean for the economy and society. The complexity of smart cities is impossible to separate from the economic, social, environmental, cultural and political contexts. New patterns of technology integration have encouraged the society to be 'more' interconnected and interactive, not only to share information, but also to allow a novel form of transactional relationships between different actors in the society. Then, other questions need to be asked. How can a smart city assure the quality of life in a city? Can a remote communication replace a face-to-face communication? How smart does a smart city have to be? How can we tackle an issue of digital inequality?

2.2 Coordinating Different Views in the Smart City Development

The 'new' practice requires wider involvements from a significant number of stakeholders including urban planners and ICT engineers who were not directly engaged in traditional planning practice. It has been widely discussed in the literature that poorly-managed conflicts during implementation can diminish the potential of smart cities and discourage future improvements. Therefore, planners have faced the complex challenge of how to deal with the different views and conflicts among different players in relation to the smart city development including: service providers (public sector); business operators (enterprises); and, end-users (local communities). The aim of this research is to investigate the stakeholder's perspective and attitude in the smart city development, and highlight lessons from their experience. The research involves a case study to investigate the local issues perceived by local government, enterprises and communities, and map conflicts in the development process of smart cities. The study of stakeholder's attitudes is important because the attitudes of decision-maker, professionals, and local communities may impact on strategies and directions of the smart city development, especially when there is less clear consensus built on this emerging issue. Additionally, considering the fact that many smart cities around the world are closely associated with planning activities driven by the public sector, it is also important to examine whether the smart city strategies are the result of wider stakeholder views including enterprises and local communities, and designed to meet their needs.

In order to identify and measure those perspectives and priorities in the development of a smart city, this research used Q methodology together with literature review, media review, interview, questionnaire survey, and brainstorming methods. Q methodology is one of most effective tools of investigating perspectives, attitudes and subjective structures from the stand point of the person, in this case, observed stakeholders. The research uses a case study of a smart city development in Gusu District, the historic city centre of Suzhou, China. This paper explores, firstly, the principles and implementation process of Q methodology. Secondly, the research moves on to developing a potential smart city model for Gusu District based on requirement survey (interviews) with government, enterprise and local communities. Thirdly, by analysing the participant's responses on the proposed smart city model, which is translated in 33 Q statements, the research is concluded by mapping subjective landscapes between different stakeholders, and proposing a strategic direction for the development of smart cities.

3 RESEARCH METHOD: Q METHODOLOGY

Q methodology was originally invented by a psychologist, William Stephenson, in 1935 in order to examine individuals' subjectivity systematically and scientifically, and then this research method has been developed further based on factor analytic theory (Stephenson, 1935; Brown, 1996). Although there had been a considerable peer criticism on Q methodology (Brown, 1997), it is now widely accepted as a scientific research method (Cross, 2005), and most frequently used method in studying attitudes (Petit dit Dariel et al., 2010). The method was initially applied to the academic field of psychology, however, it has recently been used in a wide range of disciplines, such as agriculture (Brodt et al. 2006; Davies and Hodge, 2012), public health (Kraak et al., 2014), rural planning (Previte et al., 2007), transportation (Rajé, 2007; Van Exel et al., 2011), e-learning (Petit dit Dariel et al., 2013), tourism (Stergiou and Airey, 2011), sustainability (Barry and Proops, 1999), and energy (Cuppen et al., 2010), to list a few. Despite the fact that Q methodology is not widely used in the field of urban planning, it is a well-structured and increasingly-used research method of measuring the different perspectives, attitudes or subjective opinions (Cross, 2005; Watts and Stenner, 2012; Zabala, 2014), and developing new ideas with a capturing of the human practice (Simons, 2013). Therefore, this research method has a potential in the investigation of planning practice by identifying stakeholders' particular perspectives that could pass on to relevant planning actions, such as the development of strategies, plans, and guidelines, in response to the real-life practice.

Q methodology is recognised as an evaluation tool combining both qualitative and quantitative research techniques (Stenner et al., 2008). From the qualitative point of view, this emphasises on the subjective opinions and understandings of individuals. In contrast, this method employs quantitative tool of factor analysis in order to examine the statistical correlation between the different views of individuals. This can be explained in the following five stages of the Q methodology implementation (for more extensive information, see Barry and Proops, 1999; Davis and Michelle, 2011; Simons, 2013):

- Identification of the 'concourse': this stage is to develop a wide range of discussion and discourse under investigation. The concourse is commonly described as a set of views, ideas, values, opinions, or beliefs that shared by a population under study in relation to the research question. In order to collect the concourse, many researchers have generally used the multiple survey methods of interviews, focus groups, or literature and media reviews.
- Definition of Q statements: the broader discourse collected from the above stage needs to be summarised and reduced to a manageable number of the concourse, which is often referred to Q statements. The number of Q statements is usually no more than sixty, although it varies in different studies. The most important of this stage is that Q statements should reflect the full range of the concourse.
- Implementation of Q sorting: this stage involves the survey participants to ask them to rank all Q statements on a scale from 'disagree (-4)' to 'agree (+4)'using a Q table (Fig. 1). The range, such as -4 to +4, will be used to sort the statements in the later stages.
- Factor analysis: when Q sorting is completed, the correlations between Q sorts are calculated by using the factor analysis methods. This statistical analysis is to identify and classify a distinctive group of Q sorts that shares a similar subjective opinion or position.
- Interpretation of the factors: the final stage is to interpret the results of the factor analysis. Typically, the researcher gives a name to the statistically calculated factors in order to describe the meaning of factors. Those categorised Q sorts can represent distinct characteristics of shared perspectives in the study topic.

DISAGREE AGREE

-4	-3	-2	-1	0	+1	+2	+3	+4

Fig. 1: Example of a Q Table.

The qualitative and quantitative features of Q methodology provide an empirical framework to translate a particular individual's dialogue into a systematic analysis. The advantages of Q methodology have emerged from the fact that the sorting activities are self-organised by participants, therefore, no built-in assumption has been applied into the method. This enables the results of Q sorting to be formative and emergent, and consequently, the method has the power to surprise (Cross, 2005). The greatest concern over the disadvantages of Q methodology is perhaps the lack of reliability that may provide little basis for systematic generalisation. The primary argument is that the results of Q sorting may not be the same even if it is repeated on the same individual. Taking this into account, Cross (2005) emphasises the importance of the participant's responses in the limited accounts of pre-determined statements. In order to represent the view on the research subject more accurately, it is necessary to derive Q statements from various sources and employ a number of different data collection techniques. Moreover, the wording of statements should be carefully designed to allow participants to think about the issue, rather than make them confused (Simons, 2013).

4 CASE STUDY: SMART GUSU PROJECT

According to China Smart City Huimin Development Evaluation Index Report (Information China 2014), the development of the smart city in China has improved the city's competitiveness potentiality. Based on comparative case studies among 369 cities of China, the report has suggested that the development of smart cities have generally improved the work efficiency of the city’s public services due to new information systems, and facilitated new business opportunities such as new ICT projects initiated under the concept of ‘smart tourism’ and ‘smart communities’. By 2013, over 310 cities in China had proposed or started the construction of smart cities (EU-China Smart and Green City Cooperation 2014). Smart city-related IT investments at the national level had reached more than 1 trillion RMB by 2012, and been estimated to be more than 2 trillion RMB by 2015 (Yang 2013). A recent study by CCW Research (2014) reported that there are four common development strategies of smart cities that have been used widely in China: (1) providing an intelligent urban lifestyle for citizens; (2) developing smart industries; (3) applying smart technologies and facilities (4) developing a creative city. While China has developed their own empirical ways to apply the concept of smart cities to the practice of urban development, most pilot smart cities in China have faced challenges of technology standardisations, collaborations with urban planning, and citizen-centric services (Liu and Peng 2014).

Gusu is located in the heart of Suzhou, China, which has been identified as a historic water town with its rich heritages and tourism resources (Fig. 2). The total population of Gusu district is about 742,000, but experiences the decline and aging of population (Suzhou Municipal Bureau of Statistics, 2014). According to the government reports, Gusu district has been promoting technology and information industries in order to tackle shrinking old town centre’s economy, whilst there have been practical difficulties in attracting talented workers to Gusu district (Gusu District Government, 2015). The China’s 12th Five Year Plan (2011-2015) has stressed a holistic approach connecting ICT and urbanisation by establishing the foundation for industrial development in association with the ICT industries (State Council 2011). As the following 13th Five Year Plan has also emphasised the important roles of ICT in urbanisation, Gusu District Government has initiated a strategic development of a “Smart Gusu” project in Gusu district, Suzhou, China.

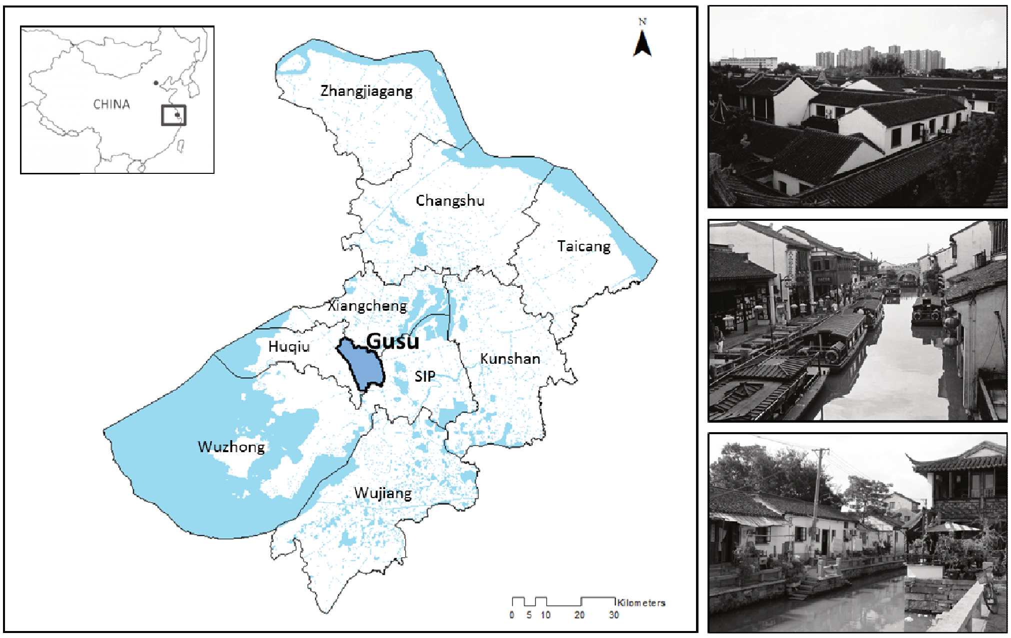

Fig. 2: Location of Gusu District and Images of the Gusu Historic Water Town.

5 IMPLEMENTATION OF Q METHODOLOGY

This research explores stakeholders' perception towards the development of smart cities, and Q methodology is used to examine the subjectivity of interests, especially from the stand point of the observed participants. The unravelled perspectives of smart city stakeholders in this paper cannot be translated as a general discourse, as there are great differences among the political traditions and economic conditions in different countries and projects. However, the results may provide valuable features and critical arguments in mapping conflicts and subjective landscape in the current practice of smart cities.

5.1 Identification of the 'Concourse'

As the first step of implementing Q methodology in this research, the existing discourses in the relevant areas of smart cities have been explored using a number of different research techniques. Firstly, at the earlier stage of the research, literature and media reviews have been implemented to acquire basic information and current issues of Gusu district from previous studies and media means such as newspapers, websites, government documents, etc. Secondly, a seminar with four government officials in Economic and Technology Bureau of Gusu District Government has been organised (3rd July 2015). The seminar identified a number of key planning issues in the Gusu district, such as economic development, historical heritage conservation, river pollution and high population density. Thirdly, in order to represent the views on the study subject more accurately and widely, the interviews with wider stakeholders of Smart Gusu project were conducted (from mid-July to mid-August 2015) including: (1) five local community representatives; (2) three senior managers of ICT industries; and, (3) four government officials in Gusu District Government working in the relevant areas including economy, tourism, cultural heritage and civil affairs. Fourthly, after the interview analysis, a brainstorming was organised by the authors with three student volunteers (10th August 2015). As the results, 97 brainstormed ideas were identified that would be applied to Smart Gusu project (Fig. 3). Those brainstorming results have drawn upon the author's seven years' consultancy experience as a smart city practitioner, and been used as baseline information in developing Q statements.

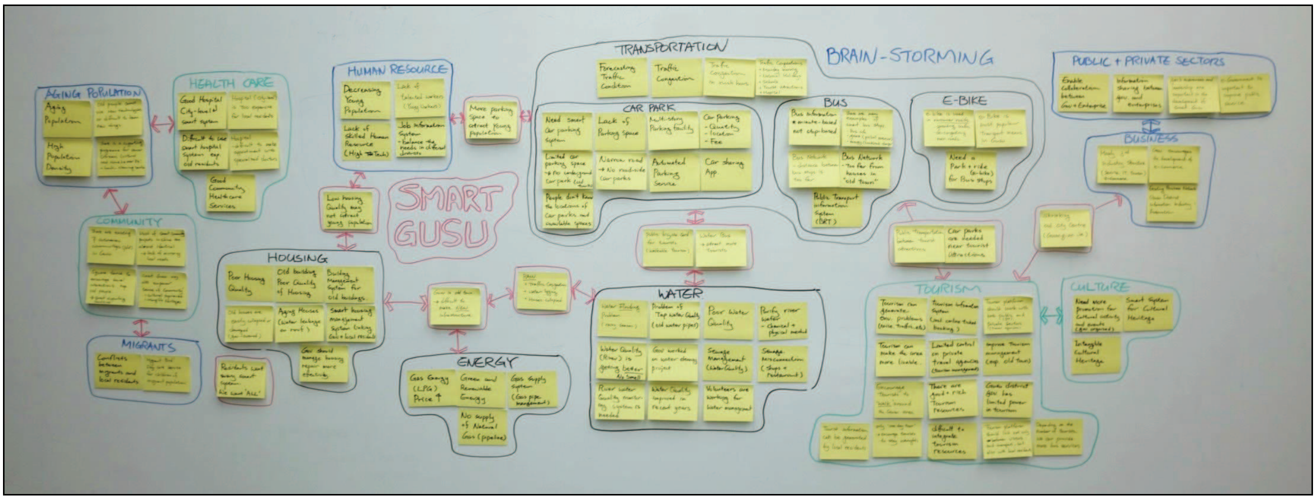

Fig. 3: Brainstorming Outcomes.

5.2 Definition of Q Statements

The next stage in the Q methodology process is to select a manageable numbers of statements for Q sorting, derived from over two hundred concourses and brainstorming results identified in the previous stage. There is variation in the size of the final Q statements in the literature, although the typical number of Q statements seems to be in between 30 and 60. Drawn from initial tests and pilot Q sorting, the research has found that 33 statements are suitable for this study. In this selection process of the final statements, a concourse matrix has been used in order to filter the statements to reflect more precise and essential arguments in the subject area by minimising the investigator's influence (Dryzek and Berejikian, 1993; Barry and Proops, 1999). Applying the key findings from the previous stage, this research developed and employed a concourse matrix with seven categories including public service, transportation, tourism, housing, water, economy, and community. Based on this concourse matrix, thirty-three Q statements were selected of the smart city stakeholder's perception in the development process of Smart Gusu (for full statements, see Table 2).

5.3 Implementation of Q Sorting

This stage of Q methodology involves the survey participants for Q sorting. Participants were asked to use an inverted pyramidal table (Fig. 1) in order to rank the 33 statements in a nine-relative scale (-4, -3, -2, -1, 0, +1, +2, +3, +4), based on how strongly they agree or disagree with the particular statement. Whether or not participants may agree or disagree on all statements, they are forced to rank the statements in the given structure. This process (so called, forced choice method) enables participants to consider the sorting process more carefully, and consequently, reveal their true feelings in response (Prasad, 2001).

In order to conduct Q sorting survey, both offline (hardcopy version) and online (web version) survey tools have been developed. For an online tool, the research used FlashQ (Rick Hoodenpyle's version, available at http://qmethod.org/links), which is a free application originally developed by Christian Hackert and Gernot Braehler (2007). The online version of FlashQ was set up on a HTTP server with PHP by modifying FlashQ's XML and the PHP-backend source codes (available at http://qmethod.org/links and http://www.hackert.biz/flashq/downloads/). For both offline and online tools, when participants start Q sorting, firstly, 33 Q statements were given one by one randomly and asks the participant to split them up into three categories: disagree; agree; and, neutral. Then, the participant is required to place all statements into the Q table in a ranked-order according to the forced distribution. At the last stage of Q sorting, the participants are required to complete a questionnaire for their personal details.

For this survey, it was difficult to attract many voluntary participants to get involved in the survey due to the complexity and time-consuming process of Q sorting. The assistance from Gusu District Government was useful to identify and approach participants. As Akhtar-Danesh et al. (2008) pointed out, it is more important to represent different opinions in the study subject precisely in Q methodology, rather than the number of the participants. There were 11 participants in this analysis: 2 from Gusu Government; 2 from local ICT firms; and 7 local residents in Gusu.

6 Q ANALYSIS AND RESEARCH FINDINGS

6.1 Factor Analysis

The PQMethod software (Schmolck, 2014) has been used in analysing the data of Q sorting, which is available online freely. PQMethod has been seen as one of the most frequently used statistical programmes, which is customised particularly for Q analysis (Simons, 2013). Using the Q sorting data, PQMethod created a correlation matrix from Q sorts, and then the factor analysis was conducted. In this process, Principal Component Analysis (QPCA), which is the most popular method of factor extraction, was used. For the factor analysis, four factors with eigenvalues greater than 1.00 have been considered initially, but only three factors were chosen from the factor-analysed outcome due to the analytical significance. After a varimax rotation (QVARIMAX) on the factors, QANALYSIS was performed in order to differentiate the factors based on the participants' Q sorting. The results of factor analysis are shown in Table 1.

Q Sort ID	Sector	Age Group	Gender	Residence in	[Factor 1] Government Perspective	[Factor 2] Non-Gov. Perspective	[Factor 3] Maternity Perspective
1	Government	20-40	F	Gusu	0.7441X	0.3422	0.2635
2	Government	20-40	M	Gusu	0.8107X	0.0622	-0.0274
3	Business	20-40	M	Outside Gusu	-0.1673	0.1143	-0.2822
4	Business	40-60	M	Outside Gusu	0.1136	0.6826X	0.0516
5	Resident	60 above	M	Gusu	-0.0369	-0.6292X	0.1979
6	Resident	60 above	F	Gusu	-0.0065	0.7905X	0.0247
7	Resident	60 above	M	Gusu	-0.5436	0.4656	0.3512
8	Resident	60 above	M	Gusu	0.1815	-0.0302	0.2357
9	Resident	20-40	M	Gusu	-0.4607	0.1702	0.3658
10	Resident	20-40	F	Gusu	-0.0172	-0.2101	0.8276X
11	Resident	20-40	F	Gusu	0.0486	0.3577	0.6781X

Table 1: The Result of Factor Analysis (X indicates a defining sort resulted from automatic pre-flagging of PQROT).

The result of factor analysis shows that two participants are identified as significant relations on Factor 1. As they are all from government, Factor 1 has been named as 'Government Perspective'. Similarly, Factor 2 can be described as 'Non-Government Perspective', considering the three participant's background profiles (business and resident) that are marked as significant relations in Factor 2. Two participants loaded in Factor 3 are female residents in the age group between 20 and 40, and Factor 3 has been named as 'Maternity Perspective'.

6.2 Interpretation of the Factors

Drawn from the factorised analysis, the detailed discourses will be investigated in this section in order to explore the subjective landscape of the 11 stakeholders in the development of Smart Gusu project. For this purpose, the above three factors have been represented by the three operant types of discourses: Discourse A (Government Perspective, Factor 1); Discourse B (Non-Government Perspective, Factor 2); and, Discourse C (Maternity Perspective, Factor 3). Table 2 shows each discourse representing the distinct perspectives and attitudes from the standing point of the participants. The presented factor arrays were produced by PQMethod in order to represent "ideal type" Q sorts by calculating a weighted average of the scores (Barry and Proops, 1999; Addams and Proops, 2000).

6.2.1 Discourse A: Government Perspective

The statistical analysis shows that the respondents in this discourse have particularly: agreed on Statement [2] and [13]; however, disagreed on Statement [18] and [26]. There are two respondents who have been loaded in this discourse, and they are working in Gusu District Government. In analysing the Q sorts, this discourse expresses a primary concern on the current agenda of Gusu Government. For example, this discourse emphasises more strongly the need of: developing smart government system (+4 for Statement [2]) in order to provide efficient administrative services; and supporting tourism industry (+4 for Statement [13]) as Gusu Government is committed to empower historic water town tourism in order to promote local economy.

Strong disagreements in this discourse are on importance of green energy solution (-4 for Statement [18]) and local community activities such as square dancing (-4 for Statement [26]). The two Statements are lowly-ranked in general across discourses, although the benefits of the two solutions are discussed significantly in the brainstorming workshop. While measuring subjective landscape can be valuable to understand the existing debates in practice, this echoes that the smart city strategy must not be developed by a single interest group, and it is important to facilitate collaborative approach involving diverse stakeholders such as public and private sectors, local residents, and experts in the development process.

Additionally, the data reported in this discourse appear to show a different view on the effective delivery of government services in relation to public housing management and public medical services. Respondents in Discourse A ranked significantly lower for: the need of smart solution for public housing management (-3 for Statement [15]); and, the need of improving the existing smart medical services in municipal hospitals (-3 for Statement [32]) than other discourses. This suggests that there are disagreements between government group and non-government groups in perceiving the quality and priority of the current public services. This gap of consensus is also necessary to be investigated further in order to develop a more citizen-centric Smart Gusu project.

6.2.2 Discourse B: Non-Government Perspective

The statistical analysis shows that, in this discourse, the respondents have particularly: agreed on Statement [22] and [29]; however, disagreed on Statement [7] and [26]. In general, this discourse expressed the importance of water management in the development of smart cities (Statements from [19] to [22]), but prioritised less the transport related issues (Statements from [3] to [8]). A likely explanation is that respondents in Discourse B may not experience car parking problems in their everyday life, but may be related more to water quality issues than the ones in the other discourses. Another strong agreement of Discourse B is on the importance of developing smart solutions considering wider users including aging population (+4 for Statement [29]). This may be because the three respondents in this discourse are in the age group of the above 40, who may experience difficulties in learning new smart applications. One possible

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implication from Discourse B is that the respondents in the same geographical area or social group might have similar views as they share similar experiences. In this context, the result of Q survey can play more positive roles if the analysis is coordinated with other investigation methods.

Category	Q Statements		Discourses		
			A	B	C
Public Service	1	Information sharing between governments and enterprises would be an obstacle in the development of Smart Gusu.	0	-1	-1
	2	Smart government systems (advanced e-government) can provide citizen-centric services with efficient administrative procedure.	4	0	3
Transport	3	I am willing to use buses more often if there is an e-bike charging station at bus stops (park-and-ride).	-2	0	-2
	4	It would be more convenient if I know the exact time of the bus arrival to the bus stop.	0	-3	2
	5	Real-time information of available car park spaces can make drivers convenient and reduce carbon emission by optimising travel routes.	1	-3	4
	6	Online reservation of car parking space can be one of solutions for the shortage of car parking space in the city centre.	-3	-2	1
	7	In order to reduce traffic congestion and car parking problem in the city centre, a car sharing mobile app for commuters may be helpful.	-1	-4	0
	8	Smart waterbus service can be useful for tourists (sightseeing) and commuters (public transport).	-1	-3	-2
Tourism	9	There is a need of monitoring rubbish collection using intelligent technology in tourist designations to make residents and tourists happy.	-3	0	-2
	10	Monitoring the numbers of tourists in the city may help providing better services for tourists, such as bus links among tourist attractions.	2	-1	-2
	11	Tourism information platform should integrate information from public sector (government) and private sector (enterprises, travel agencies).	1	1	-3
	12	Rich tourism information may encourage self-organised tour instead of a one-day package tour, which may allow tourists to stay longer in Gusu.	0	0	2
	13	Tourism information should go beyond popular attractions, and cultural tourist information can be collected via smart participatory process with local residents.	4	2	-1
	14	It is necessary to promote intangible cultural heritage widely and user-friendly through various communication methods.	2	-1	1
Housing	15	Government needs a building management system for old houses in Gusu District to organise effective repair works in advance (before the rain season).	-3	2	1
	16	Old houses also need intelligent building management system and smart home service to improve living environments of the residents.	-2	1	0
	17	Smart home system in old district should include smart meters for cooking fuel (LPG gas) to alert the replacement time of the LPG gas tank.	0	3	1
	18	Green energy solutions (e.g. solar energy generator) are becoming important in the development of Smart Gusu.	-4	-2	-1
Water	19	Intelligent rainwater management is necessary to prevent waterlogging and flooding.	-1	1	-4
	20	River water quality monitoring system is essential in Gusu District.	-2	3	0
	21	Because sewage pipes directly connected to rivers cause water pollution, intelligent system for wastewater management is necessary.	1	3	-3
	22	To improve drinking water quality, it is necessary to develop water quality monitoring system for fresh water supply pipelines.	-1	4	-1
Economy	23	In order to attract young workers to Gusu District, a mobile job recruitment application will be useful.	0	-2	-4
	24	Regeneration of old city centre as a smart street (interactive shopping information, media art exhibition, smart street furniture, etc.) can bring people back to the area, and therefore, revitalise local economy.	3	1	3
	25	The image of Smart Gusu may attract more ICT (Information Communication Technology) industries to Gusu District.	2	1	0
Community	26	The practice of square dancing can be empowered by simple technology (i.e. installed speakers with wireless connection) that may improve sense of community.	-4	-4	1
	27	Mobile platform particularly designed for your community (linked to the management office) can be useful.	3	0	-1
	28	I need to learn how to use the new intelligent systems of Smart Gusu.	1	-2	-3
	29	The development of Smart Gusu must consider wider users including senior citizens, as there is higher ratio of aging population in Gusu.	2	4	2
	30	Emergency response system for elderly household could reduce the risk of medical and fire alerts.	2	2	2
	31	Remote consultations from medical doctors may improve community healthcare service.	-1	-1	0
	32	The existing smart medical service in municipal hospitals is not easy to use, especially by elderly patients.	-3	2	3
	33	Concerning the safety issue of school kids, especially ones from migrant family, parents should be able to track the real-time location of their children after school.	1	-1	4

Table 2: Q Statements and Scores on the Three Extracted Discourses.

6.2.3 Discourse C: Maternity Perspectives

This discourse would seem to suggest the shared views from a particular social group, middle-aged female residents in local communities, with underlying assumptions that they may have particular concerns on their children and the use of private vehicles. For example, the respondents have strongly agreed (scored +4) that a smart city should: concern the safety issues of school children (Statement [33]); and, develop real-time car park information systems (Statement [5]). However, this discourse ranked lower for the urban facility management system for water infrastructure (Statements from [19] to [22]), which may not affect their living environments directly, although water management solutions have been considered as primary smart infrastructure for a city in many literatures (Sensus, 2012). This also mirrors the previous discussion in Discourse B regarding a potential of using Q methodology in mapping the perspectives and requirements from a particular social group, which can be positively contributed to the development of smart cities.

7 CONCLUSIONS

Initial observations in this study suggest that the stakeholders in smart cities have shown particular attitudes and perspectives based on their work and social backgrounds. This subjective landscape on smart cities can be valuable to understand the existing perspectives and requirements in practice. Difficulties may arise, however, when an attempt is made to apply the outcomes of Q methodology in planning practice, as it is also arguable how mapping possible conflicts in advance can implement projects more efficiently in practice. Although this research may have limitations in terms of a narrowed range of the participants, Q methodology has demonstrated great potentials in investigating the views and attitudes of the stakeholders that may influence the implementation of smart cities significantly. However, the results of Q analysis must be interpreted with caution because the methodology is to measure the individuals' subjective opinions and attitudes from the particular stand points of the observed participants with the possible bias in these responses, rather than generalise the results of the statistical aggregation from the anonymous data. It is also evident that smart cities should involve wider stakeholders including public, private and social sectors together with expert groups, in order to reflect wider considerations on local political landscapes, economic dynamics, and cultural identities.

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Mischung: Possible! Impulses for Mixed Use and Flexible Capacities in Contemprary Densely Built Urban Areas

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1 ABSTRACT

Contemporary densely built urban quarters lack impulses for mixed use and flexible capacities, often resulting in almost mono-functional housing areas. The aim of the paper is to explore this widely disregarded link between theory and practice in urban development, in other words: it's about the missing link between conceptual demands for mixed use and the contemporary implementation process.

Keywords: affordability, implementation, mixed use, transition, urban development

2 INTRODUCTION: MISCHUNG: POSSIBLE!

The paper is based on preparations and findings within the Smart City Demo-project “Mischung: Possible!” (TU Wien 2016), funded by the Austrian Climate and Energy Fund (KLIEN 2015) and refers to the Smart City Wien Rahmenstrategie (Stadt Wien 2014). Smart City Demo-projects are targeted to engage and enact on sustainability transition. Scientific activities within the program family are necessarily prescriptive efforts, have to embrace an integral approach towards innovation and therefore have to produce transformative knowledge. The project Mischung: Possible! is focused on the qualities and the development of mixed use and flexible capacities in contemporary densely built urban quarters. The goal is to establish a link between the macro, meso and micro level of planning, to evaluate the value of mixed use structures in the context of social and technological change and to build upon implementation scenarios for sustainable mixed use development. The project is based on an innovation oriented strategic-relational institutional approach, involving a mix of methods such as desk research, participatory research and stakeholder involvement (citizens, planners and public officials, developers, users etc.) through interviews, workshops and group discussions, evaluation through case studies in Vienna and short field research on innovative actors and projects in London and Amsterdam, impulse-scenario building and modeling.

Practice in urban development shows, that the outcomes lie generally behind the conceptual demands, resulting in more or less mono-functional housing areas (Bretschneider 2007; Wieland 2014; Nedden et al. 2015). This applies typically to Vienna, where the pressure of demographic growth weights heavy on housing policy since more than a decade now. The reaction of housing and urban development policy (represented through different political parties since the year of 2010) is experienced as an ambivalent mixture of satisfaction (with growth, life quality and social housing), ambition (in regard of participation, social infrastructure, mobility, energy) and disregard (of the flagging economic structure and the demands of integrative urban development). Within Mischung: Possible! monofunctionality in the urban context is presumed as an unsustainable and not resilient context of living. Such city structures may lead to more traffic and energy consumption, and to less life quality at the same time. However the opposite, the enforced homogeneously mixed carpet is – at least for the whole city – not the perfect solution as well. Hence, Mischung: Possible! is aiming at the conceptualization of place-sensible mixed usemixed use scenarios in-between these limits. The starting point of this paper is the need for innovation and research action (chapter 3). The path towards sustainability transition is introduced by involving a innovative comprehension of urban development in the process of research. To come with implementation into play the contemporary framework of urban development will be presented as an environment where the planning of the physical structure belongs to appropriate soft tools and processes as well as a different collective understanding of urban growth. The following chapter is about affordability in mixed use areas to exemplify the differentiated approach towards mixed use (chapter 4). Addressed as the precondition to decode the development of life quality, affordability is represented as the nucleus of social justice as well as of resource effectiveness and environment protection. A complex understanding of affordability and it's changing character over time will be presented by the contextualization of different understandings within urban development. Finally, the preliminary findings are presented in the conclusion for further discussion and research (chapter 5).

3 THE NEED FOR INNOVATION AND RESEARCH ACTION

In order to implement innovation in the development of mixed use, the spatial-typological dimension needs to be combined with the economic, social and ecological one. The focus here is set to post-industrial and reflexive forms of innovation (Rammert 1997), that move beyond the material/ physical dimension to ways of thinking and development and social processes that are not only different from the standard ones, but in some ways better and consequently offer an added value of some kind. We suggest to keep in mind a wide set of innovation dimensions, at least the organiszational, technological, service-based, social, policy and design-driven ones (Image 1). Within that understanding of innovation traditional and new forms of agricultural, industrial and post-industrial labor as well as alternative concepts of work may be included in mixed use-scenarios. In this sense, the approach to innovation pursued here refers both to forms of service-based innovation (Salter / Tether 2006), but as well to planning innovation by questioning existing routines through the introduction of new governance structures, process and instruments, in other words through transformative practices (Albrechts 2010) that can discard existing concepts, structures and ideas that are not supporting the development of a differentiated and sustainable urbanity.

The development and the implementation of that kind of innovation relates to a comprehensive understanding of sustainability and planning. Within the program family of the Smart City Demo the orientation towards the implementation of innovation is compulsive and generally framed by a strong pressure towards economic valorization. Interestingly the specific funding framework of Mischung: Possible! underlines as well the social dimension of innovation, which is a still underestimated aspect of sustainability change. Each funded project has to define a so called testbed for innovation. At the theoretical level these testbeds are not only to be translated as the physical and social structures within defined city areas but can furthermore be understood as 'niches' in the multi-level perspective of transition studies (Geels / Schot 2007) or in an institutionalist view as places where counter-hegemonic coalitions (Servillo / Broeck: 52) are able to stimulate innovation. In both cases, the superior frame ('regime' and 'landscape' or 'hegemonic institutional frame') is a stabilizer, causing 'locked-in situations' (Rammert 1997). Supposed sustainability transition towards mixed use urban quarters is not realized by single shots, like the invention of new mixed use typologies for single buildings or alternative regulations for shopping streets, but rather through an intelligent combination of the multiple dimensions of innovation mentioned above. In our view it is a core task to translate the additional benefit of innovative mixed use-scenarios to the stakeholder community (planners, administration, citizens, housing cooperatives, developers and investors, researches etc.). As a prerequisite of this task, the pursued common view has to be built upon a differentiated understanding and language of the qualities and values of mixed use.

As for now a variety of configurations can be defined as mixed use, but a wide consensus on defining typological criteria is missing. Relevant literature and evaluations (i. e. Bretschneider 2007; Nedden et al 2015; Wieland 2014) have defined possible qualifying indicators, mostly to compare different developments. Yet the link between different relevant aspects of mixed use remains relatively unexplored and poorly understood. In the Mischung: possible! research project the following primary categorization of criteria to define and describe mixed use has been proposed, based on qualitative interviews with stakeholders, and stakeholders' workshop, research and evaluation of three realized examples of urban development, literature research. This approach to mixed use is based on a differentiated understanding of functional and spatial/typological as well as of social aspects. With regard to the functional and spatial/typological aspects

mixed use developments can be distinguished on the basis of the degree of functional mix (which functions, how much) and of the related spatial configurations (distribution of the functions). A particular important distinction here is between fine-grained and large-grained functional mix, already highlighted in German speaking contexts (Breuer et al. 2000). An additional criteria is adaptability, with particular focus towards flexible and open-use spatial typologies that allow over time change of uses. Functional and typological criteria need to be related to a predefined observation scale or field, such as: quarter, block, building, unit. Additional selectable relevant fields include specific zone such as ground floor or ground and upper levels. An important differentiation already picked up in various studies is that between the potential of fine versus large grained mixes of built structures. This differentiation, embedded in the spatial and typological configuration, is relevant especially for the use quality and use value, for criteria linked to sustainability and strongly effects the real estate dimension. Furthermore the project is addressed to different groups of citizens and users (i. e. creative industry, zero emission industry, care work). The diversity of citizens, uses and physical structures is seen as a constitutive asset for urban quarters. These fine grained assumptions should be linked to ecological, social, cultural and economic qualities, such as the following examples shall show literally.

Regarding sustainability a focus here lies on mobility, and how mixed use developments can positively reduce car use because of proximity between live, work and services. Life-cycle of buildings and quarters constitute a further relevant criterion, especially when building can be adapted to different uses over time and are therefore more robust. Mixed use can furthermore intensify space use and therefore reduce the use of resources both in term of space itself (less infrastructure, less ancillary spaces needed) but as well in terms of heating, light, and so on).

Mixed use can strongly contribute to the quality of public space, as in most configurations it constitutes a necessary transition between housing uses and public space and makes it more lively and intense. It can therefore strongly contribute to the attractiveness of a certain area as whole for various milieus interested urbanity. It can underpin social mix and social inclusion raise the chances at the individual level of balancing work and private life thanks to physical proximity between different functions. Additionally a differentiated mixed use configuration can support the synergies among the different functions, as for example highlighted in the analysis of high-streets by the Great London Authority, where both living and working functions support retail and f&b (food and beverage) functions in their proximity (Duggan 2014: 15).

Mixed use is from a real-estate perspective rarely attractive on the short-term. It requires a mix of competences rarely in the hand of one developer alone. Additionally, differently from housing in many contexts in strong demand, non-housing functions are mostly difficult to let and represent a substantial risk. On the other hand successful examples show the potential of raising both housing and non-housing values in the long term because of the specific urban identity.

Further more the quality of the implementation process and of the mixing of technological and social components are essential aspects of mixed use development. Therefore mixed use can be understood as a process reaching from the conception to the use-phase over the long term. Specific implementation measures are necessary in order to realize mixed use, and it is important to develop an approach that moves beyond the spatial structure but integrates economic and social processes as well. The potential of mixed use thus is strongly linked to the need for a differentiated approach. Let's keep in mind that mixed use is not positive per se but that much depends on the kind of mixed use and how the technical and social components, mixed together, actually contribute to the qualitative aspects listed above. These considerations are exemplified in the following approach towards affordability.

4 AFFORDABILITY WITHIN THE CONTEXT OF MIXED USE DEVELOPMENT

4.1 Definitions of affordability within the context of mixed use development

In the context of mixed use the aspect of affordability plays a crucial role for planning, implementation and daily life and represents one of the core areas of research within the project Mischung: Possible!. Affordability is essential with regard to the mixed use development process as well as to the phase of use and re-use of the spatial capacities. Moreover in combination with accessibility, the aspect of affordability is an important cause for the distribution and redistribution of opportunities in the city and is therefore substantially responsible for the spatial arrangements as an expression of the cities social structure (Kadi / Musterd 2014). Affordability is related to spatial planning, zoning, quality standards and building regulations as well as to the labour market, the fiscal policy and the welfare system in general. There is a subjective and a collective value of affordability that is methodologically challenging to take into account (Kunnert 2014: 26). Furthermore the adaptability of the definition strongly depends on the availability of reliable data and of its standardization. And finally, the definition of affordability is already a challenging task for the single use case.

In a nutshell there are many different definitions of affordability at the macro and micro level, and regionally different preconditions to translate these definitions into empirical findings. In the case of housing, affordability is strongly linked to societal and economic change, but affordability as a whole is still underestimated within the conception and implementation of mixed use. It is hardly possible to transfer innovations from one city directly to another, but on the contrary highly relevant to carefully translate innovations in a context-sensitive way. Still there are ongoing transformations by which many different cities

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(i. e. in the European context) are hit, such as the process of globalization and economic restructuring and the rising economic inequality (Tammaru et al. 2016: 358).

Seen 'work' in the context of individualization, commodification and technological change the different forms of use are more and more interwoven in the dynamic change of spatial needs. Additionally the societal change leads to new dimensions of work, shifting partly away from gainful occupation, and again calling for affordable space to enable the resources for a meaningful life. However in comparison to housing, there is not so much knowledge about the affordability of work in the context of mixed use development at the macro and micro level.

Another aspect of affordability relates to the concepts of resource effectiveness and environmental protection. There, affordable products and services in the spatial context are facilitated through the effective allocation of resources and they are shaped by a robust design, fulfilling their "function" over a long period of time. In addition, affordability for the next generation is a sustainable way of planning cities, embarking construction processes and using materials in an intelligent manner. There is uncertainty about the real future of work and the figure of the user in a more and more global, commodified and technological world. There is uncertainty as well about the future political forces and the future public opinion. What we see for now is, that both the growth and the technological paradigm, as the predominant orientations at the macro level are failing apparently at steering society towards a sustainable way of life.

4.2 Contextualization of the understandings of affordability

Let's take housing at first: most notably the definition of affordable housing is expressed through the relation of financial incomings and outgoings (purchasing price, rental fee). On an aggregated base these values can be compared over time and/or with other locations (small units for segregation indices, cities and nations for development indication, etc.) and/or with other products of consumption. But there are even more aspects of relevance: life quality, individual preferences, social belongings, cultural traditions, household size etc. Affordability in housing played a central role in Modern architecture and planning. The long-lasting idea of achieving affordability due to the reduction of the required built space and simultaneously to the raise of efficiency has become embedded in most normative and planning systems.

Only recently, and in specific contexts (i. e. Amsterdam, London), attention has been given to the provision of affordable working spaces, as these city administrations have acknowledged the reduced availability of such spaces in newly built areas because of housing pressure, and that at the same time such spaces (also named Low Threshold Enterprise Spaces or LTES, London) play an important role for the city as a whole in terms of provision of necessary services, creation of employment opportunities, innovation (London) (Maccreanor et al. 2014: 240) and guaranteeing the survival of subcultures and related urban competitiveness (Amsterdam) (Pot 2011: 46 ff.). Also concerning the provision of work-spaces attention has been paid to the need of spatially mixing the provision of affordable and subsidized spaces with market-price ones, albeit with different reasons and motivations than in housing.

In housing in fact there is an explicit need to avoid socio-spatial segregation, and this need is so strong that public interventions have some times taken into account the distribution of housing benefits also towards higher income groups in order to guarantee social inclusion and mixing (see for example Viennese housing policy). Examples of mixing housing strategies include the VINEX locations policies in the Netherlands that mandated new housing developments to include 30 percent of social housing units, partly financed by 70 percent commercial housing (Hall 2014). More recently in Vienna housing policies have promoted the so-called 'smart housing' and introduced affordable housing as a specific category of land use. These policies are thought to approach the lack of affordable housing for the lower-income groups, for which much of the subsidized housing market (partly based on cooperative model of rent-buy) remained not accessible.

In the case of provision of mixed affordable and market-priced work-spaces the logic behind mixing both in London and in Amsterdam is similarly based on harvesting potential synergies among different kind of users and uses. In Amsterdam the provision - through the Broedplaatsen program - is aimed at the creative industries, and is based on subsidies to develop and operate such work-places when mixing 40 percent of low rental spaces for artist with 60 percent commercial spaces for creative firms. Particular relevance has been seen in the place-making potential of broedplaatsen that are consequently understood as urban regeneration tools.

In London, the Plan Policy 4.1 ‘identifies the need to ensure a good supply of workspace in terms of type, size and cost, supporting infrastructure and suitable environments for larger employers and small and medium enterprises, including the voluntary and community sectors.’ (Greater London Authority 2015). Boroughs can mandate for new developments the provision of a certain amount of affordable spaces.

The definition of affordability especially for what concerns work-spaces varies strongly in different contexts. While the definition of affordability in housing has, at least in the macro level, been agreed upon (for example Eurostat and the Council of the European Union consider housing costs- exclusive of utilities but including mortgage and interests costs for owners- as ‘overburdening’ when they are above 40 percent of the disposable income, (Pittini et al. 2015: 16), and there is a rough consensus that households spending more that 30 percent of their gross income on housing have an affordability problem (Pittini 2011) None such standard definitions exist for affordable work-spaces.

Empirical findings both in London and in Amsterdam (Great London Authority 2015: 20; Gemeente Amsterdam 2016) emphasised that the focus for affordable workspaces should be shifted from rental price to square meter to the unit price. Additionally important factors to be considered include stage of development of the business, sector, flexibility, access to information and networks. In Amsterdam, the most recent Broedplaatsen framework mandates a price of 300 Euro / month for the affordable units, independently from the units’ sizes and exclusive of utilities costs.

In London, where such spaces are not directly subsidized, affordability is often defined as percentage of market rate, and a sliding scale is applied, for example starting from 60 per cent of the market rate for the first three years, and then decreasing down to 90 per cent by year ten (Great London Authority 2105: 26, referred to Borough of Hackney). The effect of this policies has been questioned (Ferm 2014), as it is strongly linked to the profile of the involved stakeholders, in most cases are not actually apt at promoting and managing such spaces. Successful examples however confirm that the impact can be wide reaching both in terms of implementing mixed use attractive developments and positively influencing the surrounding. More in general there is an understanding within the Regeneration Unit of the Great London Authority that work-spaces act as an ‘ecosystem’, and that specific attention should be given to the interplay and synergies between low-threshold and market-price spaces (Maccreanor et al. 2014: 65).

It is clear that developing mixed use structures requires additional resources in many ways (development, construction costs, management). Without additional resources there is a consistent risk of cannibalization among the affordable components, as shown in the case of the Vienna’s Quartiershäuser. Here, the affordable rent (mandated at 4 Euro/square meter) for up to 30 percent of the total usable surface could only be achieved in combination with commercial high-end housing, and therefore eliminating to the affordable housing component (Gutheil-Knopp-Kirchwald / Kadi 2014). An integrated and long term approach to mixing, with both work and live components, each of them with affordable parts, represents without any doubt a considerable challenge for all involved stakeholders.

Differently than in regeneration projects, in most new urban developments housing the main focus of the involved stakeholders is housing. Consequently little competences are cultivated and available for the development and combination of differentiated work-spaces, beyond the provision of the standard commercial retail infrastructure for residential area. In this case the notion of affordability is questionably limited to affordable housing, following the Modern paradigm and according to the consequent still embedded in the normative and supporting system. These systems appear to be hardly able to react to societal changes pushing towards fluid borders between live and work functions and times, mandating instead the production of monofunctional spaces with fixed predefined uses.

The challenge of integrated approaches is even bigger because of the lack of coordination among responsible agencies and stakeholders (for example among housing and economic development). This lack is particularly evident in the case of new urban developments where everything is being built from scratch and housing is the main focus. Integration can only work if the notion of affordability is approached in an integrated perspective, as suggested with the idea of affordable city, and both spaces, instruments and incentives are developed accordingly. This means moving towards an integrate conception of urban development focusing on economic and social processes, next to spatial structures.

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5 CONCLUSION

Mixed use is often conceptualized in terms of building and spatial structures, while economical and social processes that are implicit in mixed use development receive little attention. This basic conceptual gap is embedded in most development processes, and reflected in housing-dominated new urban developments. In order to achieve effective implementation of mixed use, the physical space, economical and social dimensions need to be conceptually integrated. This synthetic perspective gives indications about the nature of the possible innovations in the context of mixed use urban developments: as combinations of spatial-technological structures and organizational, people and / or service based components whose effects can range from social, to economical / service-based and spatial / typological innovation. Especially fine-grained non housing functions – in order to be successful – require incentives to support affordability, and as well organizational and financial innovative structures (such as specific subsidies both object and subject based, cross-sites operators, business consultancies, branding). At the same time the preliminary findings of the project indicate that specifically these kind of uses are particularly relavant, and until now neglected, ingredients for a sustainable (and mixed) city.

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reviewed paper

Mit Potenzialanalysen die richtigen Verwaltungsdienstleistungen digitalisieren

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1 ABSTRACT

Bei der „Potenzialanalyse zur Digitalisierung von Verwaltungsdiensten nach außen" werden alle Dienstleistungen der Behörde für Umwelt und Energie (BUE) und der Behörde für Stadtentwicklung und Wohnen (BSW), die beide aus der ehemaligen Behörde für Stadtentwicklung und Umwelt (BSU) hervorgingen, mit und ohne verwaltungsrechtlicher Außenwirkung, deren Eignung für eine prozessoptimierte Nutzbarkeit von E-Government-Angeboten gegeben ist, erfasst und ausgewertet. Dies soll unter Beachtung von Bundes- und Landesrecht sowie dem sogenannten Leistungskatalog der öffentlichen Verwaltung (LeiKa) erfolgen, der vom Bund in Zusammenarbeit mit den Ländern erstellt wird. Geprüft werden sollen jeweils eine mögliche Nutzung bestehender Infrastrukturlösungen der FHH oder eigens dafür bereitgestellter technischer Lösungen der eigenen oder anderer Fachbehörden, des Bundes, anderer Länder oder öffentlicher Einrichtungen.

Das Ziel der Potenzialanalyse besteht darin

- Verwaltungsdienste zu ermitteln, welche sich für die Steigerung der Attraktivität von Online-Diensten und der Anzahl von medienbruchfreien Serviceprozessen eignen, um zunehmend mehr Bürgerinnen und Bürger für diese Art der Kommunikation mit der Verwaltung zu gewinnen
- die Entwicklung und Bereitstellung von Online-Dienstleistungen zu professionalisieren. Dabei sollen die Prozesse zukünftig zur Arbeitsentlastung in den Fachbereichen und somit zur Kostensenkungen führen. Im Fokus stehen eine höhere Servicequalität und ein effizienterer Ressourcenverbrauch
- potenzielle Online-Verfahren zu identifizieren, kritisch zu analysieren, zu dokumentieren und auf eine Neustrukturierung der Abläufe bei Nutzung einer digitalen Lösung zu überprüfen. Identifizierte Verwaltungsdienste sind nach Priorität, Kosten/Nutzen und möglicher technischer Lösung zu katalogisierten. Dabei sind möglichst viele Dienstleistungen in unterschiedlichen „Unterstützungsgraden" für den Bürger und die Wirtschaft zu erfassen. Es ist nicht zwingend notwendig, komplette Lösungen z.B. im Sinne einer vollständigen Integration in ein bestehendes Fachverfahren mit automatischer abschließender Bearbeitung von Fällen zu konzipieren. Das Lösungsspektrum kann von der Bereitstellung eines Formulars bis hin zu einer Kommunikation zwischen Bürger und Verwaltung mit abschließender Bearbeitung reichen

Bei der Identifizierung der Prozesse soll jede Option denkbar sein, von der Nutzung des sog. „Antrags- und Fallmanagements", über die Einführung von bereits bestehenden Lösungen, bis hin zur Eigenentwicklung. Unter Berücksichtigung relevanter Qualitäts- und Kostenaspekte soll die günstigste Lösung für die Umsetzung und den Betrieb vorgeschlagen werden.

Keywords: Administration, Digital, E-Government, Online Service, Potential Analysis

2 INITIATIVE UND STRATEGIE

2.1 Übergeordnete politische Initiative

Für die IT-Planung sind behördenweit drei strategische Programm-Schwerpunkte vorgegeben. Diese basieren auf den im Oktober 2012 vom Senat der Freien und Hansestadt Hamburg (FHH) beschlossenen Eckpunkten der IT- und E-Government-Strategie und umfassen:

- Online-Zugang zur Verwaltung für Bürger und Wirtschaft
- Verfügbarkeit von Daten
- Geschäftsprozessoptimierung durch digitale statt papierbasierte Prozesse

Die Potenzialanalyse wird auf Basis aller 3 strategischer Programm-Schwerpunkte durchgeführt.

Die Ergebnisse der Potenzialanalyse finden Einzug in den IT-Strategie-Plan der Behörde und werden als Grundlage für die IT-Planung herangezogen.

2.2 Strategischer Ansatz

Die politischen Schwerpunkte der FHH, die IT-Strategie „Digitale Verwaltung 2020“ sowie das Konzept des Senats „Digitale Stadt“ finden bei der Potenzialanalyse Berücksichtigung.

Vorhaben, die diesen Programmschwerpunkten zugeordnet werden können, werden für die IT-Planung vorrangig berücksichtigt. Insbesondere beim Online-Zugang zur Verwaltung für Bürger und Wirtschaft ergeben sich für die BUE/BSW etliche Berührungspunkte.

2.3 Beitrag zur Verwaltungsmodernisierung

Die Potenzialanalyse zeigt auf, in welchen Bereichen durch den Wegfall von Medienbrüchen, die elektronische Prüfung übermittelter Informationen und die automatisierte Weitergabe dieser Informationen in die Fachverfahren ein Verwaltungsdienst beschleunigt und/oder vereinfacht werden kann. Dabei geht es zum einem um eine bessere Servicequalität für die Bürgerinnen/Bürger und die Wirtschaft durch einen schnelleren und einfacheren Zugang zur Verwaltung. Zum anderen geht es um eine höhere Datenqualität und einen effizienteren Ressourcenverbrauch (Personal / Zeit) in der Verwaltung bei der Durchführung eines Verwaltungsdienstes.

Durch die Potenzialanalyse werden folgende Sachverhalte untersucht:

- Die Vollständigkeit der Daten bei Eintreffen in der Verwaltung soll elektronisch gewährleistet sowie
- die Daten so weit möglich maschinell auf Plausibilitäten geprüft werden
- Es soll eine automatische Überführung der Daten in maschinelle Fachverfahren stattfinden

Die Sachbearbeiter in der Verwaltung sollen nur noch in Einzelfällen Prüfungen manuell durchführen müssen und können weitere Verwaltungseinheiten bei Bedarf einbinden. Diese Einbindung soll dann wieder vollständig elektronisch stattfinden. Gegebenenfalls erfolgt eine Rückmeldung an die Bürgerinnen/Bürger oder Wirtschaft - mit oder ohne die Ausstellung eines Gebührenbescheides - wieder digitalisiert.

2.4 Herausforderungen bei der Verwaltungsmodernisierung

Ausgangssituation für die Potenzialanalyse war ein Zustand, in dem aufgrund personeller Engpässe bzw. priorisierter Aufgabenstellungen die Innovationsbereitschaft in den betroffenen Ämtern zunehmend stagnierte bzw. nachgelassen hatte. Dies drückte sich durch die abnehmende Anzahl von IT-Projekten aus, die von den Fachämtern initiert wurden.

Die spezifischen Herausforderungen bei der Potenzialanalyse liegen in drei Bereichen (der Struktur der Ämter und den beteiligten Personen sowie in den eigentlichen Verwaltungsdiensten):

- Je nach Struktur der Ämter gibt es einen IT-Ansprechpartner im Amt oder je Abteilung eines Amtes
- Es kann persönliche Befindlichkeiten bei den beteiligten Personen geben
- Es kann tatsächliche oder vermeintliche Umsetzungshindernisse bei den Verwaltungsdiensten geben

In jedem Amt wurden Vorgespräche mit dem IT-Ansprechpartner geführt. Dabei war die Aufgabenstellung der Potenzialanalyse klar zu benennen. Hierbei war zur Beseitigung eventueller Vorbehalte zu verdeutlichen, dass die Durchführung einer Potenzialanalyse nicht bedeutet, dass sofort personelle Ressourcen zur Umsetzung zur Verfügung stehen müssen. In diesen Vorgesprächen waren zusätzlich die notwendigen fachlichen Ansprechpartner für die Verwaltungsdienste in den Referaten zu identifizieren.

Mit den fachlichen Ansprechpartnern in den Referaten wurden dann die weiteren Ermittlungen zu potenziell digitalisierbaren Verwaltungsdiensten durchgeführt. Dieses konnte in Einzelgesprächen und / oder im Beisein des Vorgesetzten oder des IT-Ansprechpartners geschehen. Weiterhin bestehende Befindlichkeiten und Vorbehalte waren für das weitere Vorgehen sensibel zu berücksichtigen.

Es waren häufig schon klare eigene Vorstellungen der Fachbereiche in den Referaten zu den Verwaltungsdiensten vorhanden, die ohnehin digitalisiert werden sollen. Ein wesentlicher Aspekt in den Gesprächen war daher die Identifikation und Analyse von Verwaltungsdiensten, die der Fachbereich nicht oder noch nicht als geeignet für die Digitalisierung einstuft hatte. Hier mussten die Gründe (persönliche, fachliche, rechtliche, organisatorische oder technische) für die Einschätzung des Fachbereichs genau ermittelt werden. Oft war es auch eine Kombination aus mehreren dieser Gründe.

Bei der Potenzialanalyse ging es aber nicht nur um Quick-Wins (also kurzfristig digitalisierbare Verwaltungsdienste), sondern es waren auch mittel- und langfristige Umsetzungen zu erkennen und zu dokumentieren. Alle vermeintlichen oder tatsächlichen Umsetzungshindernisse, wie zum Beispiel Schriftguterfordernis, waren genau zu prüfen. Bei der Potenzialanalyse war es entscheidend, alle Verwaltungsdienste zu dokumentieren, bei denen eine Digitalisierung sinnvoll ist, auch wenn eine Umsetzung noch nicht absehbar erscheint. Die Umsetzungshindernisse sind dabei ebenfalls zu dokumentieren, damit bei deren Wegfall die Umsetzung neuerlich angestoßen werden kann.

In den Gesprächen zur Potenzialanalyse mit den Fachbereichen waren auch Bereiche abzufragen, die auf den ersten Blick nicht zum Kernprozess eines Verwaltungsdienstes der Behörde gehören.

Dazu gehörten:

- Automatisierte Erstellung von Gebührenbescheiden nach Abschluss des Verwaltungsdienstes
- Nutzung der digitalisierten Informationen durch dritte Beteiligte innerhalb der FHH, die mit dem eigentlichen Verwaltungsdienst nicht beschäftigt sind (z.B. Polizei)
- Nutzung der digitalisierten Informationen, um bisher manuelle Prozesse in der innerbehördlichen Kommunikation zu optimieren

3 VORGEHEN BEI DER POTENZIALANALYSE

3.1 Nutzen

Für die Verwaltung als Ganzes sollen durch die Steigerung der Attraktivität des Online-Dienste-Angebots und die Anzahl von medienbruchfreien Serviceprozessen zunehmend mehr Bürgerinnen und Bürger für diese Art der Kommunikation mit der Verwaltung gewonnen werden. Die Attraktivität dieser Dienste steigt und die Verbesserung der Servicequalität fällt auf die Wahrnehmung der Arbeit der Verwaltung zurück.

Für den einzelnen Sachbearbeiter sollen die manuellen Tätigkeiten für Erfassung, Überprüfung und Bearbeitung innerhalb der betroffenen Verwaltungsdienste erheblich reduziert werden. Der Verwaltungsdienst kann durch die Digitalisierung schlanker und schneller gestaltet werden, da die Prozesse der Änderung von manueller auf digitale Verarbeitung angepasst werden.

Durch eine weitestgehend maschinelle Überpüfung der Daten auf Vollständigkeit und Inhalt bei der Erfassung durch Bürger/Bürgerin oder Wirtschaft wird die Datenqualität gesteigert. Dadurch gibt es deutlich weniger Rückfragen im Rahmen der Bearbeitung, aber auch die Rückspiegelung von Informationen (z.B Geo-Daten) zu Verwaltungskunden wird durch die verbesserte Datenqualität aufgewertet und stellt somit eine höhere Servicequalität dar.

3.2 Steigende Komplexität des Verwaltungshandelns

Die Komplexität von Verwaltungsdiensten wird aufgrund steigender Anforderungen durch gesetzliche Vorgaben vom Bund, aber auch von der EU, immer größer. Das führt auch zu einer stärkeren Verzahnung der Verwaltungseinheiten der FHH untereinander, da vielfach andere Behörden oder Landesämter an Verwaltungsdiensten beteiliegt werden müssen. Die vorhandenen Prozesse, die einem Verwaltungsdienst zugrunde liegen, sind immer noch häufig manueller Art und beziehen sich zumeist auf die Erledigung genau einer Aufgabenstellung.

Eine verstärkte Digitalisierung dieser Verwaltungsdienste führt dazu, dass die vorhandenen Prozesse auf manueller Basis, jetzt tiefgreifend überarbeitet werden können. Wenn Bürgerinnen/Bürger und Wirtschaft ihre Anfragen durch eine digitale Abfrage erledigen oder ihre Anträge digital einreichen können, besteht die Möglichkeit, die komplexen Prozesse deutlich zu vereinfachen und zu standardisieren. Die Verlagerung von Prüfungen von der manuellen Sachbearbeitung auf die maschinelle Online-Erfassung trägt dazu bei. Alle Muss-Angaben sind vorhanden und es werden nur Werte innerhalb der gültigen Wertebereiche erfasst. Rückfragen an den/die Antragsteller sind dadurch deutlich geringer.

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Manuelle Erfassungen von Daten in der Sachbearbeitung und damit mögliche Fehlerquellen entfallen in den meisten Fällen. Die Weiterreichung von Daten zwischen Fachämtern erfolgt ebenso digital wie die Rückmeldung an den/die Antragsteller und die Erstellung von Gebührenbescheiden.

Durch die Digitalisierung der Verwaltungsdienste ist es ggf. möglich, dass Bürgerinnen/Bürger oder Wirtschaft immer sehen können, wie der Bearbeitungsstand einer Anfrage oder eines Antrages ist. Dieses schafft eine hohe Transparenz und damit Verständnis und Akzeptanz für die Verwaltungsarbeit.

3.3 Aufgabenanalyse, -kritik

Grundsätzlich wurden alle Verwaltungsdienste nach außen innerhalb der Potenzialanalyse kritisch hinterfragt. Das gilt für:

- den Übertragungsweg von Anfrage / Antrag von außen in die Verwaltung
- den aktuellen Geschäftsprozess (ggf. unter Verzicht auf Einzelfallprüfungen)
- die Kommunikation innerhalb der Verwaltung für einen Verwaltungsdienst, auch Fachamt übergreifend
- etwaige Umsetzungshindernisse, die eine Digitalisierung vermeintlich oder tatsächlich verhindern
- maschinelle Einbindung zusätzlicher Verwaltungsbereiche (z.B. Gebührenbescheide, SAP)

Das Ergebnis der Potenzialanalyse kann also einen stark veränderten und optimierten Verwaltungsdienst zur Folge haben. Verbesserte Servicequalität und optimierter Ressourcenverbrauch sind wesentliche Kriterien. Eine enge Kommunikation mit Rechtsabteilung und Datenschutz kann gerade in den Bereichen Signatur / Authentifizierung und Datensicherheit wichtig sein. Generell werden pragmatische Lösungen zur Erreichung der Projektziele angestrebt.

3.4 Neugestaltung der Verwaltensprozesse

Durch den neuen Ansatz „digital first“ soll die Hamburgische Verwaltung eine grundsätzliche Onlineausrichtung erfahren. Der Online-Kanal soll der priorisierte Zugang zur Verwaltung werden. Den Verwaltungszweigen soll ein entsprechendes Umdenken in integrierte, fachübergreifende und interbehördliche Geschäftsprozesse bei nach außen gerichteten Dienstleistungen der Stadt abgefordert werden.

Die fachlichen Kompetenzen für Geschäftsprozessanalyse und –optimierung, die in der IT-Abteilung der BUE/BSW aufgebaut wurden, sind in das Projekt integriert. Ebenso werden die speziellen Kompetenzen im Projektmanagement aus dem IT-Projektpool der Finanzbehörde im Projekt genutzt.

Durch die Vernetzung und Unterstützung mit und aus den Kompetenzcentern der FHH für Projektmanagement und Geschäftsprozesse ist sichergestellt, dass im Projekt immer nach den neuesten Richtlinien der FHH gearbeitet wird. Durch diese Zusammenarbeit findet auch immer ein Rückfluss der Erkenntnisse aus dem Projekt in diese Bereiche statt.

Am 22. Dezember 2015 wurde die neue Verwaltungsvorschrift zur transparenten und kostenstabilen Umsetzung von IT-Projekten (VV IT-Projekte) vom Senat der FHH in Kraft gesetzt. Diese wurde schon im Vorfeld und wird auch aktuell im Rahmen der Projektarbeit berücksichtigt.

3.5 Rechtliche Rahmenbedingungen

Hier wurden im Verlauf der Projektarbeit immer wieder drei Bereiche beleuchtet und hinterfragt:

- Schriftgut-Erfordernis
- Authentifizierung / Signatur
- Datensicherheit

Es war häufig zu klären, ob Schriftgut-Erfordernisse noch gegeben sind, denn nach Inkrafttreten des E-Government-Gesetzes des Bundes (EGovG) werden kurz- bis mittelfristig Hindernisse für elektronische Verwaltungsdienstleistungen, wie zum Beispiel Schriftgut-Erfordernisse, beseitigt.

Ist eine Authentifizierung erforderlich, dann ist immer die Tiefe der Authentifizierung zu klären. Hier können ausreichen:

- Aktenzeichen
- Aktenzeichen und Adresse
- ID des Personalausweises
- Personalausweis mit Chip
- Zugestellte PIN-Nummer
- …

Bei der Datensicherheit ist immer die Schutzstufe zu klären. Es muss immer wieder die Frage gestellt werden:

- Welche Daten sind öffentlich zugänglich (Hamburgisches Transparenzgesetz)?
- Welche Daten dürfen nur den für sie berechtigten Personen zugänglich gemacht werden?
- Welche Daten sind ausschließlich behördenintern?

Ergeben sich in diesen drei Bereichen Unsicherheiten, so sind die Rechtsabteilung und/oder der Datenschutz hinzuzuziehen. Dieses kann dazu führen, dass Verwaltungsdienste in der Potenzialanalyse erfasst und dokumentiert werden, aber erst nach Klärung oder Wegfall von Umsetzungshindernissen auch digitalisiert werden können.

3.6 Fazit

Entscheidend für den Erfolg der Potenzialanalyse zu Verwaltungsdiensten, die digitalisiert werden sollten, ist der richtige Ansprechpartner im zu untersuchenden Amt. Hilfreich war hier die Expertise der IT-Abteilung der BUE/BSW, die durch jährliche IT-Plangespräche die Ansprechpartner und Bedürfnisse der Ämter genau kennt. Da die Ämter unterschiedlich aufgestellt sind und die IT-Affinität unterschiedlich ausgeprägt sein kann, ist dieses bei der Herangehensweise zu berücksichtigen.

Neben den zum Teil sehr klaren Vorstellungen über zu digitalisierende Verwaltungsdienste durch die Ämter selber, müssen folgende Verwaltungsdienste und deren Nutzung besonders betrachtet werden:

- Verwaltungsdienste, die von den Ämtern als ungeeignet eingestuft werden. Hier liegen eventuell Umsetzungshindernisse vor, die mittel- oder langfristig ausgeräumt werden können oder schon ausgeräumt sind. Vielleicht sind auch die technischen Möglichkeiten für eine Umsetzung nicht hinreichend bekannt oder es gibt (unbegründete) Ängste / Vorbehalte
- Verwaltungsdienste, die schon digitalisiert sind. Hier kann es die Möglichkeit von Prozessoptimierungen geben oder weitere fachliche Funktionen können zusätzlich angeschlossen werden
- Digitalisierte Informationen können auch die Arbeit von am eigentlichen Verwaltungsprozess unbeteiligten Stellen der FHH optimieren
- Verwaltungsdienste, die nach außen digitalisiert sind oder werden, müssen auch auf die Möglichkeit untersucht werden, interne Prozesse zu optimieren. Dabei können dann auch interne, manuelle Prozesse digitalisiert werden

4 ERKENNTNISSE UND AUSBLICK

4.1 Pilot Amt

Es war sinnvoll, erste Erfahrungen für den weiteren Analyseverlauf anhand der Erhebung und Potenzialanalyse von Verwaltungsdiensten zur Digitalisierung in einem ausgewählten Pilot-Amt zu sammeln.

Dabei gewonnene Erkenntnisse konnten einfließen, als die Potenzialanalyse auf die anderen Ämter einer Behörde ausgerollt wurde.

Es kann sich bei dem Piloten auch um ausgewählte Abteilungen eines Amtes handeln. Werden in besonderen Konstellationen (kürzlich erfolgte Aufsplittung von einer Behörde in zwei Behörden) zwei Behörden parallel begutachtet, sollte man für den Piloten aus jeder Behörde ein Amt, beziehungsweise eine Abteilung oder ein

Referat, auswählen. Die Größe von Amt, Abteilung oder Referat sollte den Ressourcen des Projektes (Zeit, Personal) angemessen sein.

Zu den Auswahlkriterien für ein Pilot-Amt gehören:

- Interesse des Amtes an einer Erhebung von Verwaltungsdiensten, die sich für eine Digitalisierung eignen, muss vorhanden sein
- Es muss der Umsetzungswille für die Digitalisierung der empfohlenen Verwaltungsdienste vorhanden sein
- Hohe Auslastung oder geringe Verfügbarkeit der Sachbearbeiter des möglichen Pilot-Amtes dürfen Erhebung nicht behindern
- In dem Pilot-Amt sollte mindestens je 1 Verwaltungsdienst aus den Darstellungsgruppe (Service, Antrag, Bescheid) vorhanden sein, der sich überhaupt oder besser digitalisieren lässt als bisher
- Es sollte 1 Verwaltungsdienst je Komplexitätsstufe (einfach, mittel, gering) vorhanden sein, dessen Digitalisierung angestrebt wird
- Sind ein oder mehrere Verwaltungsdienste aufgrund niedriger Fallzahlen nicht für die Digitalisierung geeignet, ergibt sich diese Erkenntnis vermutlich erst während der Erhebung im Pilot-Amt und ist damit auch ein wichtiges Ergebnis für die Erhebung
- Die derzeitige Rechtslage bei erforderlicher Signatur oder Schriftguterfordernis muss genau geprüft werden, da es Initiativen des Bundes zur Verbesserung der Situation für eGovernment gibt
- FHH kann auch Vorreiter sein; bedeutet jeder Veraltungsdienst muss kritisch auf die Möglichkeit der Digitalisierung geprüft werden
- Verwaltungsdienste mit hohen Fallzahlen (Fälle im Amt, Webseitenzugriffe) sollten hinsichtlich Digitalisierung genau betrachtet werden
- Verwaltungsdienste mit großer politische Bedeutung durch eine hohe Außenwirksamkeit oder durch ein großes öffentliches Interesse sind sorgfältig auf Digitalisierung zu prüfen

4.2 Ergebnisse

Die Potenzialanalyse ergab einen guten Digitalisierungsstand in den beiden untersuchten Behörden der FHH. Trotzdem haben sich noch etliche Potenziale in unterschiedlichen Ausprägungen ergeben.

Zu ungefähr gleichen Anteilen ergaben sich die Potenziale bei Zustandmeldungen und bei Antrags-, und Genehmigungsverfahren. Bei den Zustandmeldungen erfolgen zyklischen Meldung von Werten an die Fachämter, wie zum Beispiel bei der Grundwasserförderung oder bei der Mengenabfrage Müll. Beim Antrags-, oder Genehmigungsverfahren werden nicht nur Informationen von außen an die zuständigen Fachämter übermittelt, sondern die entsprechende Bewertung des Antrages auch wieder an die Bürgerinnen und Bürger oder die Wirtschaft zurückgegeben, wie zum Beispiel bei den Nacharbeitsgenehmigungen oder dem Antrag auf wasserrechtliche Erlaubnis.

In einigen wenigen Fällen wurden Potenziale bei der Ergänzung von bestehenden Fachverfahren identifiziert. In einem Fall lag das Potenzial zur Digitalisierung in der Kommunikation zwischen an einem Verwaltungsdienst beteiligten Ämtern, durch das die Bearbeitung für Bürgerin/Bürger beschleunigt werden kann.

Zwischen den einzelnen Ämtern beider Behörden gibt es zum Teil erhebliche Abweichungen bei den Ergebnissen der Potenzialanalyse. Diese Abweichungen sind in den fachlichen Aufgaben der Ämter begründet. Bei Ämtern mit geringen bis keinen Aussenkontakten sind keine Verwaltungsdienste mit Potenzial zur Digitalisierung zu erkennen. In anderen Ämtern sind nur Serviceangebote vorhanden, bei denen Informationen für Bürgerinnen und Bürger zur Verfügung gestellt werden. Hierunter fallen zum Beispiel die Informationen über die Qualität der Badegewässer im Amt für Umweltschutz und auch das Baumkataster im Amt für Naturschutz, Grünplanung und Energie. Diese Serviceangebote sind in den meistens Fällen in den untersuchten Ämtern schon digitalisiert.

Die meisten Potenziale fanden sich in der BUE im Amt für Immisionsschutz und Betriebe, wo es hauptsächlich um Erweiterungen zu bestehenden Fachanwendungen geht, sowie im Amt für Umweltschutz. Hier liegt der Schwerpunkt auf Anzeigen/Meldungen zu fachlichen Sachverhalten und Anträgen.

In der BSW lag das größte Potenzial im Amt für Bauordnung und Hochbau. Dabei gibt es bei den dort identifizierten Verwaltungsdiensten keinen Schwerpunkt in der Ausprägung der Digitalisierung.

Insgesamt wurden in beiden Behörden zusammen 25 Verwaltungsdienste identifiziert, bei denen eine Digitalisierung nach Auswertung der Potenzialanalyse empfohlen wird.

Die Gründe für die Empfehlung dieser Verwaltungsdienste sind (Mehrfachnennung möglich):

- Ca. 50% haben jährliche Fallzahlen im 4- bis 5-stelligen Bereich
- Über 90% erfahren eine Prozessoptimierung und damit einen zum Teil erheblich reduzierten Ressourcenverbrauch
- Über 50% stellen eine Verbesserung der Servicequalität für die Bürgerinnen und Bürger oder die Wirtschaft dar
- Bei ca. 75% wird eine Verbesserung der Datenqualität durch maschinelle Prüfungen und Wegfall eines Medienbruches erreicht

Dazu haben ca. 60% eine geringe Komplexität und lassen sich mit verhälnismäßig wenig Aufwand umsetzen, so dass hier von Quick-Wins gesprochen werden kann.

4.3 Weiteres Vorgehen

Nach Abschluss der Potenzialanalyse soll zügig mit der Digitalisierung der identifizierten Verwaltungsdienste begonnen werden. Dazu sind sowohl die personellen, als auch die finanziellen Ressourcen zur Verfügung zu stellen.

Die personellen Ressourcen kommen aus dem Fachamt dessen Verwaltungsdienst digitalisisert werden soll und aus der IT der BUE/BSW. Zusätzlich wird weiterhin auf die speziellen Kompetenzen im Projektmanagement aus dem IT-Projektpool der Finanzbehörde zurückgegriffen.

Zur Sicherstellung der finanziellen Ressourcen wurde in einem IT-Plan-Antrag ein Sammelvorhaben über die 25 zur Digitalisierung anstehenden Verwaltungsdieste definiert. Dadurch konnte der Antrag für die notwendigen Gelder schon parallel zur Potenzialanalyse gestellt werden. Durch den Sammelantrag war es möglich, dass die Details und die Priorisierung zu den Verwaltungsdiensten im Verlauf der Potenzialanalyse immer weiter verfeinert werden konnten, ohne dass es Auswirkungen auf den Sammelantrag hatte.

Das schnelle Umschalten von Potenzialanalyse auf Umsetzung der Digitalisierung ist vor dem Hintergrund wichtig, dass durch die Potenzialanalyse das Verständnis und die Akzeptanz für die Digitalisierung in den Fachämtern der beiden Behörden erzeugt wurden. Eine längere Pause zwischen den beiden Projekten (Analyse – Umsetzung) birgt die Gefahr, dass das Tagesgeschäft, welches zwangsläufig vorhanden ist, die positive Grundstimmung für die Digitalisierung wieder überlagert.

5 UNTERSTÜTZENDE MASSNAHMEN

5.1 Projektbegleitende organisatorische Maßnahmen

In der IT-Abteilung wurde eine spezielle Kompetenz für Geschäftsprozessanalyse und Geschäftsprozessoptimierung geschaffen. Auf diese Kompetenz wird im Rahmen des Projektes zurückgegriffen.

Weitere Mitarbeiterinnen und Mitarbeiter wurden im Antrags- und Fallmanagement geschult. In der FHH wurde das Antrags- und Fallmanagement (AFM) eingeführt. Die Infrastruktur des AFM ermöglicht die frei gestaltbare und flexible Umsetzung von Online-Verfahren, mit denen Informationen in die Verwaltung eingesteuert oder Informationen der Behörden übersichtlich im Internet dargestellt werden können. Die fachlichen Anwendungsmöglichkeiten der Infrastruktur sind vielfältig und reichen von Antragsverfahren, Verfahrensklärungen, Informationsangeboten und Ausfüllhilfen bis hin zu anonym ausfüllbaren Fragebögen.

Durch beide Maßnahmen sollen optimale Ergebnisse bei der Potenzialanlyse und eine zielgerichtete und schnelle Weiterleitung in die Umsetzung dieser Ergebnisse erreicht werden.

5.2 Good Practice

Im Verlauf der Potenzialanalyse wurde ein Vorgehens-Handbuch („Kochbuch“) erstellt, in dem die Erkenntnisse aus dem Pilot-Amt, aber auch deren Weiterentwicklung beim Rollout über alle Ämter der BUE/BSW dokumentiert sind. Dabei wird auf Besonderheit in der Struktur der Ämter und dem daraus resultierenden unterschiedlichen Vorgehen eingegangen.

Es wird das Vorgehen in der Zusammenarbeit mit den Sachbearbeitern beschrieben (Besonderheiten, Befindlichkeiten, Lösungsansätze). Es werden Bereiche beispielhaft beschrieben, die nicht zum Kernprozess eines Verwaltungsdienstes gehören, aber großes Potenzial zur Digitalisierung beinhalten können. Ebenso sind Schnittstellen und Abgrenzungen zu anderen Projekten der FHH (z.B. Bezirksverwaltung-Online) dokumentiert. Das Vorgehens-Handbuch so gehalten, dass es auf andere Behörden oder Landesämter der FHH ausgerollt werden kann und es wurde auch schon aus anderen Bereichen der FHH angefragt.

reviewed paper

Model-based Planning for a Sustainable Urban Development

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1 ABSTRACT

The objective of the presented project is the development of methodological and information-technical fundamentals for the realization of an integrated urban information management. The main focus is on demand-oriented development of an integrated multi-scale city model for the application context of the municipal energy efficiency, which convergently depicts all relevant objects with their semantic properties and their topologies for the representation of municipal transport and energy networks. The technical implementation of the model is effected by a prototypical model management platform with functionalities for rule-based semantic model analysis. The provision of standardized interfaces enables the integration, accompanying planning, of simulations and optimization processes.

Keywords: energy-efficient city, model-based planning, multiscale analysis, urban development, urban planning tool

2 INTRODUCTION

Together with climate and energy policy plans Germany has framed ambitious targets for the next decades. Yet federal measures and regulations primarily focus on accelerated extension of regenerative energy carriers and on a correlating adjustment of network infrastructure, and thereby foremost on the levels of energy production and distribution. However, significant improvements on the part of energy consumption are needed in future in order to achieve the defined objectives in the long run. Germany's building sector accounts for 43% of the cumulated energy consumption, and falls under the federal responsibility of the local authorities. Furthermore, other system relevant factors lie on that level, e.g. development of local supply infrastructure and private motorized transport, where about one third of all driven passenger-kilometers are short trips by car or in local urban transport. It thus becomes clear that cities and municipalities have to make a crucial contribution in order to achieve the set targets within the prescribed time frames – since federal and state-wise political competencies, respectively controlling instruments alone are not sufficient.

Development, evaluation and implementation of sustainable concepts in urban planning demands application of integrated concepts and methods based upon early inclusion of all relevant aspects within the complex, dynamic and highly emergent systems „city + energy(flow)“. Due to the complexity involved, it is required taking into consideration prospectively systemic interactions and dependencies. It is also necessary to include all involved planning participants in communal goal definition and planning processes at an early stage. These requirements still pose great difficulties especially for small municipalities. When compared to bigger cities, they have less personnel resources and specialized professional competencies due to less diversification in political and administrative institutions. On the strategic decision-making level a solution-neutral localization of situational proper fields of action often already fails during preliminary planning stages because of poor availability of an up-to-date, transparent and consistent information basis, describing the given local situation.

Frictionless exchange of information along the communication chain is frequently impaired by largely heterogeneous data basis, in form and content, which entails information loss and misinterpretations. This will result in an inadequate efficiency of municipal planning processes, and often also leads to quality deficits in the planning object, or non-archievement of specified targets. A functioning trans-cyclical information management, therefore, necessarily requires an early provision and consistant application of a common, formally standardized and content-related consistent database (Gianella 2005). To define a sustainable urban development concept, it is first necessary to attain an appropriate selection and improved alignement of individual measures.

Essential questions in this regard are a) assesment and selection of the most suitable measures for a specific local problem, b) the long-term utility of these measures as well as c) the contextual coherence of individual measures with each other proportionately in the timeframe of the planning horizon in order to provide one sustainable approach. Creating a sustainable overall concept essentially requires detailed information about the location-specific current situation and strategic objectives. Therefore, the appropriate measures must be identified and evaluated in accordance with their respective capabilities. This requires a holistic situation analysis of, for example, energy consumption situation, supply situation and distribution situation, taking into account all relevant actors and local stakeholders such as residents and users, or respectively, consumers and suppliers (BMBF 2008). The problem context's high complexity and the demand for systematic observations (BMWI 2007) indirectly implicate that developed planning solutions cannot be evaluated directly and with regard to their interaction. As has been shown, both in practice as well as in research, a goal-oriented planning is only possible through consistent integration of optimization processes which support an early validation of solution concepts by means of integrated simulation and analysis tools. An efficient and transdisciplinary application of these information technological tools presupposes the availabilty of an appropriate modelbased information base, the core of which is an integrated semantic information model with a standardized respectively unified type system.

Within the framework of the funding initiative 'Energy Efficient Cities' ('Eneff:Stadt') of the Federal Ministry of Economics and Technology (BMWi) the research project „ISIS – Development of an integrated semantic information model as planning tool", the department Building Lifecycle Management (BLM) at the Karlsruhe Institute of Technology (KIT) has designed concepts and tools for the management and semantical analysis of integrated municipal information models. Based on an integrated multi-scale urban information model, the project focusses on the development of semantic analysis methods and tools.

Before explaining the solution approach and the results of the project, first of all a short overview of the examined fields of research shall be given.

3 REVIEW OF LITERATURE

Ongoing digitilization in economy and society has also reached the building industry and urban development. In terms of the application context of the here presented research project a plurality of different – open and proprietary – models, formates and formal description methods were found. However, most of the solutions depict dedicated domain specific aspects. By examining the technical base respective integration capacity of those most relevant to the projects aim a main focus was set on open and manufactor-independant solutions. Since their application is not bound by licensing and importantly they are more likely to provide a better interoperability and serve more common practical needs especially as regards the public sector.

Furthermore a majority of the standards already share a common base syntax, namely XML. Due to its popularity and application in terms of webservices, especially in recent years, an integrated set of core modeling solution provided by World Wide Web Consortium (W3C) is up to date very well established through-out the domains. Beside the wide-spread use respective support of the XML Schema XSD todays market situation also adopted many of the related W3C specifications as e.g. webservices, eXtensible Style Sheet Languache (XSL) in terms of formating websites and its realization technology XSL Transformation (XSLT).

Note that the following subchapters can only highlight certain aspects of the comprehensive literature review conducted in the framework of the project to ensure a common understanding as needed for this contribution.

3.1 Product data models in building and construction industry

Within the field of building design computer-aided methods and tool were adopted at early stage in terms of digitalization. And thus have interpenetrated today's market situation. At the base of building design processes commonly stands the architectural design. While the first generation of Computer Aided Design (CAD) systems mainly focused on digital development and graphical presentation of 2D, and later on 3D building models the second generation followed a more integrated approach. Thus, the 3D planning matter is described by objects respectively components that besides geometrical and visual representation also faciliate additional explicit semantic information (e.g. object type, quality, function or cost) and allow associative interrelations among them. The object respectively building-component oriented method (socalled Building Information Modeling – BIM) thereby allows the involvement of different professional concerns in a common data model. Importantly, this depiction method continuously carries on through-out the lifecycle of the product (planning – construction – usage – renovation/demolition).

In the mean time many BIM-based applications established in the market superseded classic geometry based drawing tools. Although in pactice some of the proprietary formats are still being used for exchange (e.g. Autodesks DWG/DFX industry standard) the Industry Foundation Classes (IFC) is more and more recognised as manufactor-independant solution for seamless transfer and integration base regarding collaborative data. The obligatory use of IFC is furthermore established for public building permit process in many countries.

The latest version “IFC 4 Add1” has grown up description possibilities, e.g. sophisticated depiction facility for Heating Ventilation Air Conditioning (HVAC) domain as regards the application context this contribution. Noteworthy on behalf of IFC’s syntax base that – besides the original IFC/STEP schema in EXPRESS language – a XML variant was introduced as ISO 10303-28 (“XML representation of EXPRESS schemas and data“) derivate “ifcXML2x3”. This was technically further optimized by stripping overhead comming from the default XML schema binding and is now applicable as stand alone XSD “ifcXML4ADD1”.

3.2 Data models and formal description method in urban development

Inspite of obligatory use of office applications, early digitilization in spatial planning primarly focussed on representation of spatial-related planning data. Virtual geographic, landscape and urban models were initially used for visualisation purposes – thereby differentiated by their granularity depending on the spatial scale of the focussed depiction matter. However, in recent years the demand has emerged for extended semantic connotation of properties besides the facility to depict geometric respective spatial information only. Thus many different geographic models and description methods were established mainly focusing on requirements of single professional domains or as proprietary data format of commercial software.

In order to streamline the development within this field of standardization in 2002 the ISO 191xxx series was established specifying a common base for geographic information models. Great potentials arise thereby from the Geographic Markup Language (GML) as it provides a common base model for depicting geographic information aimed to harmonize the up-to-date wide spread and heterogeneously implemented use of Geographic Information Systems (GIS). Although promoted in international standardisation initiatives as e.g. INSPIRE for the European countries the support especially on side of commercial GIS is still cumbersome. Besides its harmonizing momentus toward existing GIS solutions, GMLs object-oriented extension facility also builds the base of consequent semantic 3D city modeling approach specified by the Special Interest Group 3D (SIG3D) as the OpenGIS standard CityGML. This open, and to great extend, established standard allows multi-granular depiction of 3D city structures as well as annotation of semantic properties and topological relations. Furthermore, a facility is provided for modular thematic extensions regarding individual domain specific concerns (Application Domain Extension – ADE). Thus it is a predestinated integration basis for energy-related aspects in context of domain-overarching analysis and planning processes on urban scale (see Brüggemann 2015 for a comprehensive overview).

Regarding Germany’s offical data on the one hand, the above mentioned INSPIRE initiative led to the specification of a GML based interface “Normbasierte Austausch Schnittstelle” (NAS) for official land-use and measurment data. On the other hand national regulational code has been formalised e.g. for official urban development planning the “XPlanung” model built on GML provides a digital format to the officially obligatory planning data descriptions. Inspite of these generally harmonized approaches still isolated approaches can be found in official data specification effords e.g. concerning the German Energy Saving Ordinance (ENEV) that in its latest version requires digital input of building energy performance assessment data in form of XML-based “Kontrollsystem” format.

3.3 Model-based information management in collaborative planning processes

A holistic analysis of the processes in spatial planning identified integral parts as a) steering system – operative planning, b) information system – acompanying information management and c) controlled system – spatial planning matter (Laurini 2001). All these parts are tightly interrelated while the binding element and methodically basic structure is provided by the information system (Streich 1998), as it includes the informational basis for steering the processes and thus enables the supervision of the planning effects.

The strongly segregated German urban planning process chains require a better horizontal as well as vertical interlinkage of the involved stakeholder. And this again is not expediently possible without appropiate means in demand-led retrieval, management and provision of information (Lakes 2006). Following the paradigm of Integral Planning to solve complex problem situations requires the application of integral methodologies and tools that are founded upon the early consideration respective weighing of all contextual relevant aspects as well as the inclusion of all involved stakeholder (von Both 2006).

4 UNDERLYING INTEGRATED SEMANTIC URBAN INFORMATION MODEL

ISIS, the „Integrated Semantic Information model for the context of energy-efficient city" can describe and associatively link – in addition to common urban objects and urban aspects, especially regarding the energy-efficient city – all relevant structures, classes, and corresponding ancillary information on different scale. As the following figure shows it therefore faciliates a level over-arching reference system.

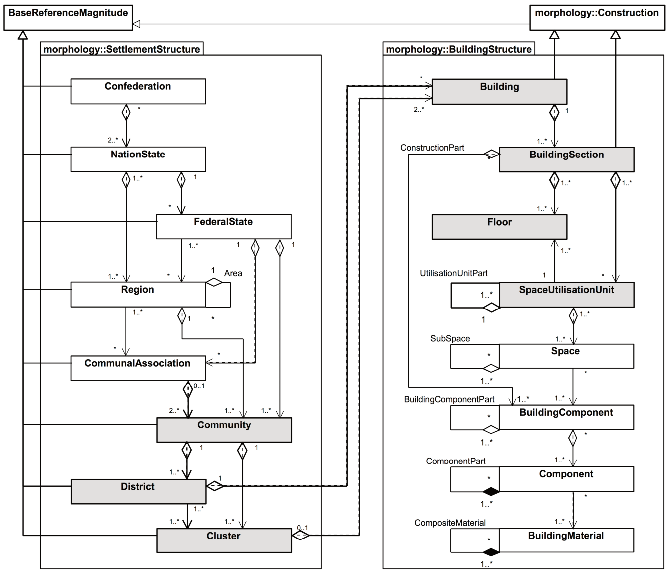

Figure 1: Modeling concept of the base dimensions (partial model 'morphology')

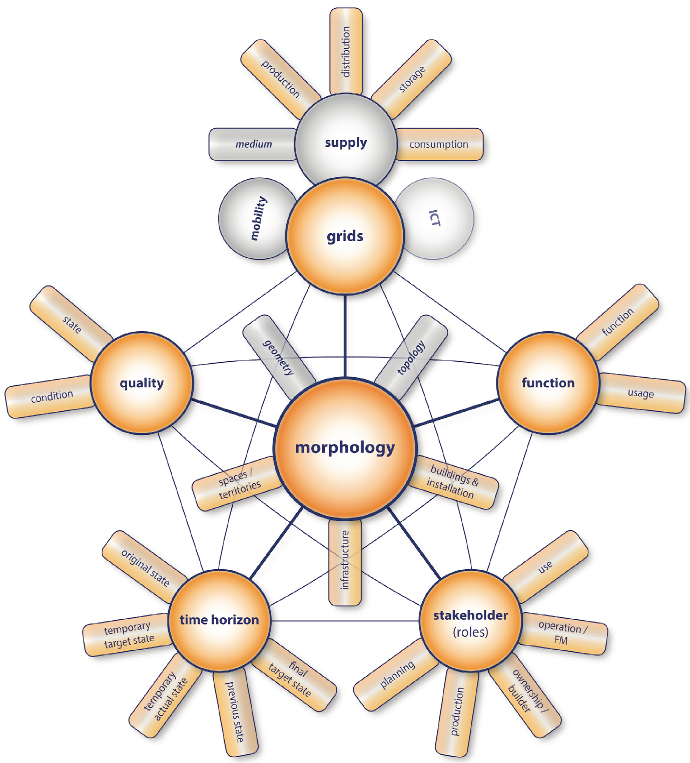

Figure 2: Dimensions and aspects of the urban information model

In addition to representing buildings, land uses, territorial or functional boundary lines, and topografical surface structures, within the systemic order of city and energy the model also supports the integral depiction of (topo)logical network infrastructure – supply and mobility – as well as energy-related quality of building structures. The differently modeled dimensions and professional aspects are shown in the following figure 2.

As a – transparent and convergent – information basis the model can constitute a suitable knowledge base for the strategic level of municipal planning to a) identify local specific deficits more easily, and to b) enable evaluating and prioritizing concerning their effective relevance in the context of energy efficiency. Thus, ISIS also supports political decision-makers in their efforts to define adequate and realistic goals for a sustainable development, context-sensitively. This increases the decision-making reliablity on the strategic level and removes possible constraints towards necessary political initiatives. Regarding a detailed description of the information model, see Brüggemann 2012.

Another objective is the support of the information generation process – that is, the development of a municipal information base building on the developed model. An important approach of the integration effort,, inspite of the technical integration of professional information into the ISIS system model itself on side of modeling, is to prepare the ground on side of the model to enable integrative linking of established professional models and data standards. In order to implement this goal, for the model specially an adequate translation from detailed BIM-based building information – specifically of the established BIM exchange standard Industry Foundation Classes (IFC) – was also projected. In this context an apropiate aggregation and exchange mechanism for the information regarding the individual building – especially concerning energetic aspects – has been concepted and realized as prototype. This involves the development of methods for information compaction as well as mechanism for the technical conversion. Furthermore solution proposals could be worked out as of how such process could be embedded in a supporting way into existing communal planning procedures.

Thus, the here presented system model (ontology model) provides the conceptual and structural base for developing application-oriented planning tools.

5 DEVELOPED MODEL BASED METHODS AND TOOLING CONCEPTS

The evaluation of the system model was based on an application case related translation and prototype implementation of an urban planning tool. In the framework of the project this was accomplished for the use case of a "convoi renovation" urban planning approach. The real-world context out of which this scenario was derived is the beacon project „Effizienz-Konvoi Waldstadt" sponsored by the state of Baden-Württemberg Ministry for Environment, Climate and Energy Sector. It introduced a new approach to multiply the rate of renovation by harvesting synergetic potentials out of over-arching organisation of multiple renovations of same typed dwellings (KEK 2012). As a research and realisation project it follows the conduction of a scientific feasability study „Klimaneutrales Karlsruhe 2050" (Vogeley 2011) with the Karlsruher Energie- und Klimaagentur (KEK, local energy agency) and the city of Karlsruhe as official stakeholder.

Following an analysis of existing normative directives and guidelines, a specific process pilot was concepted in close feedback coupling with KEK. Its implemention as a process navigator enables accessing specifically needed information (views) on behalf of the respective processes and working steps (see figure 7).

In order to ensure high flexibility on the data mangement level with regard to the application in existing IT-system environments a link was also projected to well established and practice-oriented data standards. The content management interoperability service (CMIS) is an open and manufactor-independant standard for linking Content Management Systems, e.g. the widespread Microsoft Sharepoint Server. Thus by offering support for CMIS standard with in the framework of practical implementation enables to take into consideration already existing communal system environments.

For further specification of the projected prototype a concrete application case within the above mentioned process navigator was derived. In the course of stocktaking this use case contains the analysis and integration of energetic characteristic value – as required by the German Energy Saving Ordinance (ENEV) – regarding individual buildings into the urban model.

Achieving high practical relevance as well as accessibility to the established object-oriented model formats CityGML on urban level respective IFC on building level was focussed on side of prototype realisation. Thus, the application-relevant partial models of the overall system model were transferred and persisted in XML-based structure. This derived application model was also used by the project partner IAI (KIT Institute of Applied Informatics) as a base of implementation of the convertion tool from IFC to CityGML. Built ontop of this tool then within the project (energetic) building information could be aggregated and integrated into the urban model. A model analysis tool also aligned to the above mentioned standards that was implemented within the project enables likewise level (scale) and domain over-arching logical model checking. It furthermore serves as a concrete support tool regarding complex interdisciplinary decision-making processes.

5.1 Further development of preparatory work

In the proposal to the research project it was intended to reuse existing software components from the author's BLM collaboration tool kit (BLM.CTK). This repository is based on mainly self-financed generic software building blocks. It serves in these kinds of application context as a base of implementation. Furthermore as most prototype developments derived in various research projects are uniformly classified within the repository it provides the means for software managment and maintenance.

Thus the main technological base of the projected prototype planning tool was derived from the tool „BBR ModelCheck" that was also built up on BLM.CTK and developed for the Federal Office for Building and Regional Planning (BBR) in 2011. This model checking software within the framework of the BIM pilot project „Humbold Forum" in Berlin enables BBR to check incomming IFC model data with regards to the alpha-numeric contents. The software uses seperate rule XML files for depicting the logical checking aspects as derived e.g. from official building code regulations for public buildings. A requirement of BBR to be able to configure respective further develop and administer their rule base stands at core of the rule-based concept. The therefore designed rule XML files and the facility of configuration and administration is described in detail in Ebertshäuser 2013. Further development of the abilities of this stand-alone software was on the one side to extend the application context in order to check different XML-based model types (e.g. CityGML). On the other side, since it was developed on base of generic building blocks developed within BLM.CTK, was refactoring the software to be used as a module rather than a standalone program. Its rule-based facility thereby was used besides checking the contents of the model, to have a uniform way to e.g. manipulate respectivly map certain data, extract partial models.

5.2 Testdata and external expert tool

The associate project partner City of Karlsruhe that had prior to the research project already established a CityGml data basis provided a data set of the concerned district that was used as communal information base of the scenario-project. In addition to that information on city level a IFC building model was chosen as exemplaric information which in terms of the scenario stands for the detailed building information contributed by the participating building owners. With these testdata the last necessary item of the scenario was specified as needed to implement a prototype aggregation mechanism within a framework of a planning tool. An expert on side of tooling, the project partner IAI with conssesive experience on providing tools for both CityGML and IFC, was involved in the development. As an exemplaric external tool that would be bound in one step of the planning tool's procedure an existing IAI tool the IFCExplorer was further developed to provide the technical mechanism – receiving an IFC building (see fig. 3) model (and needed information of its geo-position) and transforming it into a CityGml representation (see fig. 4). The information flow between the planning tool and this external modeler tool is either possible by having both installed on one system or in case of distributed working spaces by establishing the connection on behalf of the above mentioned CMIS webservice interface.

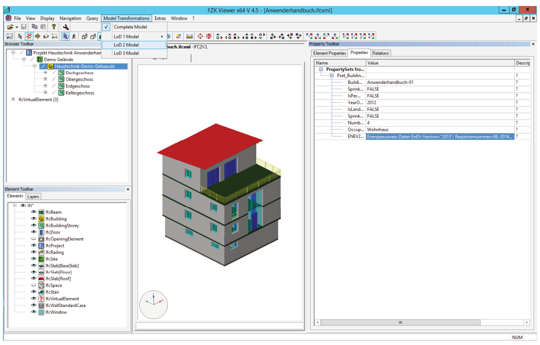
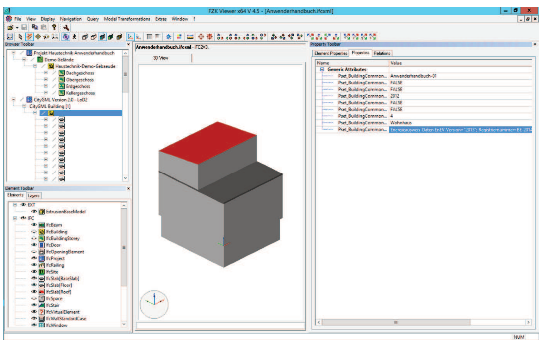

Figure 3 (left): IfcExplorer – loaded IFC model. Figure 4 (right): IfcExplorer – converted CityGML model

5.3 Use Case within process navigator to specify prototype‘s (functional) ratio

On the basis of the process navigator’s overarching workflow – strategic, tactical and operative phase – the thematic basis for a functional implementation of a prototype planning tool was further concentrated to a focus on the operational phase. Here especially the threesome stage of building assement data collected from the participants of the scenario-project – as is, planned respective realised – was found to be a suitable (recursive) task to functionally cover in the prototype software. Furthermore, the hereby also implied aggregation concept to transform the fine granular input information of building-specific information to urban level in order to provide a clearer strategic overview – reflecting the three „building-wise“ conducted stages in a combined city wide overview – was seen with potentials for reuse in a more generic manner.

The figure 5 shows the core data exchange workflow as specified for the use case – an organisation team maintaining a central project-model receives a further detailed building model as extended IFC file from a participating building owner and synchronises the CityGML based urban model with this incomming data. In the prototype planning tool this specification is implemented into four different procedure steps. The internally computed steps on the one side trigger a checking respective manipulation rule on a targeted model in respective software modules. And on the other side one step calls the external convertion tool with the corresponding input model as argument, idles while transformation is executed and resumes when the resulting data is returned.

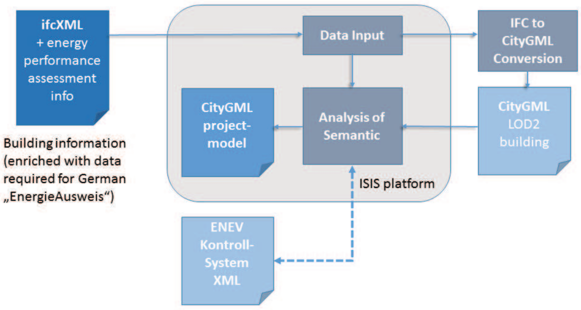

Figure 5: Specification of data flow in implemented use case

6 PROTOTYPE OF A PLANNING TOOL ‘ISIS-PLATFORM’

In the following sections the implemented user interface of the prototype planning tool is presented that consists of different modules. First, the generic funcionalty provided by the integrated rule-based model analysis module is described. And then the workflow-based project module with the above mentioned process navigator together with the use case specified in the previous chapter is introduced. Thereby the provided configurable procedures of the implemented use case are explained. On technical side they implement the concept of a unified business logic entity – in each case consisting of separate rule files and a designated software module respective external tool to execute the work task described by the procedure.

Analysis Module – arbitrary model checking facility

While opening the analysis module (see fig. 6) the user decides which model format (e.g. IFC or CityGML) to be checked. This triggers the correct rule repository for the respective format to be loaded while initializing the module.

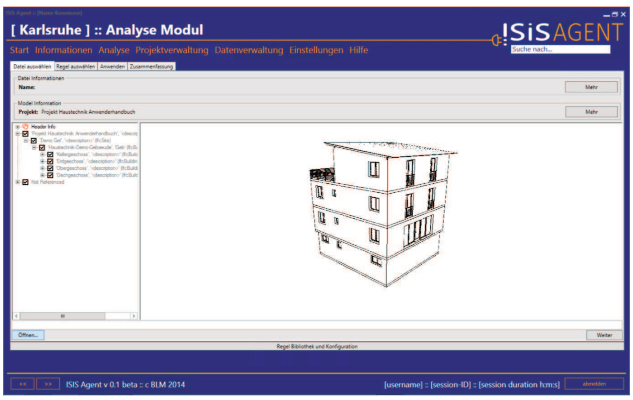

Figure 6: Prototype planning tool – model analysis module

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Editors: Manfred SCHRENK, Vasily V. POPOVICH, Peter ZEILE, Pietro ELISEI, Clemens BEYER

In order to check model contents this module provides following four straight-forward steps to the user that are implemented in seperate tabs:

(1) open the model file

(2) choose rule(s) for checking the model

(3) execute the model check

(4) summarize the result(s) [and persist report as table file if needed]

Project Modul – demonstration of workflow-based use case orchestration (general platform)

The following sections will describe the planning tool from designated user's view in the municipal level. Firstly if the user as designated member of the organising team opens the convoi renovation project, the current status as overall project-workflow is presented by the process navigator (see fig. 7). Each single step of the workflow by an instance of the underlying application model is connected to information (view) on a) who is involved, b) what is the planning matter and c) what task to be accomplished. Thereby, the previous step's results commonly are the input information to the current step. Furthermore since some steps are obligatory respective flows depict the necessary path of steps to be accomplished.

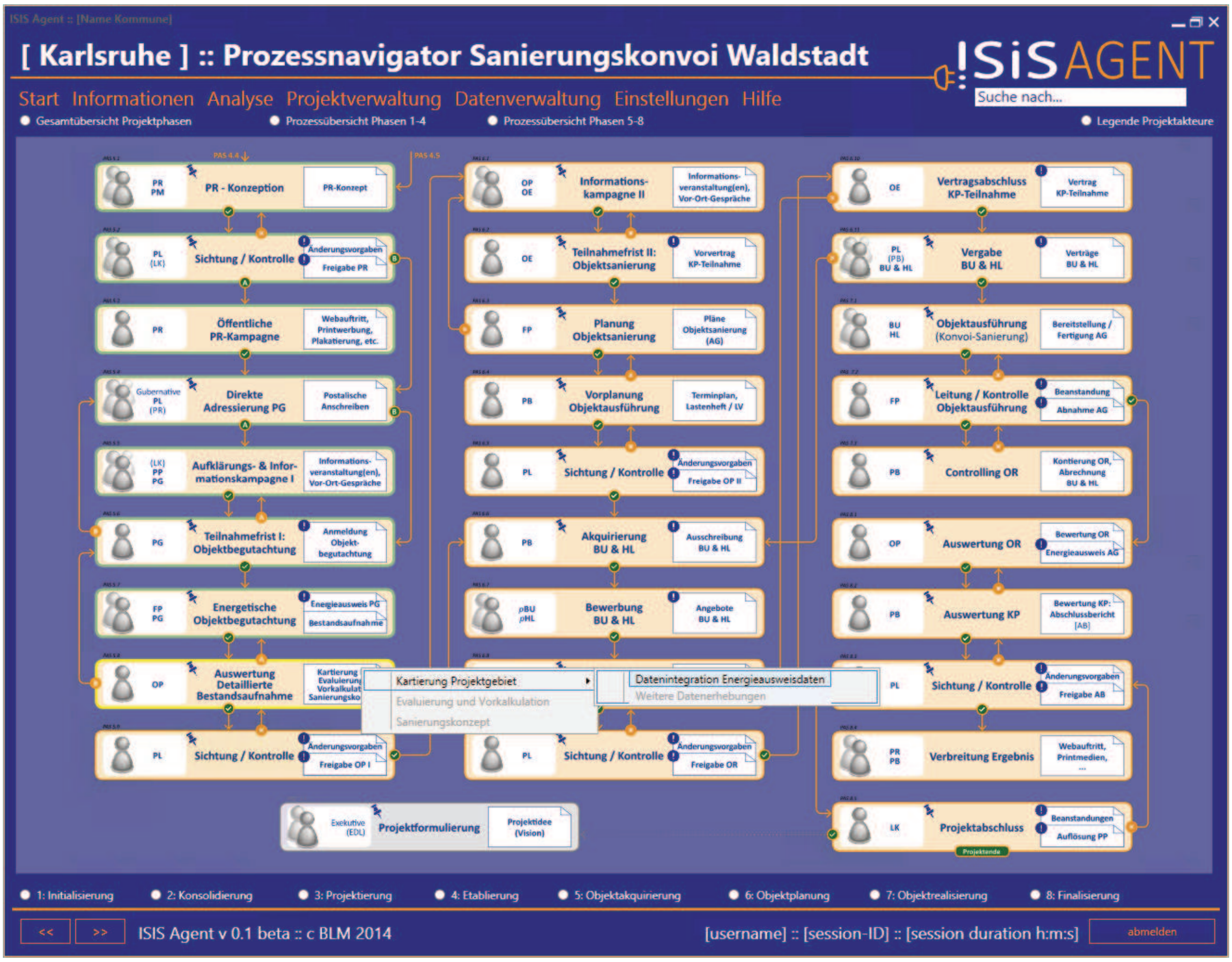

Figure 7: Prototype planning tool – process navigator of project module

The purpose of the process navigator is to enable – besides an above mentioned current status overview on the project – choosing a specific task from one of the depicted workflow steps. This is implemented as a context menu underlying the representation of the planning matter within the workflow step depiction. Thus, the user can load an associated task into the project module in order to accomplish the required work. In the prototye – as the introduced use case specifies a collection of IFC building models that have been uploaded in a previous step by participating building owners to be synchronised with the central urban project-model – this has been implemented as a tasklist for each building model. Each task thereby consists of four sub-procedure step, where the accomplishment of the previous step enables the button to trigger the next step (see fig. 8).

Preliminary while opening the project, the concerned city quarter is loaded with a rule that filters all buildings of the owners participating in the Renovation Convoi scenario-project from the communal CityGml data base. This cached partial CityGML model is now updated building-wise with the received information. Extracting this partial project-model dynamically also builds the base for continiously versioning the information compaction taking place in context of the project with regard to the state of the central urban data basis.

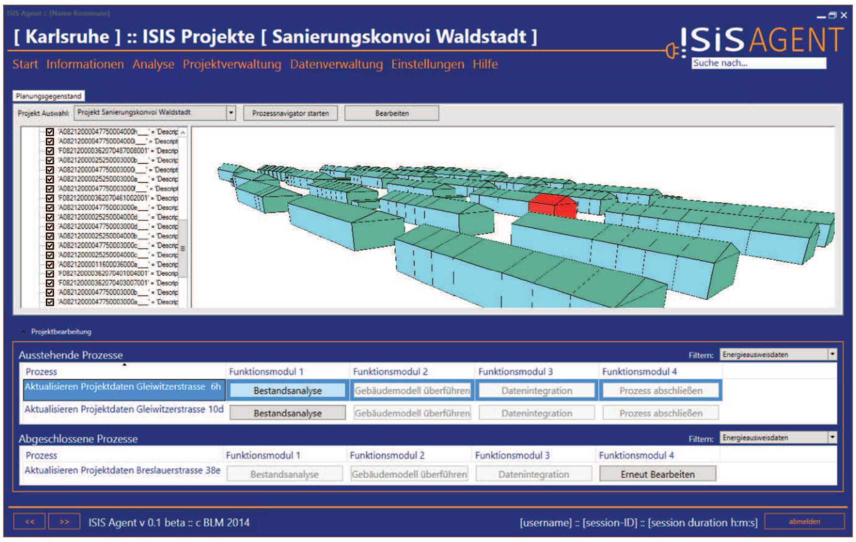

Figure 8: Prototype planning tool – project module with loaded project

The highlighted first task below the depiction of the project-quarter in figure 8 shows the four steps to synchronize the project's citymodel with new information comming from one of the IFC files with energetic assessment information on the respective building.

- Step 1 (filter the to be updated building from project-model): In order to have the current state of a buildings' information in the project-model (e.g. geographic location).
- Step 2 (employ external tool for transformation): Together with the location information the IFC file carrying the to be updated energetic assessment information are opened in the external modeler IFCExplorer where the transformation from a IFC building to a CityGML building is executed (see fig. 3 and 4). Finally after the resulting transformed CityGML building is returned this step is accomplished.
- Step 3 (integration of new data into project-model): Having all necessary data at hand – results of previously processed steps are intermediatly persisted and thus can be accessed by following steps – the project-model can be synchronized. Therefore a manipulation rule containing the exchange-procedure replaces the current building in the project-model with the transformed building (Fig. 9)

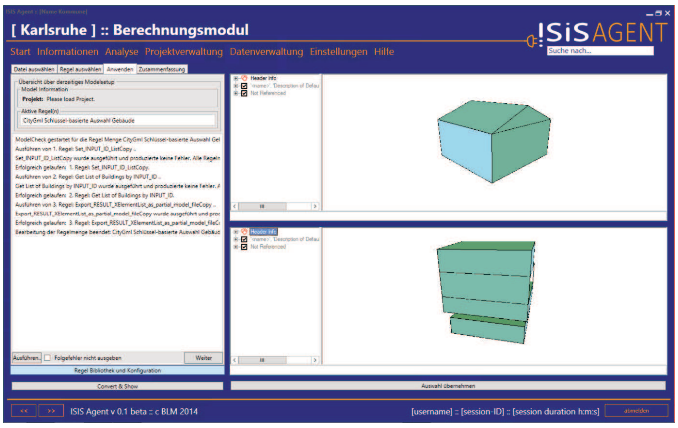

Figure 9: Prototype planning tool – rule-based configurable step

- Step 4 (completion of the procedure of the currently worked on building): In this step the synchronization procedure is finalized and the completed task is moved to the list of resolved tasks.

By applying the presented procedure repetitivly – update a CityGML building with information received as IFC building – the central CityGML-based project-model is gradually enriched with more accurate information regarding energetic performance of the contained buildings. Thus on this base integrated analysis with the developed ISIS analysis module on city scale can be accomplished, in terms of the defined scenario this e.g. can be an (strategic) overview on the energy consumption of the projected quarter before, during and after the implementation of the scenario-project.

7 SUMMARY

The presented research project examined a designed urban system model in the context of an urban development planning scenario. Thereby, throughout modeling and specification effort putting a major emphasis on the integration respective linkage of established standards. Thus the model-based methods and according tooling concepts derived from the specific development bear great potential of reusability. The method of deriving an application-oriented model from a holistically designed system model furthermore provides a base from where of further application contexts can be approached. As the presented thematic was concerned with energy-efficient urban structures a projected further application context is the super-ordinated lifecycle assement on urban scale.

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Modelling Microclimates in the Smart City: a Campus Case Study on Natural Ventilation

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1 ABSTRACT

In recent years, modeling tools have been developed that allow quantifying and comparing the microclimatic impacts of different design options, e.g. modeling wind tunnel effects or surface heat.

Our research for open spaces as an essential part of smart cities investigates how landscape architecture designs, e.g. tree planting strategies, green roofs, etc. will interact with the microclimate and natural ventilation or air flow. Addressing open spaces is also an important connecting element across the various disciplines involved and will facilitate close interdisciplinary collaboration. Interdisciplinary collaboration could address the interrelation between outdoor spaces and indoor conditions, public stakeholder involvement, and the risks through extreme weather events. The expected results will inform sustainable landscape design solutions and increase resilience to climate change.

We started with a case study in modeling the micro-climate for the new campus masterplan of the University of Sheffield, currently developed by Feilden Clegg Bradley Studios, Grant Associates, & AECOM (2014). Peng & Elwan (2011) had already used ENVI-met to model the impact of climate change on building temperatures; Wong & Jusuf (2008) used GIS. After testing different software packages, we decided to use Autodesk Vasari in comparison, which is well integrated with other Autodesk products. First, past and current wind speeds were collected to calibrate the model. Applying our modelling approach provided figures on how the proposed masterplan design will change the local microclimate on campus and predicted effects on wind speeds on central parts of the campus.

The results show that street trees have a significant influence on the air flow and that improved street tree design can increase natural ventilation mitigating the UHI effect on campus. The model also showed some of the interactions between buildings and trees although the used software was rather limited with regard to different vegetation types. The presentation will conclude with suggestions for further research and for future software development to improve the accuracy of microclimate and air flow modeling in smart cities.

Keywords: microclimate, ventilation, environmental modelling, landscape design, Vasari

2 INTRODUCTION

Landscape architects have to be able to test design solutions against their climate performance. Without such an understanding of the urban micro-climate and how landscape elements will affect them, designers are at risk of creating urban landscapes, which will perform poorly or even have a negative impact on the micro-climate (Lenzholzer and Brown, 2013). Recent research has increasingly addressed the environmental modeling of design interventions and their impact on temperatures and air flow in open spaces. Gago et al. (2013) reviewed recent research of the Urban Heat Island (UHI) effect, i.e. the additional heat from solar radiation and urban activities contributing to increased inner-city temperatures, and various mitigation strategies such as green spaces with and without trees, albedo, ground surfaces and building types and materials. They also look into urban design and air flow as a factor and assume that a reduction in mean velocity will reinforce the UHI effect. While multiple authors studied the impact of building typologies on surface temperatures (e.g. Baumgart and Berger, 2015) and climate and comfort perimeters (Pedraza et al., 2013), Bruse and Fleer (1998) provided an early study of the impact of urban greening. At the time, they concluded that even small changes can effect local air flow and temperatures. More recently, Bowler et al. (2010) reviewed available evidence of the impact of greening interventions. Their meta-analysis showed that on average, a park was 0.94°C cooler in the day and that trees provided an additional cooling impact. However, they also concluded that future research is needed, i.e. investigating how different distributions and types of greening will impact the micro-climate. Evidence at the time did not allow any specific design recommendations of how to design urban greening to achieve specific mitigation effects.

Air flow in urban areas is linked to the relationship between buildings and open spaces. Furthermore, turbulences around buildings may have a negative impact on perceived comfort. On the other hand, gentle air flow can help mitigating UHI effects. In response to these questions, this study is looking at the micro-

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climate in general and air flow in particular on an university campus and how it may change as the result of proposed landscape changes, especially tree planting, in a masterplan. The benefits of trees in urban settings have been emphasized many times (cf. Tree and Design Action Group, 2012) but only recently, these benefits have been quantified and modeled in urban settings. Air flow models can further inform models of the distributions of pollutants or neighborhoud energy models.

Trees can be categorized in different ways with the basic distinction between deciduous and coniferous trees. More detailed classification factors are species, age, size, canopy height, condition and shape. Some commonly planted street trees for the UK are Acer platanoides, Acer pseudoplatanus, Betula pendula and Fraxinus excelsior. Gromke and Buck (2007) modeled street canyons with trees with varying crown diameter, crown permeability, trunk height and tree spacing. For small trees, only small changes could be measured. Trees of increasing size can ameliorate air-quality. In general, trees reduce wind speeds at crown-height and disrupt the air flow near the canopy. However, unlike buildings, trees are somewhat permeable and air flow can partially penetrate into the tree canopy. Wania et al. (2012) point out that the effect of trees on street ventilation in higher-density built-up areas is still not very well understood.

3 CASE STUDY: THE UNIVERSITY OF SHEFFIELD MASTERPLAN

The University of Sheffield Masterplan provides an ideal case study because it allows the comparison of current and proposed future landscape designs in a coherent urban space. Campuses have been used as case studies for micro-climate modeling before, e.g. by Lenzholzer and Brown (2013) or Wong and Jusuf (2008). Peng and Elwan (2011) examined the Sheffield university campus in terms of resilience to future climate change predictions – allowing for a comparison with the methods and results of this study. They first used Autodesk Ecotect building simulations and then ENVI-met to contextualize the results of the building simulations at campus scale using weather data from 2010 to predicted data until 2050. Their results were modeled air temperatures. They concluded that further field measurements are required to validate the potential correlations between urban neighborhood scale micro-climate simulations and the individual building simulations.

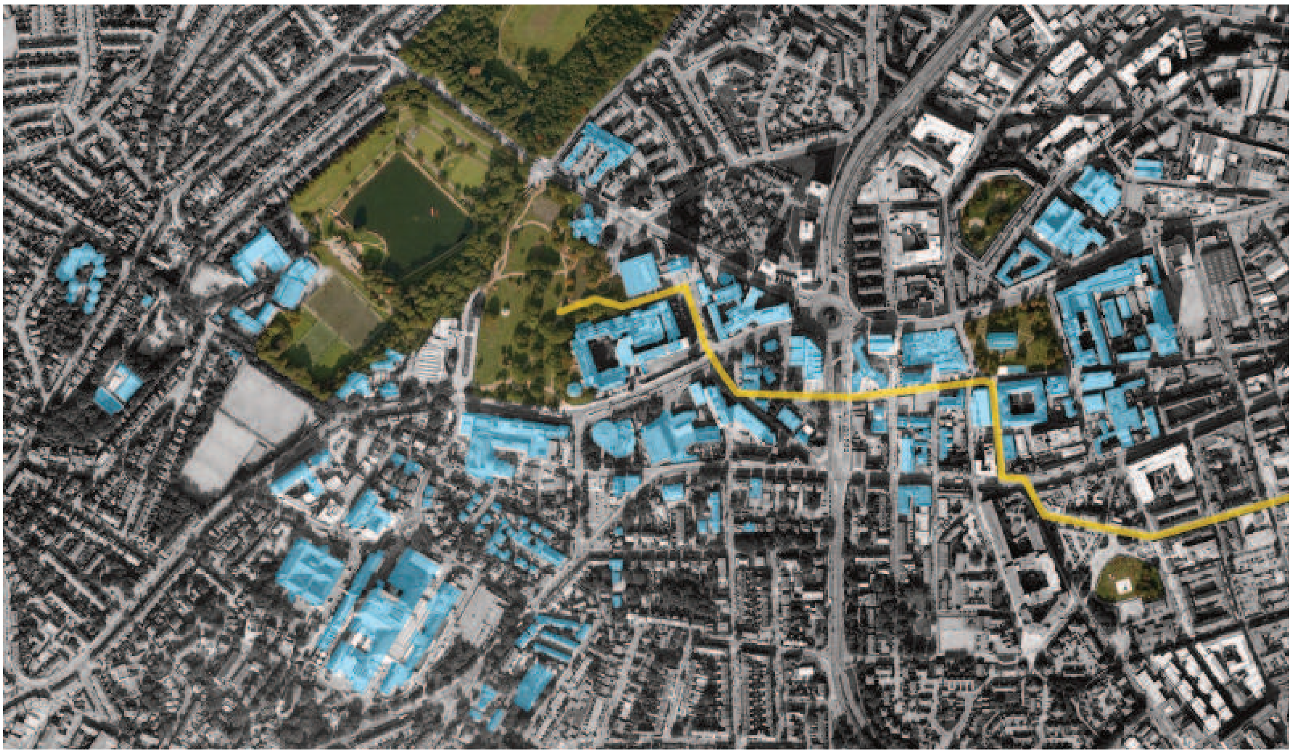

Fig. 1: The University of Sheffield draft masterplan 2014 (Feilden Clegg Bradley Studios, Grant Associates, & AECOM, 2014: 32).

This study follows up from there focusing particularly on air flow and the implications of the proposed campus masterplan (see Figure 1) by Feilden Clegg Bradley Studios, Grant Associates and AECOM (2014). Within the wider campus area, we selected the open space between the Arts Tower and the library (named “Information Commons IC”) building (see the annotations in Figure 1) and the proposed redesign of this area. Figure 2 is a map of the existing tree planting on campus, tree species and their approximate height were recorded in a linked table. Dominant species are Acer platanoides (13 trees, 8m), Platanus x hispanica (16 trees, 10-12m) and Tilia x europaea (18 trees, 4-10m). In comparison, Figure 3 shows the proposed tree planting according to the masterplan.

Fig. 2: Trees on campus under current conditions (base map: OS MasterMap Topography Layer, Coverage: The University of Sheffield, Updated Jan 2014, Ordnance Survey, GB. Using: EDINA Digimap Ordnance Survey Service, http://edina.ac.uk/digimap, downloaded: June 2014)

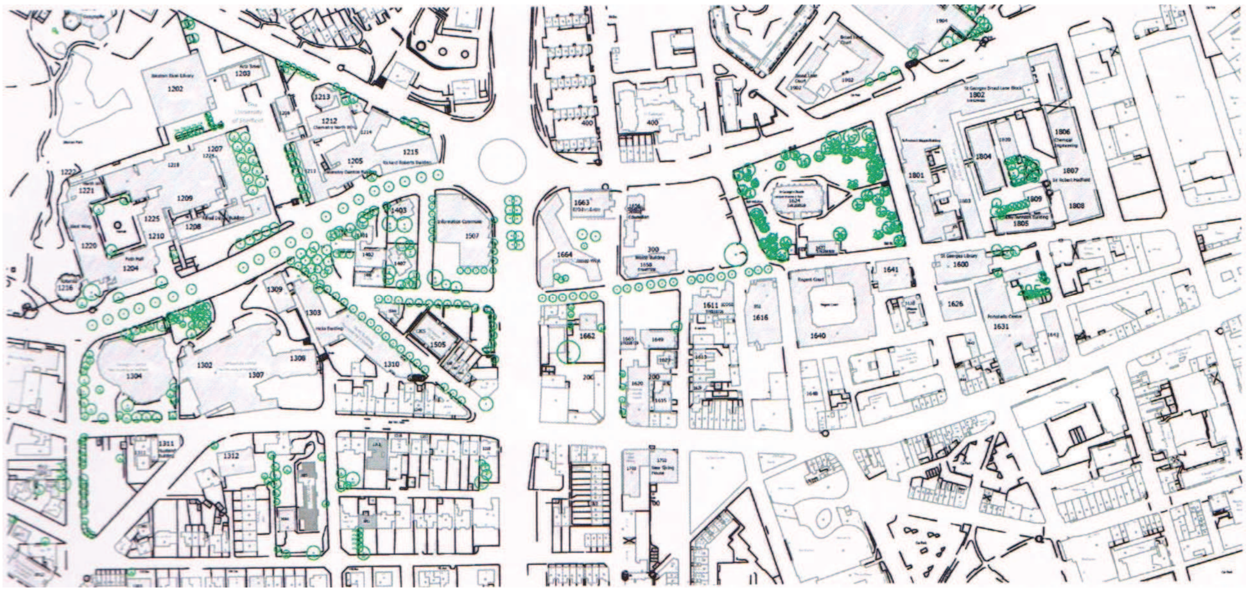

Fig. 3: Trees on campus according to the proposed masterplan (base map: OS MasterMap Topography Layer, Coverage: The University of Sheffield, Updated Jan 2014, Ordnance Survey, GB. Using: EDINA Digimap Ordnance Survey Service, http://edina.ac.uk/digimap, downloaded: June 2014)

Peng and Elwan (2011) further recommend the use of "3D virtual neighborhood modeling" to more effectively communicate environmental modeling approaches. Trimble Sketchup was used to model the case study area in 3D (Fig. 4).

4 METHODOLOGY

Computational Fluid Dynamics (CFD) are software programs for wind analysis in open space environment (Moya, 2015). One of these programs is Autodesk Vasari (http://autodeskvasari.com), which is based on Autodesk Ecotect (Pedraza et al., 2013). Since the campus data is also managed in Autodesk products (Autodesk AutoCAD) and because the Vasari Wind Tunnel Tool provides two different air flow simulations, a quick 2D analysis based on 2D slices and a more accurate 3D analysis, we decided using Vasari for this study. Moya (2015) compare Autodesk Vasari with ODS-Studio and ANSYS CFX. If even more detail is needed, Moya comes to the conclusion that the latter two provide better resolution and other advantages, but at the cost of usability. A short cost-benefit discussion will be included in the conclusions. Another well-established modeling software is ENVI-met (http://envi-met.com), which was used by Ng et al. (2012), Wania et al. (2012), Peng and Elwan (2011) and Wong and Jusuf (2008), and has just been released as version 4.

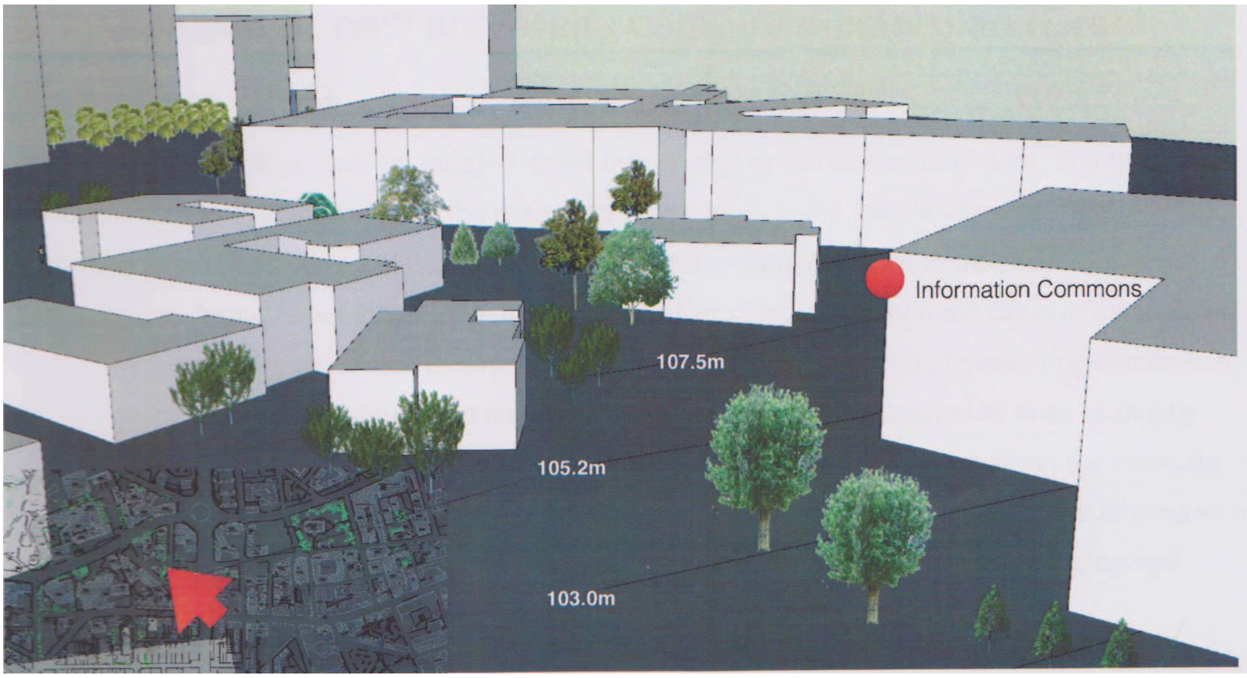

Fig. 4: 3D Visualisation of tree planting in Trimble Sketchup.

Main source for past weather data for the calibration of the model were Met Office averages based on the website http://sheffieldweather.co.uk/. In addition, wind speeds were measured throughout the study with a hand-held wind meter (Fig. 5).

Last not least, species and condition of existing trees were identified in a tree survey. Figure 2 and the underlying data were complemented based on the results from the tree survey.

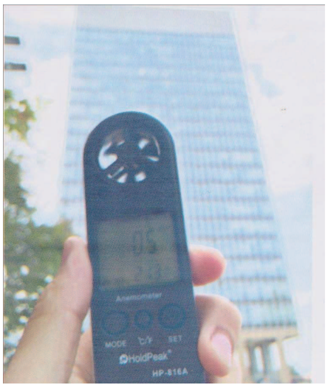

Fig. 5: Wind meter

5 RESULTS

For the results from the Vasari wind tunnel model, shown in Fig. 6, the prevalent wind direction was set as south-west to north-east. Based on a classification of our wind speed measurements and historic wind speed data, three different wind speeds were used to calibrate the model: a low wind speed of 0.98 m/s, a medium mean wind speed of 2.7 m/s, and the maximum wind speed of 23 m/s. It must be noted that Vasari only allowed the distinction of two different types of trees: broadleaf and coniferous. Another limitation is that topography is only considered in the wind tunnel simulation if provided as a mass object. The wind tunnel simulation will not consider a topographical surface as you would normally import from CAD software.

First, we ran the Vasari wind tunnel 2D analysis for existing and proposed street tree designs for the three wind speeds (Fig. 6). The comparison of current and proposed design indicate a general increase of air flow, especially during high wind speeds. However, it is difficult to draw any more detailed conclusions from the 2D analysis and the 3D analysis was run next.

The 3D analysis succeeded in providing much more detail: For the existing conditions, the highest wind speeds are modeled for the surrounding of the Arts Tower (Fig. 7). According to the Vasari model, the proposed design will mitigate this critical "hotspot" while providing a more even air flow on the wider campus area. In this respect, the masterplan is likely to improve air flow on campus.

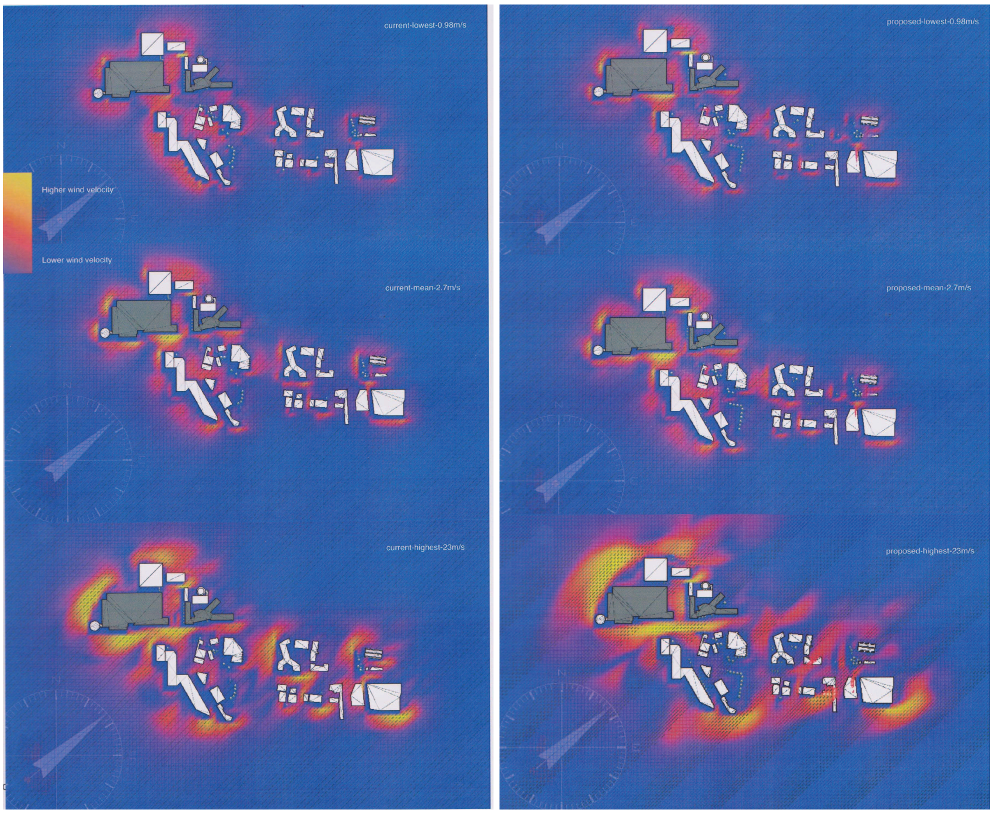

Fig. 6: 2D Vasari Wind Tunnel simulations under current conditions (left) and future conditions (right) for three different wind speeds.

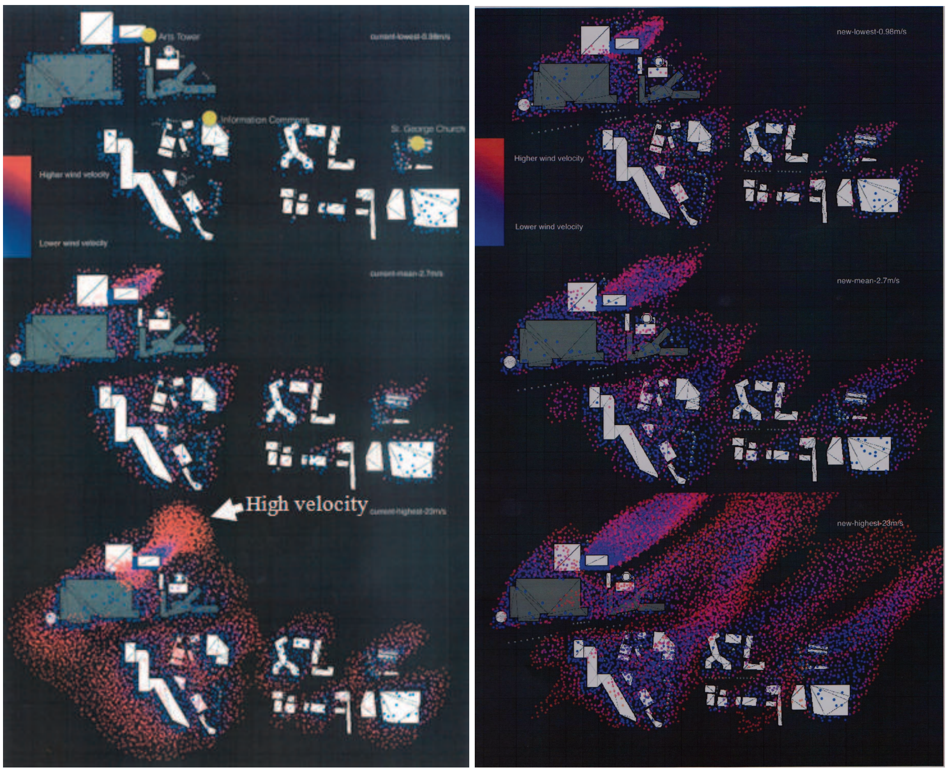

Fig. 7: 3D Vasari Wind Tunnel simulations under current conditions (left) and future conditions (right) for three different wind speeds.

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6 CONCLUSIONS

The 2D Analysis provided a quick and easy to read but rather coarse model of air flow. Comparing current and future conditions, there are hardly any obvious changes and it is difficult to locate more specific phenomena. In contrast, the 3D Analysis of the existing conditions revealed extreme wind velocities around the Arts Tower (see the annotation in Fig. 7). Anecdotal evidence matches the model result: When the Arts Tower was built, a shallow pond had been constructed next to it. The pond had to be removed because the strong wind would shower bypassers with water from the pool. Even today, the main entrance has occasionally been closed during very windy weather conditions due to safety concerns. Comparing current and future conditions in the 3D Analysis, the model results for the proposed design show an increased but more evenly distributed air flow campus-wide. In conclusion, the 3D Wind Tunnel Analysis in Autodesk Vasari provided a quick and sufficiently accurate way of modeling the impact of a campus masterplan in this case study.

However, the case study also revealed the main limitations of Autodesk Vasari, namely difficulties integrating terrain surfaces and the limited choice of tree species (broadleaf and coniferous). Other vegetation such as bushes or climbers are not available at all. Comparing the results to Peng and Elwan (2011), ENVI-met provides much more options in customizing vegetation objects. Furthermore, ENVI-met allows integrating the air flow model into a wider model of the microclimate. However, the higher usability comes at the cost of a steeper learning curve although this might change with version 4 of ENVI-met. Moya (2015) also compared Vasari with ODS-studio and ANSYS CFX. According to Moya, ODS-studio can be used for a more detailed visualisation of wind interaction with windbreak screens and as validation method for Vasari's results. Only if the results between them are significantly different, Moya recommends incorporating a third wind analysis program like ANSYS CFX to verify results. However, its use requires a more complete knowledge and possibly consultation from an expert. These conclusions must be considered by architects if they want to incorporate these tools for design exploration, in the early stage of the design process, with a dynamic feedback level. (Moya 2015)

For future research, it is recommended to customize more types of plants and more plant species for both Vasari and ENVI-met. Since the latter is open source, it would be easier for researchers to set up a plant library in ENVI-met. Then, landscape architects could systematically test different configurations in terms of their performance in terms of air flow and microclimate. For examples, please see Pedraza et al. (2013) for their work on urban buildign blocks and Cho (1996), who started such a typology in his PhD thesis. If CFD programs are then integrated with the Building Information Model (BIM) workflow, all stakeholders in the construction process could not only share and but also test their design changes.

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🏆 *reviewed paper*

Modernisierung im sozialen Wohnbau – wie dabei Smart Mobility unterstützt wird

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1 ABSTRACT

In diesem Artikel werden Ergebnisse aus dem laufenden Sondierungsprojekt „SCIG – Smart City im Gemeindebau“ (EIW 2015) vorgestellt. In diesem Projekt befasst sich ein inter-disziplinäres Team am Beispiel einer kleinen Wohnhausanlage im 19. Wiener Gemeindebezirk mit der Frage, was eine smarte Bestandssanierung und Modernisierung im sozialen Wohnbau sein kann und soll. Die im Projekt erarbeiteten Handbücher mit technisch-organisatorischen und prozessorientierten Lösungsvorschlägen sollen als Werkzeuge für zukünftige smarte und leistbare Bestandssanierungen zur Verfügung gestellt werden.

Die Moderisierung von Siedlungen des sozialen Wohnbaus der 1950er- bis 1970er-Jahre stellt die Stadt Wien, ebenso wie andere europäische Großstädte, vor neue Aufgaben und Herausforderungen. Die Frage, wie solche Gebiete „smarter“ gemacht werden können, geht über die thermisch-energetische Bestandssanierung weit hinaus. Im Spannungsfeld zwischen hoher Wohnqualität und guter Leistbarkeit sind viele Facetten zu behandeln: Wie können Bauten architektonisch an neue Wohnformen und Bedürfnisse angepasst werden? Wie können Potenziale für Nachverdichtungen genutzt werden? Welche Verbesserungen sind im Wohnumfeld erforderlich? Wie sollen die in der Anlage Wohnenden am besten in den Planungsprozess eingebunden werden?

Im Projekt SCIG wird unter anderem das Thema Wohnen und Mobilität bearbeitet – für den Bereich der Bestandssanierung ein Novum! Für den Wohnungsneubau und die Stadtentwicklung liegen bereits Ideen und Konzepte für die Implementierung von Smart Mobility vor, wie etwa die Einrichtung von „Mobility Points“ in Wohnanlagen, wo Sharing-Fahrzeuge gebucht und diverse Mobilitäts-Services in Anspruch genommen werden können. Auch autofreie oder autoreduzierte Wohnanlagen mit einem großzügigen Angebot an Radabstellplätzen wurden bereits erfolgreich umgesetzt. Es stellt sich die Frage, wie Maßnahmen, die sich im Neubau bewährt haben oder erfolgversprechend sind, auch unter den Rahmenbedingungen der Bestandssanierung im sozialen Wohnbau umgesetzt werden können.

Ein Ziel im Projekt SCIG lautet: Die Modernisierung im sozialen Wohnbau soll Smart Mobility unterstützen. Wer im Gemeindebau wohnt, soll kostengünstig, effizient und umweltgerecht mobil sein können, und dazu technische und soziale Innovationen nutzen können. Das Konzept „Nutzen statt Besitzen“ spielt dabei eine große Rolle.

Am Beispiel einer kleinen Wohnhausanlage der Gemeinde Wien im 19. Wiener Gemeindebezirk wurde im Projekt SCIG eine umfassende Bestandsanalyse zu Mobilität und Verkehr (in der Anlage selbst und im Umfeld!) durchgeführt. Daraus wurden Verbesserungspotenziale abgeleitet und prioritäre Handlungsfelder für Smart Mobility definiert:

- Bessere Voraussetzungen für das Radfahren
- Mobilitäts-Services und Sharing-Angebote
- Mobilitäts-Information
- Verbesserung des Fußwegenetzes
- Veränderung der Parkordnung.

Bei der Umsetzung müssen Maßnahmen innerhalb der Wohnhausanlage mit Maßnahmen im Wohnumfeld kombiniert werden, vielfach auch mit einer Beteiligung oder Aktivierung der Bewohnerinnen und Bewohner. Dazu ist es unbedingt erforderlich, bestehende Organisations- und Koordinationsstrukturen zu verbessern bzw. neue zu schaffen.

Keywords: Smart City, Smart Mobility, Modernisierung, Stadtplanung, sozialer Wohnbau

2 EINLEITUNG

2.1 Gemeindewohnungen in Wien

Im Unterschied zu anderen Formen des sozialen Wohnbaus werden Gemeindewohnungen von der Stadt selbst errichtet, vermietet, verwaltet und saniert. Die Vermietung ist an einen bestimmten Personenkreis gebunden; die Kriterien dafür sind insbesondere Einkommensgrenzen, des weiteren auch die Wohndauer in Wien. Die Gemeinde Wien hat eine lange Tradition des Gemeindewohnbaus und ist mittlerweile Europas größter Wohnungseigentümer. Über die aus der öffentlichen Verwaltung ausgegliederte Gesellschaft „Wiener Wohnen" verwaltet sie derzeit rund 220.000 Mietwohnungen in Wien. Die Gemeindewohnungen sind ein wichtiger Faktor für die Stadtentwicklung, die Bauwirtschaft und für das soziale Gleichgewicht in der Stadt. Während viele der in den 1920er- und 1930er-Jahren errichteten Wohnhausanlagen bereits saniert wurden, steht diese Aufgabe beim großen Bestand der Gemeindewohnungen der Nachkriegszeit bis in die 1970er-Jahre zu einem großen Teil noch bevor. Derzeit werden jährlich etwa 40 Wohnhausanlagen modernisiert. Im Vordergrund stehen thermische Sanierungen der Gebäudehülle und auch Einzelverbesserungen wie etwa Ein- oder Umbauten der Aufzüge.

2.2 Anforderungen an smarte Bestandssanierung im sozialen Wohnbau

Die im Juni 2014 beschlossene Smart City Rahmenstrategie (Magistrat der Stadt Wien 2014) legt für die Stadt Wien drei grundsätzliche Ziele fest, die durch Entwicklungen in den Bereichen Energie, Mobilität, Gebäude und Infrastruktur vorangetrieben werden sollen:

- Radikale Ressourcenschonung
- Hohe, sozial ausgewogene Lebensqualität
- Entwicklung und produktiver Einsatz von Innovationen/neuen Technologien

Anders als stärker technologie-orientierte Vorstellungen von Smart City bezieht die Smart City Wien Rahmenstrategie auch die soziale Komponente von Innovationen mit ein. Die Sanierungen und Modernisierungen von Gemeindebauten, wie sie heutzutage gemacht werden, werden den umfassenden und ambitionierten Smart City-Zielen der Stadt Wien aber noch nicht gerecht. Wenn die Smart City mit der eingeforderten hohen Lebensqualität auch in Bestandsquartieren realisiert werden soll, lassen sich daraus viel weiter gehende Anforderungen an Sanierungen und Modernisierungen ableiten, etwa die architektonische Anpassung an neue Wohnformen und Bedürfnisse durch flexible Raumkonzepte, die Qualitätsverbesserung der halböffentlichen Räume und auch der öffentlichen Räume im Wohnumfeld, innovative Bautechnologien und Kommunikationslösungen. Diese Anforderungen stehen immer im Spannungsfeld zwischen hoher Wohnqualität und guter Leistbarkeit. Nicht zuletzt deshalb gilt es, die in der Anlage wohnenden Menschen bestmöglich in den Planungsprozess einzubinden.

Die Smart City Rahmenstrategie bezeichnet die ressorcenschonende und sozialverträgliche Mobilität als einen Kernbereich. Es liegt auf der Hand, dass die Mobilität auch in Bestandssanierungen und Modernisierungen von Wohnhausanlagen eine größere Rolle spielen sollte.

Eine weitere Anforderung wurde im Stadtentwicklungsplan für Wien STEP 2025 (Magistratsabteilung 18, 2014) festgeschrieben: Für Wohngebiete aus der Zeit der 1950er- bis 1970er-Jahre sollen maßgeschneiderte Konzepte für architektonische und funktionale Verbesserungen, aufbauend auf Standortanalysen und Bewertungen, erarbeitet werden. Im Vordergrund steht hier die wegen des derzeitigen Stadtwachstums aktuelle Frage, wie Potenziale für Nachverdichtungen genutzt werden können.

2.3 Innovationen zum Thema Wohnen und Mobilität

Diverse Innovationen zum Thema Wohnen und Mobilität wurden seit etwa 20 Jahren entwickelt. Bekannt sind vor allem Konzepte zum autofreien oder autoreduzierten Wohnen, die bereits in mehreren Ländern erfolgreich umgesetzt wurden, meist aber explizit auf eine besonders umweltbewusste Klientel fokussieren und die regelmäßige private Autonutzung vertraglich untersagen. Ein gutes Beispiel ist die bereits im Jahr 1999 errichtete Autofreie Mustersiedlung im 21. Wiener Gemeindebezirk; ein neueres Best-Practice-Beispiel ist die Siedlung Kalkbreite in Zürich (Genossenschaft Kalkbreite, 2014). Autofreie Siedlungen verfügen meist über besonders gute Radverkehrs-Infrastrukturen und verschiedene Sharing- und Service-Angebote.

Auch aus dem Bereich des Mobilitätsmanagements, das als Hauptzielrichtung den Umwelt- und Klimaschutz verfolgt, kommen gute Ideen für die Gestaltung der Mobilität in Wohnsiedlungen, umfassend dokumentiert etwa im Schweizer Projekt MIWO Mobilitätsmanagement in Wohnsiedlungen (Arbeitsgemeinschaft Fußverkehr Schweiz, 2014). Diverse Aktivitäten zur Verankerung von mobilitätsbezogenen Innovationen, vor allem bei Service-Angeboten und Sharing-Konzepten, finden bei Neubau-Projekten statt, in Wien etwa in einem Projekt am Helmut Zilk-Park im neuen Stadtquartier am Hauptbahnhof (Raum & Kommunikation GmbH o.J.)

2.4 Smart Mobility im sozialen Wohnbau

Ausgehend von den verkehrspolitischen Zielsetzungen der Stadt Wien formulierten wir im Projekt SCIG folgendes Ziel: Bei Bestandssanierungen im sozialen Wohnbau sollen Mobilitätsthemen mitbehandelt werden. Wer in bestehenden sozialen Wohnbauten wohnt, soll mit unterschiedlichen Maßnahmen und Aktivitäten dabei unterstützt werden, die Alltagswege auf effiziente, kostengünstige und umweltgerechte Weise zurückzulegen. Die Menschen sollen über mehr individuelle Wahlmöglichkeiten verfügen und für ihre Mobilität technologische und soziale Innovationen nutzen können. Schließlich sollen sie dadurch ihre Zufriedenheit mit der Wohn- und Mobilitätssituation steigern können.

In diesem Sinne fokussiert der hier verwendete Begriff von Smart Mobility nicht auf technologisch innovative Lösungen, sondern bezieht auch bewährte verkehrliche Lösungen ein, etwa zur Erleichterung und Förderung der „aktiven“ Mobilität der Bewohnerinnen und Bewohner zu Fuß und mit dem Fahrrad. Wichtiger als der Charakter von technologischen Vorzeigeprojekten ist die breite Umsetzbarkeit bei Modernisierungen im sozialen Wohnbau.

3 FALLBEISPIEL WOHNHAUSANLAGE KROTTENBACHSTRASSE 40; 42-46

3.1 Über die Wohnhausanlage und die Umgebung

Die beiden benachbarten Wohnhausanlagen der Gemeinde Wien Krottenbachstraße 40 sowie 42-46 haben zusammen etwa 150 Wohnungen. Die Baubewilligungen wurden in den Jahren 1957 und 1966 erteilt. Die zwei Bauteile bilden eine räumliche Einheit und werden im folgenden Text als eine Wohnhausanlage (WHA) bezeichnet. Es handelt sich um eine fünfgeschossige Blockrandbebauung mit 12 Stiegen um einen Innenhof.

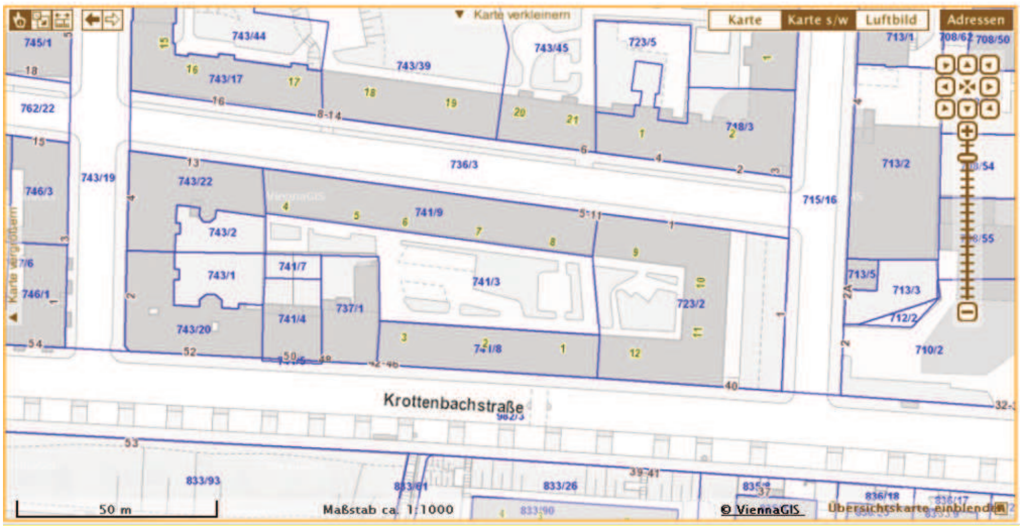

Fig. 1: Wohnhausanlage Krottenbachstraße 40; 42-46. Quelle: Stadt Wien, https://www.wien.gv.at/flaechenwidmung/public/

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Fig. 2: Ansichten der Wohnhausanlage Krottenbachstraße 40; 42-46. Fotos: Andrea Weninger

Die Wohnhausanlage liegt im 19. Wiener Gemeindebezirk innerhalb des dicht bebauten Stadtgebiets und westlich der tangential verlaufenden S-Bahn-Linie S45 (Vorortelinie). Die Krottenbachstraße ist eine radial in west-östlicher Richtung verlaufende Hauptstraße, die für die untersuchte WHA eine Erschließungsfunktion im motorisierten Individualverkehr und im öffentlichen Verkehr (Buslinie 35A) hat. Die Krottenbachstraße liegt an einer Geländekante, die auch eine bauliche und sozialräumliche Grenze bildet. Südlich davon steigt das Gelände deutlich an; in Hanglage liegen Freizeiteinrichtungen und Wohnbauten, weiter oben ein Villenviertel und mehrere Gebäude der Universität für Bodenkultur. Das nördlich der Krottenbachstraße liegende Wohngebiet „In der Krim“ ist durch ein rasterförmiges Straßennetz erschlossen und wird einerseits durch Wohnbauten der Gründerzeit geprägt, andererseits durch zahlreiche Gemeindebauten, die überwiegend in der Zeit nach 1955 erbaut wurden. Die wohnortnahe Versorgung mit Gesundheits-, Bildungs- und Freizeitein¬richtungen ebenso wie die Nahversorgung sind gut; vieles ist zu Fuß in kurzer Zeit erreichbar.

3.2 Die Mobilität derBewohnerinnen und Bewohner

Im Rahmen des Projekts SCIG fand im November und Dezember 2015 in der Wohnhausanlage Krottenbachstraße eine ausführliche, persönliche Befragung der Bewohnerinnen und Bewohner statt, die sich auf einen Fragebogen stützte. Sie wurde von „wohnpartner“, einer Organisation, die sich im Auftrag der Stadt Wien um die Kommunikation in Gemeindebauten kümmert, durchgeführt und zielte auf Informationsgewinn und auf das Erkennen von Potenzialen für eine smarte Sanierung ab. Der Frageboge enthielt unter anderem auch mobilitätsbezogene Fragen.

Ein Drittel der Haushalte wurde bei der Befragung erreicht. Es konnten ausführliche Gespräche mit 52 Personen – 50 Bewohnerinnen und Bewohner und 2 Geschäftsinhaberinnen und Geschäftsinhaber – geführt werden. 64% der befragten Bewohnerinnen und Bewohner sind Frauen. Alle Altersgruppen von „20-30“ bis „über 80“ sind vertreten, am stärksten die der 51- bis 60-Jährigen (28%). Rund ein Viertel der Bewohnerinnen und Bewohner ist derzeit berufstätig, die Hälfte ist in Pension – zum Teil wegen Krankheit oder Invalidität, 18% sind arbeitslos. Bei den Haushaltsgrößen dominieren die Ein- und Zweipersonenhaushalte (68%), die Drei-, Vier- und Mehrpersonenhaushalte sind durchwegs die mit kürzerer Wohndauer. In 32% der Haushalte leben Kinder/Jugendliche unter 18.

Zur Mobilität machten die befragten Bewohnerinnen und Bewohner folgende Angaben: 60% der befragten Bewohnerinnen und Bewohner besitzen eine Jahreskarte für den städtischen öffentlichen Verkehr, 28% haben ein Fahrrad zur Verfügung (unter den jüngeren Personen deutlich mehr als unter den älteren), 36% können uneingeschränkt, 8% eingeschränkt bzw. nach Absprache über einen Pkw verfügen. Bei 56% der Befragten gibt es keinen Pkw im Haushalt, bei 40% hat im Haushalt auch niemand den Führerschein. Niemand gab an, ein E-Bike oder ein Elektroauto zu besitzen. Von den 22 befragten Bewohnerinnen und Bewohner, die (mindestens) einen Pkw im Haushalt besitzen, gaben 13 an, dass dieser im öffentlichen Straßenraum geparkt wird, 9 auf einem gemieteten Parkplatz der Wohnhausanlage, davon 5 im Innenhof. Die vorhandenen Fahrräder werden überwiegend im eigenen Kellerabteil abgestellt, einige auch in einem Abstellraum. Die Errichtung von Fahrradabstellplätzen im Rahmen der Sanierung halten zwei Drittel der Befragten für eine gute Sache; 22% der Befragten wollen diese gern selbst nutzen.

Bezüglich der Verkehrsmittelnutzung sind das Zu-Fuß-Gehen und das Fahren mit öffentlichen Verkehrsmitteln weitaus am wichtigsten: Jeweils 86% der Befragten gaben an, dies „häufig“ bis „gelegentlich“ zu tun. Beim Lenken eines Autos trifft das nur für 22% der Befragten zu (Mitfahren im Auto 38%), beim Radfahren nur für 10%.

Die Zufriedenheit mit der Wohnhausanlage und der Wohnumgebung ist insgesamt recht hoch. Unter den problematischen Faktoren der Wohnumgebung nimmt die mangelhafte Verkehrssicherheit den Spitzenplatz ein: 36% der Befragten bezeichneten die Verkehrssicherheit als „schlecht“ bis „sehr schlecht“. Dies bezieht sich auf Probleme von Fußgängerinnen und Fußgängernbei der Überquerung der stark befahrenen Krottenbachstraße.

3.3 Bestandsanalyse Verkehr und öffentlicher Raum

Die untersuchte Wohnhausanlage ist ganz gut mit öffentlichen Verkehrsmitteln erschlossen (Buslinie 35A und S-Bahn-Linie S45). Die Bedingungen für das Zu-Fuß-Gehen im Wohnumfeld sind wegen des dichten Fußwegenetzes (mit Gemeindebau-Durchgängen) recht gut, bieten aber noch viel Verbesserungspotenzial. Das Radfahren ist im Untersuchungsgebiet nicht attraktiv, da keine Radverkehrsinfrastruktur vorhanden ist. Besonders das Radfahren auf der Krottenbachstraße ist gefährlich. Das Parkplatzangebot im Straßenraum ist hoch und stark ausgelastet. Die bestehende Parkordnung schränkt den Bewegungsraum für aktive Mobilitätsformen (Gehen, Radfahren) ein. Die Auslastung der 28 hausinternen Kfz-Stellplätze ist vergleichsweise gering. Die Gestaltung des öffentlichen Raums und die Attraktivität des Wohnumfelds werden überwiegend negativ beurteilt. Der öffentliche Raum im Bereich der WHA wird fast ausschließlich zum Durchgehen und nicht für den Aufenthalt genutzt.

Fig. 2: Ansichten zur Verkehrssituation in der/um die Wohnhausanlage Krottenbachstraße 40; 42-46. Fotos: Andrea Weninger

Es bestehen folgende Verbesserungspotenziale:

- Attraktive Gestaltung und Ausstattung der Autobus-Haltestelle
- Verbesserung der Verkehrssicherheit für Fußgänger beim Queren der Krottenbachstraße
- Attraktive Gestaltung der Ein- und Ausgänge in die Wohnhausanlage
- Verbesserung und Sicherung der halböffentlichen Durchgangswege durch die Gemeindebauten
- Verbesserung der Information über das bestehende Fußwegenetz
- Schaffung einer barrierefreien Fußwegeverbindung zwischen der Krottenbachstraße und der Hartäckerstraße (z. B. Schrägaufzug für Rollstuhlfahrerinnen, Rollstuhlfahrer, Radfahrerinnen und Radfahrer)
- Einhaltung der Gehsteig-Mindestbreite von 2 m durch eine veränderte Parkordnung
- Verringerung des Stellplatzangebots im öffentlichen Straßenraum durch die Errichtung von Wohnsammelgaragen
- Errichtung von Radabstellanlagen in der Wohnhausanlage

- Verbesserung der Bedingungen für den Radverkehr in der Tempo-30-Zone durch das Zulassen von Radfahren gegen die Einbahn bei ausreichenden Querschnittsbreiten (gegebenenfalls durch die Reduktion von Stellplätzen)
- Verbesserungen für das Radfahren in der Krottenbachstraße durch Errichtung einer Radverkehrsanlage, z. B. Mehrzweckstreifen
- Schaffung einer Nord-Süd-Verbindung für Radfahrer mit sicherer Querung der Krottenbachstraße und Überwindung der Steigung südlich davon (z. B. Schrägaufzug, Fahrradlift etc.)
- Radabstellanlagen bei Zielen im Gebiet, z. B. Schulen, Geschäfte, Sportverein, Park
- Schaffung einer Wohnsammelgarage für das Wohnviertel, damit der Parkdruck im öffentlichen Raum verringert und der Gestaltungsspielraum erhöht werden kann
- Entfernung der Innenhofstellplätze in der Wohnhausanlage zu Gunsten einer hochwertigen Freiraumgestaltung
- Attraktivere Gestaltung der Abfallsammelstelle und anderer Container im Straßenraum.

3.4 Handlungsfelder Smart Mobility

Ausgehend von den oben genannten Verbesserungspotenzialen und unter Berücksichtigung der Literatur zu zukunftsfähigen Mobilitätslösungen im Wohnbau (Raum & Kommunikation, 2014; Arbeitsgemeinschaft Fussverkehr Schweiz, 2014; VCÖ, 2015) wurden für die untersuchte Wohnhausanlage bzw. das Umfeld folgende prioritäre Handlungsfelder definiert:

3.4.1 Bessere Voraussetzungen für das Radfahren:

Bei der Sanierung der Wohnhausanlage sollen alltagstaugliche Radabstellanlagen für die Bewohnerinnen und Bewohner (und für Besucherinnen und Besucher) geschaffen werden. Dafür ist die betreffende Wohnungsgesellschaft (Wiener Wohnen) als Eigentümerin bzw. Verwalterin zuständig. Grundsätzlich möglich sind Abstellanlagen im Freiraum oder in ungenutzten Erdgeschossräumen, unter bestimmten Voraussetzungen (Lift!) auch in den Obergeschossen oder im Keller. Dabei sind die aus Richtlinien (v. a. RVS 03.02.13 Radverkehr) bekannten Qualitätskriterien zu berücksichtigen: direkte Erreichbarkeit von der Straße (ohne Stufen), kurze Zugangswege zu den Eingängen, gute Praktikabilität und Stabilität der Befestigung, Schutz vor Diebstahl und Witterungseinflüssen, Beleuchtung. Beim Zutritts- und Schließsystem für Radgaragen und -abstellräume bieten sich smarte elektronische Lösungen an.

→ Als Good-Practice-Beispiele für bedürfnisgerechte und funktionale Radabstellanlagen können etwa die Wohnhausanlagen „Autofreie Mustersiedlung“, 1210 Wien, und „Bike City“, 1020 Wien, herangezogen werden.

Wenn die Voraussetzungen für das Radfahren verbessert werden sollen, ist aber ein Qualitätssprung bei der Radverkehrsinfrastruktur in der Umgebung der Wohnhausanlage Krottenbachstraße ebenso notwendig, insbesondere eine Radverkehrsanlage (Mehrzweckstreifen) in der Krottenbachstraße und die Öffnung der Einbahnen in der Tempo 30-Zone. Die Umsetzungsverantwortung dafür liegt bei den zuständigen Dienststellen der Stadt Wien bzw. des 19. Wiener Gemeindebezirks.

3.4.2 Mobilitäts-Services und Sharing-Angebote:

Durch verschiedene Angebote soll das Konzept „Nutzen statt Besitzen“ unterstützt und die Verwendung des Fahrrads als städtisches Verkehrsmittel erleichtert und attraktiver gemacht werden. Darüber hinaus können auch Angebote für das Ausprobieren und die Nutzung von E-Bikes und Elektro-Autos gemacht werden. Folgende Services sind grundsätzlich möglich:

- Druckluftpumpe, Zubehör für Fahrrad-Reparaturen bzw. Fahrradwerkstatt
- Verleih E-Bike und E-Auto, Ladestation für Elektrofahrzeuge
- Unterstützung für bzw. Info über Carsharing, (selbst-organisiert oder Nutzung des in Wien bestehenden kommerziellen Angebots),
- Verleih von diversem Zubehör, wie z. B. Fahrradanhänger, Kindersitz, Einkaufstrolley.

Es bestehen unterschiedliche Optionen für den Umfang und die Zielgruppe der Angebote, die Organisationsform und die räumliche Anordnung. Die Umsetzung erfordert eine klare Regelung der Verantwortlichkeit zwischen allen Beteiligten. Ein Organisationsmodell muss ausgearbeitet werden, in dem festgelegt wird, was durch die Hausverwaltung betrieben werden soll, was durch ein kommerzielles Angebot abgedeckt werden soll, und was in Selbstorganisation der Mieterinnen und Mieter funktionieren soll. Allenfalls kann ein Angebot wie etwa eine E-Ladestation zwar im Gemeindebau situiert sein, sich aber ebenso an Bewohnerinnen und Bewohner der Umgebung richten und von einer externen Firma betrieben werden.

→ Mobilitäts-Services in Wohnbauten sind ein neues Konzept. Als bereits realisierte Good Practice ist der 2014 eröffnete Autofreie Wohnbau Zürich Kalkbreite zu nennen: „Zu den Servicedienstleistungen …gehören die Vermietung von Elektrovelos, Anhänger sowie ein ganztags besetztes Office im Eingangsbereich, welches als Informations- und Koordinationsdrehscheibe funktioniert. Es dient auch als Depot für Warenanlieferungen“ (Genossenschaft Kalkbreite, 2014): In der älteren Autofreien Mustersiedlung in Wien stehen den Bewohnerinnen und Bewohnern eine Fahrradwerkstatt und eine Druckluftpumpe für Räder zur Verfügung. Diese Einrichtungen werden in Eigenverantwortung der Bewohnerinnen und Bewohner betrieben. Außerdem liegt ein Stellplatz einer kommerziellen Carsharing-Firma in der Siedlung. Derzeit befinden sich in Wien zwei Neubausiedlungen im Planungsstadium, die nach dem Mobilitätskonzept die Einrichtung eines „Mobility Points“ mit diversen Serviceeinrichtungen (z. B. Fahrradwerkstatt, Carsharing, e-Bike-Sharing) vorsehen (Raum & Kommunikation o.J.).

3.4.3 Mobilitäts-Information

Ergänzend zu neuen Mobilitäts-Services bieten Info-Packages für die Bewohnerinnen und Bewohner einen hohen Mehrwert. Sie können etwa einmalig für alle Mieterinnen und Mieter und laufend für neu Einziehende bereit gestellt werden. In gedruckter und/oder digitaler Form sollen neu eingerichtete Mobilitätsservices und deren Benützungsregeln vorgestellt werden, darüber hinaus sind auch standortbezogene Verkehrsinformation, z. B. über die vorhandenen öffentlichen Verkehrsmittel und Radverkehrsanlagen, sowie Öffentlichkeitsarbeit für smarte und nachhaltige Mobilitätsformen sinnvoll. Die Umsetzungsverantwortung muss bei der Hausverwaltung liegen. Darüber hinaus könnte eine noch höhere Qualität des Info-Angebots erreicht werden, wenn es gelingt, die Mieterinnen und Mieter zu aktivieren und einzubeziehen, beispielsweise durch die Sammlung und Aufbereitung diverser Informationen über Geschäfte, Bildungs-, Gesundheits- und Freizeiteinrichtungen in der Umgebung (was gibt’s wo – von Bewohnerinnen und Bewohnern für Bewohnerinnen und Bewohner).

→ Good Practice: Bei der vor wenigen Jahren erfolgten Besiedlung der „Bombardier-Gründe“ in 1210 Wien (ca. 600 Wohnungen) erhielten die künftigen Bewohnerinnen und Bewohner Mobilitätsmappen „Mobil im Donaufeld“, mit Informationen über die Nahversorgung, über diverse öffentliche Einrichtungen in der fußläufigen Umgebung, über bestehende Angebote im öffentlichen Verkehr und im Radverkehr. Die Mappen wurden auf Initiative eines Vereins und in Kooperation mit der Stadt Wien erstellt. Beim derzeit geplanten Neubauprojekt Perfektastraße (1230 Wien) ist laut Mobilitäts-konzept eine umfangreiche Mobilitätsberatung mit Hilfe von Willkommens-Packages geplant. (Raum & Kommunikation, o.J.)

Falls im Rahmen der Sanierung der Wohnhausanlage ein Digitales Schwarzes Brett zur Kommunikation zwischen den Mieterinnen und Mietern und der Hausverwaltung eingerichtet wird, soll es auch für Verkehrs- und Mobilitäts-Information genutzt werden können (z. B. Anzeige der Abfahrtszeiten der nahe gelegenen öffentlichen Verkehrsmittel, Carsharing-Zugang, Taxi-Info, Link zum persönlichen Routenplaner usw.).

→ Digitale Schwarze Bretter werden derzeit bereits erfolgreich in Wohnanlagen der Wohnbaugesellschaft Wien-Süd, eines SCIG-Projektpartners, eingesetzt – bislang allerdings ohne Einbeziehung von Mobilitäts-Informationen.

Falls Interesse daran besteht, könnte den Bewohnerinnen und Bewohnern der Wohnhausanlage und der Umgebung zusätzlich das Ausprobieren bisher nicht genutzter Mobilitäts-Services angeboten werden, und mobilitätsbezogene Kompetenzen könnten an Kinder und Erwachsene vermittelt werden. Das Spektrum an möglichen Inhalten ist breit, z. B. praktisches Radfahrtraining, Einschulung Carsharing, Fahrstunde E-Bike/E-Auto, Fahrradreparaturkurs, Verkehrssicherheit, Schulwege usw. Voraussetzung dafür ist die Kooperation mit geeigneten Träger-Organisationen und/oder die Eigeninitiative von Bewohnerinnen und Bewohnern.

3.4.4 Verbesserung des Fußwegenetzes

Das bestehende dichte Fußwegenetz mit den öffentlichen Durchgängen durch Wohnhausanlagen soll gesichert und noch attraktiver gestaltet werden. Bei der Sanierung der Wohnhausanlage sollen die Wege im Innenhof und die Zugänge zu den Stiegenhäusern direkt, attraktiv und barrierefrei gestaltet werden. Die insgesamt fünf Eingänge von der Straße sollen erhalten und die Durchgangsfunktion aufrecht erhalten werden. Die Eingänge sollen attraktiver gestaltet und gut beleuchtet werden. Durch direkte und attraktive Verbindungen soll mehr Qualität für das Zu-Fuß-Gehen im Wohnviertel erreicht werden. Die Wünsche der Bewohnerinnen und Bewohner können am besten in einem Beteiligungsprozess für die Innenhof- bzw. Freiraumgestaltung berücksichtigt werden.

Zusätzlich zu den direkt der Wohnhausanlage zuzurechnenden Maßnahmen sind Maßnahmen im öffentlichen Raum sinnvoll, mit denen die Qualität des Fußwegenetzes im Wohnviertel noch weiter gesteigert werden kann. Die Umsetzungsverantwortung dafür liegt bei den zuständigen Dienststellen der Stadt Wien und des 19. Wiener Gemeindebezirks. Insbesondere die verkehrssichere Querung der stark befahrenen Krottenbachstraße wurde bei der im Projekt SCIG ausgeführten Befragung der Bewohnerinnen und Bewohner als einer der größten Wünsche an das Wohnmfeld geäußert. An der Schnittstelle zwischen innen und außen, d. h. zwischen Wohnhausanlage und Straßenraum, sollten die Gehsteige von parkenden Autos freigehalten und insbesondere dort verbreitert werden, wo der Fußweg eine Fortsetzung im Nachbarbau findet. Eine weitere Verbesserung der Begehbarkeit des Wohnviertels könnte erzielt werden, wenn die Überwindung der Steigung südlich der Krottenbachstraße erleichtert wird, etwa durch Rampen.

3.4.5 Veränderung der Parkordnung

Vorgeschlagen wird, den geschlossenen Innenhof, wo derzeit Stellplätze für 12 Pkw liegen, bei der Sanierung autofrei zu machen. Dafür sprechen einerseits die schwache Auslastung der in der Wohnhausanlage vorhandenen Pkw-Stellplätze, andererseits Überlegungen zu alternativen Nutzungen des Hofs. Die Pkw-Stellplätze der Wohnhausanlage (12 im Innenhof, 18 im straßenseitigen, zur Wohnhausanlage gehörenden Freiraum Flotowgasse) sind, obwohl alle vermietet, laut Verkehrszählung vom September 2015 wesentlich weniger stark ausgelastet als die Stellplätze im Straßenraum. Abends sind demnach nur etwas mehr als die Hälfte dieser Stellplätze belegt. Außerdem bestehen für den Innenhof im Zuge der Sanierung mehrere Nutzungsoptionen, die derzeit nicht verwirklicht sind und von vielen Bewohnerinnen und Bewohnern in der Befragung befürwortet wurden (z. B. Sitzplatz, Kleinkinderspielplatz, Fahrradabstellanlagen). Gerade in einer Wohnhausanlage wie der untersuchten, in der sowohl der Anteil der Autobesitzerinnen und Autobesitzer als auch der Anteil der mit dem Auto zurückgelegten Wege deutlich unter dem Durchschnitt der Stadt Wien liegt, sollte grundsätzlich ein autofreier Innenhof angestrebt werden. Die Stellplatzverpflichtung, die bei der Sanierung im Fall der Neuschaffung von Wohnnutzflächen zu erfüllen wäre (Wiener Garagengesetz), sollte besser im Bereich Flotowgasse erfüllt werden, etwa durch die Errichtung eines Parkdecks.

Im Wohnumfeld werden derzeit die verkehrspolitisch gewünschte faire Aufteilung des Straßenraums (vgl. STEP 2025 Fachkonzept Mobilität – Magistrat der Stadt Wien 2015) und der Spielraum für eine attraktive Gestaltung des Wohnumfelds durch den hohen Parkdruck und die bestehende Parkordnung stark eingeschränkt. Den Gestaltungsspielraum zu erhöhen ist eine schwierige Aufgabe. Entsprechend der Garagenstrategie der Stadt Wien (Magistrat der Stadt Wien, 2014) werden in dicht bebauten Stadtvierteln Wohnsammelgaragen im Zuge privater Bauvorhaben gefördert, wenn dabei ein Stellplatzrückbau an der Oberfläche erfolgt (im Verhältnis 1 : 3 in den Wiener Außenbezirken). Die dicht bebaute Wohnhausanlage Krottenbachstraße bietet – anders als größere und weniger dichte Gemeindebauten in Wien – kein Potenzial für die Errichtung einer Wohnsammelgarage für das umliegende Quartier. Im Zuge der Sanierungsvorbereitung sollte aber geprüft werden, ob allenfalls auf Liegenschaften in der Umgebung eine Wohnsammelgarage geschaffen und dadurch der Parkdruck im Quartier verringert werden könnte.

SCHLUSSFOLGERUNGEN

Im Sondierungsprojekt SCIG wurden viele, auch detaillierte Überlegungen zu einer smarten Sanierung angestellt, die Maßnahmen wurden aber bisher weder mit allen potenziell Beteiligten diskutiert noch bis zur Umsetzungsreife weiter entwickelt. Es liegen also noch keine konkreten Umsetzungserfahrungen vor. Dennoch lassen sich aus den bisherigen Ergebnissen einige Schlüsse ziehen, die nützlich sein können, wenn bei weiteren Sanierungen im sozialen Wohnbau die Anforderungen an Smart Mobility berücksichtigt werden sollen.

3.5 Umfassende Analysen zur Vorbereitung der Sanierung

Im Vorfeld einer smarten Sanierung sollen zunächst die mobilitätsrelevanten Bedingungen in der Wohnhausanlage erhoben und eine Befragung der Bewohnerinnen und Bewohner durchgeführt werden. Diese ermöglicht es, die Möglichkeiten und Prioritäten der Bewohnerinnen und Bewohner richtig einzuschätzen und erlaubt Rückschlüsse auf die Akzeptanz möglicher Maßnahmen. Weiters sollen auch bestehende versorgungsrelevante Infrastrukturen im Wohnumfeld sowie die Verkehrssituation und der öffentliche Raum in der Umgebung erhoben, analysiert und dargestellt werden. Die festgestellten Defizite, aber auch besondere Qualitäten der Wohnumgebung können Ansatzpunkte für mögliche Verbesserungsmaßnahmen bei einer smarten Sanierung sein. Kartendarstellungen und Fotodokumentationen sind nützliche Instrumente dafür.

3.5.1 Mobilitätserhebung Bewohnerinnen und Bewohner

Zur Sanierungsvorbereitung ist eine umfassende Befragung der Bewohnerinnen und Bewohner sinnvoll. Für den Teilbereich Mobilität sollen folgende Kategorien abgefragt werden:

- Grundlagen der persönlichen Mobilität: Netzkarte für öffentliche Verkehrsmittel, Führerschein, Pkw-Verfügbarkeit, vorhandene Mobilitäts-Einschränkungen und Barrieren
- Anzahl der Fahrzeuge im Haushalt, übliche Abstellorte (Pkw, Fahrrad, Moped/Motorrad)
- Übliche Verkehrsmittelwahl
- Beurteilung der Verkehrssituation im Wohnumfeld, Ideen zur Verbesserung
- Ideen zur Nutzung von Freiräumen und Gemeinschaftsräumen in der Wohnhausanlage
- Einstellung zu möglichen Maßnahmen in der Wohnhausanlage (z. B. neue Fahrradabstellplätze, Carsharing)

3.5.2 Analye des Wohnumfelds und der Versorgungsinfrastruktur

Folgende Kategorien sollen erhoben, bewertet und dargestellt werden:

- Lage im Stadtgebiet, Topographie, Bebauungsstruktur
- Versorgungsrelevante Infrastrukturen im fußläufigen Einzugsbereich (ca. 300 bis 1.000 m)
    - Bildungseinrichtungen vom Kindergarten bis zur Universität
    - Gesundheit/Soziales: Ärztin/Arzt, Apotheke, Pflegeeinrichtungen
    - Einzelhandel und Dienstleistungen des täglichen Bedarfs
    - Freiraum, Freizeit, Kultur: Park, Spielplatz, Treffpunkte für verschiedene Bevölkerungsgruppen

3.5.3 Bestandsanalyse Verkehr und öffentlicher Raum

Die Erhebung und Bewertung der Verkehrssituation sowie des Zustands und der Nutzung des öffentlichen Raums liefert die Grundlagen dafür, dass Verbesserungspotenziale für das Wohnumfeld erkannt werden. Die Analyse soll folgende Kategorien enthalten:

- Öffentlicher Verkehr, Sharing-Infrastruktur
- Straßen- und Wegenetz, Radverkehrsinfrastruktur, Verkehrsorganisation
- Parkordnung, Parkplatzangebot und -auslastung
- Verkehrsstärken, Verkehrslärm und Verkehrsunfälle
- Gestaltung, Ausstattung, Zustand und Nutzung des öffentlichen Raums

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3.6 Projektentwicklung und Kooperationsstrukturen

Die oben genannten Smart Mobility Ziele können im Rahmen eines Sanierungsvorhabens wohl dann am besten erreicht werden, wenn Maßnahmen in der Wohnhausanlage selbst mit Maßnahmen im Umfeld sinnvoll kombiniert werden und sich die Bewohnerinnen und Bewohner in die Planung von mobilitätsrelevanten bzw. die Gemeinschaft betreffenden Vorhaben einbringen können.

Im Hinblick auf die mögliche Umsetzung können drei Maßnahmen-Typen unterschieden werden (vgl. Tabelle 1).

Derzeit fehlen allerdings organisatorische Strukturen zur umfassenden Planung und Koordination komplexer Modernisierungsvorhaben im sozialen Wohnbau. Diese müssten erst geschaffen werden, sodass, aufbauend auf umfassende Grundlagenanalysen in der Wohnhausanlage und im Wohnumfeld, und unter Einbeziehung der Wohnbevölkerung, eine schrittweise Projektentwicklung und Koordination zwischen den umsetzungsrelevanten Stellen erfolgen kann.

Maßnahmen-Typ	Beschreibung	Verantwortliche Organisation(en)
A Raumbezogene Maßnahmen in der Wohnhausanlage	Bauliche Maßnahmen in Gebäuden oder Freiräumen Neue Nutzungen für bestehende Räume Anschaffungen für Gemeinschafts-Räume	Wiener Wohnen
B Begleitende aktivierende, partizipative und organisatorische Maßnahmen	Aktivierung der Bewohnerinnen und Bewohner, Förderung der Selbstorganisation Entwicklung von Geschäftsmodellen für Mobilitäts-Dienstleistungen (ehrenamtlich oder kommerziell) Verkehrsinformation und Mobilitätsmanagement	Beauftragung durch Wiener Wohnen bzw. durch die Stadt Wien Organisationsstrukturen und Verantwortungsbereiche sind noch zu klären
C Verkehrs-, Gestaltungs- und Baumaßnahmen im Umfeld der Wohnhausanlage (können auch unabhängig von der Wohnhaussanierung ausgeführt werden**)**	Verkehrsorganisation, Verkehrssicherheitsmaßnahmen Änderung der Parkordnung, Gestaltung des öffentlichen Raums Qualitätsverbesserung im öffentlichen Verkehr Baumaßnahmen im Umfeld	Jeweils zuständige Stellen (Dienststellen der Stadt Wien, Bezirk, Wiener Linien, Bauträger in der Umgebung, …)

Tabelle 1: Maßnahmen-Typen für die Umsetzung von Smart Mobility bei Sanierungen in Gemeindebauten der Stadt Wien

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reviewed paper

Open-Innovation- und Living-Lab-Ansätze in der Praxis der Stadtentwicklung – Herausforderungen, Dilemmas und Chancen

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1 HINTERGRUND

Die Herausforderungen für Europas Städte sind komplex und mannigfaltig. Der Urbanisierungsgrad, also der Anteil der Stadtbewohner an der Gesamtbevölkerung, lag im Jahr 2014 im EU-Schnitt bei 75%, in Österreich bei knapp 66%. Die meisten Prognosen gehen davon aus, dass der Trend der Landflucht weiter anhalten wird. Lt. Statistik Austria ist die Bevölkerung in den österreichischen Landeshauptstädten zwischen 2003 und 2013 durchschnittlich um 7,4% gestiegen, wobei Eisenstadt (14,1%), Graz (12,9%) und Wien (9,3%) das stärkste Wachstum verzeichneten. Erste spürbare Auswirkungen sind steigende Immobilienpreise, Verkehrsüberlastung, eine zunehmende Verknappung von Grünflächen und attraktivem öffentlichen Raum, Luftverschmutzung, soziale Spannungen sowie steigende Kosten von städtischer Infrastruktur.

Angesichts der Dringlichkeit und Komplexität urbaner Herausforderungen muss klar sein, dass „business as usual“ diese Probleme nicht lösen wird und es neue gesellschaftliche Praktiken und Governance-Systeme benötigt, um die Lebensqualität in Europas Städten nachhaltig zu sichern. Typische Beispiele für „Business as usual“ sind etwa Verwaltungsgrenzen der Städte, welche die physische, soziale, wirtschaftliche und kulturelle Realität nicht mehr widerspiegeln, was insbesondere die Verkehrsplanung bzw. das Schaffen abgestimmter Angebote des öffentlichen Verkehrs erschwert. Ein weiteres Beispiel betrifft das sektorale Denken und Handeln auf Verwaltungsebene, das erst langsam aufbricht und Platz macht für integrative sowie kooperative Planungsprozesse.

Bürgerinnen und Bürger sind von politischen Entscheidungsprozessen, die ihr unmittelbares Lebensumfeld in ihrem Stadtteil betreffen, in vielen Fällen so gut wie ausgeschlossen. Sie werden meist nicht danach gefragt, wie ein Platz gestaltet sein soll, was sie zu einem Umstieg auf den öffentlichen Verkehr bewegen würde oder wie der Leerstand in den Erdgeschoßzonen reduziert werden könnte. Bürgerbeteiligung wird von Politik, Verwaltung und Wirtschaft viel zu oft als lästige Pflichtübung betrachtet und manchmal auch mit dem Argument verhindert, dass „eh immer nur die Kritiker, Nein-Sager und Schlecht-Macher teilnehmen“ (was manchmal durchaus stimmen mag). Der Schluss daraus darf aber nicht weniger Beteiligung sein. Vielmehr muss es gelingen, niederschwellige und attraktive Beteiligungsangebote zu entwickeln, welche die vielen konstruktiven Ideen, Lösungsansätze und das lokale Wissen der Menschen und Unternehmen vor Ort einbeziehen. Neue Lösungen entstehen nicht dadurch, dass immer wieder dieselben Experten mit denselben Haltungen und Vorgehensweisen zusammensitzen, neue Ideen entstehen vielmehr an den Rändern des Systems und durch Impulse von außen. Es macht daher Sinn, Beteiligung und Kooperation in der Stadtentwicklung verstärkt aus dem Blickwinkel von Innovationsprozessen zu betrachten, um den notwendigen gesellschaftlichen Wandel und Transformationsprozess hin zu nachhaltigen Städten zu unterstützen.

Keywords: Casestudy, kooperative Stadtentwicklung, Open Innovation, Smart City, urbane Herausforderungen

2 OPEN INNOVATION UND LIVING LAB ANSÄTZE

Der französische Soziologe, Philosoph und Urbanist Henri Lefebvre (1901-1991) erweiterte den Stadtbegriff um die Dimension menschlicher Kreativität und Wirksamkeit sowie die Dimension der Wechselwirkung. Die Stadt als „Oevre“ ist weit mehr als ein Ort, als die Summe an Versorgungs-, Entsorgungs-, Infrastrukturleistungen und Konsumgütern. Das dynamische und lebendige „Oevre“ Stadt ist jener Ort und jener Raum, der durch und in dem die Begegnungen von Unterschiedlichem stattfinden, Aktivitäten und wechselseitige Beziehungen entstehen. Die aktuelle/tatsächliche Stadt muss immer die mögliche Stadt als Entwicklungspotenzial und Gestaltungsraum beinhalten. Die Stadt und das Urbane sind über Orte hinaus also vielmehr soziale Verhältnisse der wechselseitigen Inspiration und des gemeinsamen Agierens - wobei die Verstädterung von ihm als dialektisch ablaufender Prozess mit unbestimmtem Ausgang beschrieben wird – in dem die fortlaufende Reflexion und Integration der menschlichen Kreativität und Wirksamkeit

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notwendigerweise für ein Gelingen, für eine wünschenswerte Entwicklung in Richtung Urbaner Lebensqualität Voraussetzung ist. Diese frühzeitige Einbindung relevanter Akteure in die Entwicklung des „Oevre“ Stadt sowie Governance im Sinne offener, transparenter und partizipativer Entscheidungsfindungsprozesse werden in europäischen Strategie¬dokumenten mehrfach explizit gefordert. Ebenso betonen internationale Vorreiter wie Jan Gehl (Dänemark) in ihren Projekten die Bedeutung der „human dimension“ für eine qualitätsvolle Stadtentwicklung.

In den letzten Jahren ist zudem eine steigende Bedeutung von “Open Innovation” bzw. „Living Lab“ Konzepten auch im Bereich der Stadt¬entwicklung zu beobachten. Das European Network of Living Labs (ENoLL) definiert “Living Labs” als “user-driven innovation environments where users and producers co-create innovation in a trusted, open ecosystem that enables business and societal innovation”. Die Idee baut auf Open Innovation Ansätzen aus der Innovationstheorie auf, die darauf abzielen, externe Ressourcen in den Innovationsprozess (beispielsweise von Produkten und Dienstleistungen) zu integrieren. Durch das Open Innovation Prinzip wandelt sich die Rolle des passiven Konsumenten zunehmend in Richtung aktive „Prosumenten“. Ein „Living Lab“ kann somit zum einen als innovationsfördernde Umgebung verstanden werden, anderseits aber auch als Innovationsmethode mit sehr konkreten Tools, Werkzeugen und iterativen Abläufen.

Das Konzept der „Living Labs“ wurde mittlerweile in die europäische Innovationspolitik aufgenommen und findet auch im urbanen Kontext seine Anwendung (Stichwort: Smart City Labs, Urban Labs). Zu wichtigen Grundprinzipien von „Living Labs“ zählen:

- Öffnung von Entwicklungsprozessen und inklusive Beteiligung: Qualitätsvolle Stadtentwicklung erfordert Ressourcen, Kompetenzen und Expertise möglichst vieler Menschen und Disziplinen, um neben dem notwendigen Fachwissen auch das (lokale und Alltags-)Wissen von Bewohnerinnen und Bewohnern, Aktivbürgerinnen und Aktivbürgern, Unternehmen, zivilgesellschaftlichen Akteurinnen und Akteuren oder Kunst- und Kulturschaffenden einbinden und nutzen zu können. Damit dies gelingen kann, sind eine professionelle Planung von Beteiligung, hohe Methodenkompetenz sowie Kontinuität und Reflexionsprozesse unabdingbar. Das alles passiert nicht nebenbei, sondern braucht neben einer von allen Seiten akzeptierten und allparteilich agierenden intermediären Instanz auch entsprechende finanzielle Ressourcen. Die Praxis zeigt hier bereits eine Vielzahl an Beteiligungsmodellen und -methoden (z.B. Planugszelle, Charette-Verfahren, …).
- Design geeigneter Dialog-, Lern-, und Kooperationsformate und -räume: Hier geht es angesichts immer kürzer werdender Innovationszyklen nicht nur darum, Wissen schneller und umfassender als bisher zu teilen bzw. gemeinsam zu generieren sondern auch darum, Dialog- und Lernprozesse als Erfahrungsprozesse zu gestalten. Lernende, egal ob aus Unternehmen, Forschung, Politik, Verwaltung oder Gesellschaft müssen über die Bearbeitung konkreter Problemstellungen in alltagsnahen Lernumgebungen neue Wege der Problemanalyse und -lösung (mit allen Sinnen!) erfahren können. „Living Labs“ fordern hier ein deutliches „Raus“ aus der „Komfortzone“ steriler Konferenz- und Seminarräume und das Schaffen von niederschwelligen, für alle zugänglichen Begegnungsräumen am Ort des Geschehens (Straßenlokale, Co-Working Spaces, etc.). Hackatons, barcamps, learning safaris, Design Thinking sind nur einige Beispiele aus der Praxis, die hier immer wieder neue Methoden hervorbringt und ausprobiert.
- Co-Creation, Experimentieren und Prototyping: Ein Kernelement und Ziel des „Living Lab“ Ansatzes ist es, deutlich schneller als bisher vom Reden ins Tun zu kommen. Um die Kluft zwischen Denken und Handeln, zwischen Forschung und Umsetzung zu überwinden, braucht es „hands-on Formate“ mit (temporären) Experimenten, Prototypen und iterativen Problemlösungsprozessen, die unterschiedliche Disziplinen, Wissensformen, Akteure, Methoden und Problemlösungsansätze zusammenbringen.

Abhängig von den Zielen und Rahmenbedingungen von „Living Labs“ können diese ihren Aufgabenschwerpunkt auf das Vernetzen unterschiedlicher Aktuere („connect“), auf Inspiration („Awaken the spark“), auf das Anstoßen/Vorantreiben neuer Projekte oder Ideen („incubate“), auf die Unterstützung und Beschleunigung von Vorreitern („Accelerate“) oder auf das Beleuchten/Explorieren von neuen Themenfeldern („Illuminate“) legen.

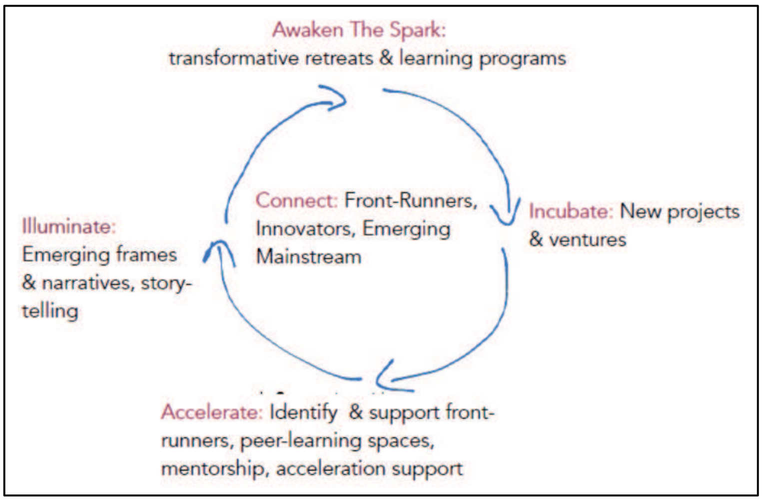

Abbildung 1: Hauptausrichtungen von „Living Labs“, Quelle: Labcraft, R. Berkhout et al.

3 LIVING-LAB-ANSÄTZE IN DER PRAXIS DER STADTENTWICKLUNG

Die im Kapitel 2 skizzierte Theorie ist nur eine Seite. Auf der anderen Seite steht ihre Umsetzung in die tägliche Beteiligungs- und Innovationspraxis, die viele Fragen und Herausforderungen aufwirft. Das StadtLABOR Graz beschäftigt sich in einem sehr ganzheitlichen und praxisorientierten Zugang mit nachhaltiger Stadtentwicklung bzw. mit Innovations- und Transformationsprozessen in Städten. Ein Hauptaugenmerk liegt dabei auf sozialen Innovationen, neuen Formen der Kooperation und inklusiver Beteiligung, wobei die Grundprinzipien von „Living Labs“ für alle Aktivitäten handlungsweisend sind. Was haben wir aus diesen kooperativen Prozessen bis dato gelernt? Was hat sich bewährt und was sind die konkreten Stolpersteine, wenn es darum geht die Theorie in der Praxis anzuwenden? Durch welche Art von Dokumentation kann der Nutzen kooperativer Stadt¬ent¬wicklugsprozesse besser sichtbar gemacht werden und wie können „soft facts“ messbar gemacht werden? Was braucht es in Zukunft, um Relevanz, Mehrwert und Qualität der Ergebnisse weiter zu erhöhen?

Im Folgenden werden auf Basis von zwei Casestudies aus der Stadtteil- bzw. Quartiersentwicklung Erfahrungen mit der praktischen Umsetzung der theoretischen Grundprinzipien kritisch reflektiert sowie erste Schlussfolgerungen zur Diskussion gestellt.

3.1 Casestudy 1: Brauquartier Puntigam

Das StadtLABOR Graz begleitet im Auftrag eines privaten Immobilienentwicklers und Bauträgers seit Anfang 2014 die Entwicklung eines Quartiers im Süden von Graz, das für einen bis dato eher vernachlässigten Randbezirk die Funktion eines neuen Bezirkszentrums einnehmen soll. Auf einer Fläche von 4,2 ha entsteht in den nächsten 10 Jahren eine neues Quartier mit 800 Anleger- und Eigentums-wohnungen, das im Endausbau Wohn- und Arbeitsraum für knapp 2000 Menschen bieten wird. Urbane Mischnutzung, attraktive Freiräume und eine gute räumliche und soziale Verwebung mit dem lokalen Umfeld sollen die Lebensqualität für die zukünftigen Bewohnerinnen und Bewohner und Nutzerinnen und Nutzer sicherstellen.

Ausgangspunkt der Zusammenarbeit war der Wunsch des Auftraggebers, ein Brandingkonzept sowie eine Quartiersmarke für das neue Quartier zu entwickeln, das die Besonderheiten und Alleinstellungsmerkmale des zukünftigen Quartiers für unterschiedliche Zielgruppen beschreibt. Für das StadtLABOR war von Beginn an klar, dass dieser Auftrag eine viel breiter gefasste Perspektive benötigt, da es hier um die langfristige Transformation eines Bezirks in ein urbanes Zentrum mit hoher Ausstrahlungskraft auf das Umfeld geht. Der Bauträger hatte bereits große Erfahrungen in der Entwicklung von Einzelobjekten, ein Projekt in dieser Dimension war auch für ihn Neuland. Da zunächst noch nicht einzuschätzen war, wie sehr der Auftraggeber einen größeren Blickwinkel einnehmen wollte, wurde der Entwicklungsprozesses zwar von Anfang an groß gedacht und geöffnet, ohne dies zunächst explizit zu betonen.

Es wurde ein regelmäßiger Jour Fixe des Kernteams eingeführt, das sich neben dem Auftraggeber, aus dem aus einem Realisierungwettbewerb als Sieger hervorgegangenen Architektenteam, einer Landschaftsarchitektin sowie dem Team des StadtLABORs zusammensetzte. Der Auftraggeber war mit dem

Projektleiter, einem Vertreter der Marketingabteilung sowie häufig auch mit einem Vertreter des Vorstands mit dabei. Es waren somit unterschiedlichste Fachexpertisen vertreten – (Landschafts)architektur, Planung, Mediation und Kommunikation, Verfahrenstechnik sowie Innovations-, Finanz- und Projektmanagement - wodurch gute Voraussetzungen für eine interdisziplinäre Zusammenarbeit und Bearbeitung der Aufgabenstellungen geschaffen werden konnten. Im Jour Fixe wurden die einzelnen Planungsstände der Beteiligten präsentiert, diskutiert und aufeinander abgestimmt. Ein interessanter Aspekt, der gleich bei einem der ersten Jour Fixe entstand, war die Überlegung, die Abwärme aus der benachbarten Brauerei für die Wärmeversorgung des Quartiers zu nutzen. Diese synergetische Nutzung wurde sehr schnell prototypisch weiterverfolgt und befindet sich gerade in der Detailplanung.

Das StadtLABOR trat zu einem Zeitpunkt in den Planungsprozess ein, als der Architekturwettbewerb bereits abgeschlossen war und - parallel zum Bebauungsplanverfahren – mit den Einreichplanungen begonnen wurde. Dadurch waren die Eckpfeiler des Projekts bereits eingeschlagen, gleichzeitig gab es noch genug Gestaltungsspielraum auf unterschiedlichen Ebenen, sodass eine Öffnung der Entwicklungsprozesse möglich war. Die Behörde (Abteilung für Stadtplanung, Verkehrsabteilung) wurde neben den Abstimmungsgesprächen im Zuge des Bebauungsplanverfahrens auch regelmäßig über die informellen Prozesse im Rahmen der Entwicklung des Brandingkonzepts informiert, wodurch ein spürbarer Vertrauensaufbau erzielt werden konnte.

Der eigentliche Markenentwicklungsprozess verlief in 3 Phasen (siehe Abbildung 2).

Abbildung 2: Ablauf Brandingprozess

Zunächst ging es uns darum, eine möglichst vollständige „Innensicht" zum Projekt seitens des Auftraggebers und der beteiligten Planerinnen und Planer zu erhalten. Dieser Schritt erfolgte im Rahmen des Jour Fixe bzw. über Einzelgespräche. Interessant war dabei, dass seitens des Bauträgers noch relativ wenig konkrete Überlegungen v.a. bezüglich der Zielgruppen vorlagen und die Formulierugen und Planungsgedanken des Architektenteams maßgebend waren: „Inmitten des heterogenen Nebeneinander von Industrie- und Gewerbeflächen, Geschäften, Einfamilienhäusern und Sportplatz bildet der geplante Wohnbau mit seinem zentralen Platz einen neuen Ortskern, welcher als Knotenpunkt von öfentlichem und privatem Verkehr eine überörtliche Bedeutung für Handel und Gewerbe erlangen wird. […] Die Sockelzone des Baukörpers wird als halböfentliche Stadtlandschaft mit ihren verschiedenen Durchwegungs-Situationen zum Knotenpunkt urbaner Kommunikation. Ein „Dorfplatz" mit Gewerbeflächen und Cafes im Erdgeschoß bildet das neue Zentrum am Bauareal. […]".

Die „Außensicht" auf das Projekt wurde über mehrere Analyseschritte eingeholt. Im Zuge einer sozialräumlichen und Umfeldanalyse wurden relevante Stakeholder, städtebauliche Strukturen, soziale Infrastruktur und sonstige Einrichtungen erhoben, um Chancen, Potenziale aber auch Herausforderungen in Bezug auf das Umfeld zu identifizieren. In Einzelinterviews mit ausgewählten Schlüsselakteuren wurden spontane Assoziationen mit dem, Erwartungen an das Projekt sowie Stärken und Schwächen des Bezirks erhoben. Die Gesprächspartner waren Vertreterinnen und Vertreter des Bezirksrates, des benachbarten Heimgarten und Sportvereins, der Brauerei sowie von Unternehmen, der lokalen Gastronomie, Kindergärten und auch der Pfarre. Hier zeigte sich erste für die Markenentwicklung interessante Anknüpfungspunkte hinsichtlich Stärken/Chancen des Bezirkes bzw. des Projekts aber auch in Bezug auf Herausforderungen und Schwächen (siehe Abbildung 3).

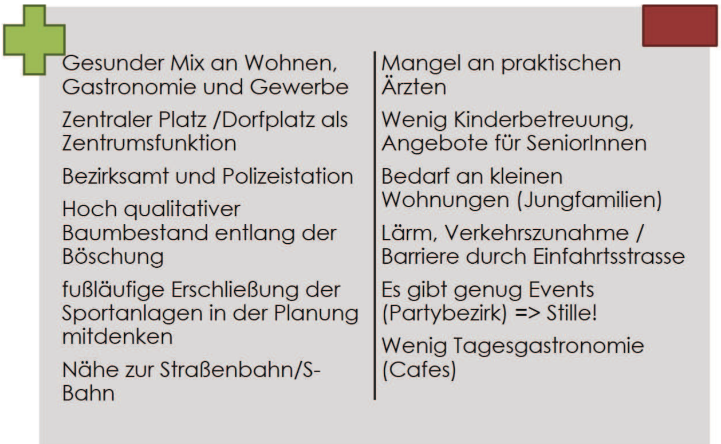

Abbildung 3: Ergebnisse der Einzelinterviews mit Schlüsselakteuren

Die frühzeitige Information über das Projektvorhaben sowie die Einbindung lokaler Akteure wurde von ausschließlich allen Gesprächspartnern sehr positiv bewertet, gleichzeitig bestand vereinzelt der Wunsch nach mehr Beteiligung und regelmäßiger Information, der mangels Auftrag in dieser Phase des Projekts nicht weiter erfüllt werden konnte. Hierin zeigt sich ein Dilemma der Öffnung von Entwiclkungsprozessen, durch die natürlich Erwartungen und Beteiligungsinteressen geweckt werden, die nicht immer erfüllt werden können. Trotz wiederholter Vorschläge weitere Beteiligungsformate anzubieten, um vertiefende Sichtweisen von außen einzuholen, wollte der Auftraggeber zunächst den Beschluss des Bebauungsplanes abwarten, um Rechtssicherheit zu erlangen bzw. keine Zeitverluste zu erleiden.

Ergänzend kamen in der ersten Phase Medienanalysen zur veröffentlichten Meinung über das Projekt, Benchmarkanalysen zu vergleichbaren städtebaulichen Vorhaben sowie weitere Sekundärrecherchen hinzu (Megatrends, Lebensqualitätsindikatoren der Stadt Graz, Smart City Graz Strategie, Immobilienmarkt, etc.).

Die Phase 2 startete mit einem Markenoptionen-Workshop bei dem ausgewählte Stakeholder zu einem halbtägigen Workshop eingeladen wurden, um die Ergebnisse der ersten Phase gemeinsam zu reflektieren und erste Ideen für Markenoptionen zu entwickeln. Es ging als um das Generieren von Positionierungsoptionen für das neue Quartier, die Fakten und Emotionen gleichermaßen berücksichtigen sollten. Der Teilnehmerkreis setzte sich aus dem Kernteam, erweitert um Städtebauexperten der TU Graz, Verteter der lokalen Kreativszene, Designstudierenden sowie Architekten zusammen. Hervorzuheben ist, dass der Workshop vor Ort in der benachbarten Brauerei stattfand und somit direkte Eindrücke vom Ort des Geschehens vermittelt werden konnten. Im Rahmen dieses Workshops wurden auch erste Vorschläge zur Namensfindung für das Quartier gesammelt, der Name „Brauquartier“, der auf den historischen Bezug bzw. die räumliche Nähe zur benachbarten Brauerei anspielt, wurde seitens des Auftraggebers als Highlight ausgewählt.

In mehreren Bearbeitungsschleifen innerhalb des Kernteams wurde im Anschluss an den Markenoptionen-Workshop die Positionierungsstrategie erarbeitet. In diese Phase fiel noch ein weiteres Lernformat, durch das sehr wesentliche und weitreichende Entscheidungen für die Markenentwicklung bzw. die Qualität des zukünftigen Quartiers vorbereitet wurden. Gemeinsam mit der TU Graz organisierte das StadtLABOR eine Studytour zu interessanten städtebaulichen Projekten in Wien (u.a. Wohnprojekt, Sonnwendviertel, Sargfabrik), bei dem neben dem Projektleiter auch zwei Vorstandsmitglieder des Auftraggebers mit dabei waren. Im Rahmen der Studytour konnten bereits erprobte Modelle und Innovationen für Stadtquartiere erlebbar gemacht werden, die nun auch für das Brauquartier – zum Teil erstmals in Graz – umgesetzt werden (u.a. Quartiersmanagement. Gästewohnungen). Diese Studytour war neben der grundsätzlichen Öffnung und Einbeziehung lokaler Stakeholder ein Schlüsselereignis im gesamten Prozessverlauf.

Die Verdichtung und eigentliche Entscheidungsfindung für die Quartiersmarke erfolgte letztlich in kleiner Runde innerhalb der Marketing- und Vertriebsabteilung des Auftraggebers. Zentrales, übergeordnetes Markenelement ist die Vernetzung bzw. das Leben in (anlaogen und digitalen) Netzwerken, durch das der Alltag der Bewohnerinnen, Bewohner, Nutzerinnen und Nutzer des Brauquartiers wesentlich erleichtert

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werden soll. Zusätzliche Markenattribute beziehen sich auf vielfältige, sanfte Mobilitätsformen, Sport und Gesundheit sowie Kulinarik und Entertainment. Die Umsetzung der Markenstrategie über Website, Folder etc. erfolgt aktuell durch eine Werbeagentur, der offizielle Vertriebsstart ist für Juni 2016 geplant.

3.2 Casestudy 2: Smart City Graz Waagner Biro

Die zweite Casestudy betrifft das „Smart City Project Graz Waagner Biro“[1], in dem ein innerstädtisches ehemaliges Industrieareal westlich des Grazer Hauptbahnhofes innerhalb der nächsten 10 Jahre zu einem lebendigen und „smarten“ Stadtteil mit modernen Technologien für eine nachhaltige Energieversorgung und Ressourcenschonung entwickelt wird. Der Stadtteil soll im Endausbau einen nachhaltigen Wohn- und Arbeitsstandort mit qualitativ hochwertigem öffentlichen Raum und einer hohen Lebensqualität bieten. Das StadtLABOR Graz betreibt dort seit knapp zwei Jahren ein Stadtteilmanagement und agiert an der Schnittstelle zwischen der lokalen Bevölkerung, den Unternehmen und Einrichtungen vor Ort, den städtischen Abteilungen, Planerinnen, Planern, Architektinnen und Architekten sowie Grundeigentümern, Bauträgern und Investoren.

Ausgangspunkt für das Leitprojekt „Smart City Project Graz Waagner Biro“ war das einjährige Sondierungsvorhaben „I live Graz“[2], in dem eine Vision für die Smart City Graz für das Jahr 2050 partizipativ entwickelt wurde. Aufgrund seiner interdisziplinären Projektbearbeitung konnten neue Lösungsansätze und gesamtstädtische Strategien in den sogenannten „7+1 Handlungsfeldern“ kooperativ erarbeitet werden (siehe Abbildung 4), die die Grundlage für eine smarte und zukunftsfähige Stadtentwicklung von Graz bilden und die im nachfolgenden Leitprojekt umgesetzt werden. Dazu zählen Smart City Grundsätze wie die „Stadt der kurzen Wege“, urbaner Nutzungsmix, Energie- und Ressourceneffizienz, Förderung sanfter Mobilitätsformen oder effiziente Gebäudetechnologien.

Abbildung 4: 7 + 1 Smart-City-Kriterien

Im Leitprojekt ist das StadtLABOR für das Stadtteilmanagement „vor.ort“ zuständig, mit dem Ziel die Ressourcen, Ideen, das lokale Wissen sowie Anliegen der Nachbarinnen, Nachbarn, Unternehmen und Initiativen einzubinden und die Akzeptanz der Anrainerinnen und Anrainer für die Transformationen, für die baulichen Neuerungen und die eingesetzten technologischen und sozialen Innovationen im Stadtteil zu stärken. Für die breite Öffentlichkeit wiederum gilt es, die Sichtbarkeit der Smart City Idee generell zu vermitteln und möglichst viele Menschen für die Vision zu begeistern und mit ins Boot zu holen. Das Team des Stadtteilmanagements trifft sich monatlich mit Vertreterinnen und Vertretern der städtischen Abteilungen (Stadtplanung/Stadtbaudirektion/ Verkehrsplanung/Grünraum) und der Technisches Universität Graz zu einem Jour Fixe, um Informationen schnell weiterzugeben und die Aktivitäten und Planungsschritte abzustimmen.

Neu war, dass sich das Stadtteilmanagement bereits weit vor Baubeginn am Ort des zukünftigen Geschehens angesiedelt hat, zunächst mit einem Baucontainer, der als Anlauf- und Informationsstelle dient.

[1] Leitprojekt, gefördert durch den Klima- und Energiefonds im Rahmen der 2. Ausschreibung Smart Energy Demo – FIT for SET www.klimafonds.gv.at; Die Projektlaufzeit beträgt 60 Monate (Juni 2012 - Juni 2017).

[2] gefördert durch den Klima- und Energiefonds im Rahmen der 1. Ausschreibung Smart Energy Demo – FIT for SET www.klimafonds.gv.at

Abbildung 5: Stadtteilmanagement „vor.ort“

Der Startpunkt der Öffnung des Stadtteilentwicklungsprozesses war die Information und die Einladung zur Beteiligung und war geprägt vom Wunsch der Bürgerinnen und Bürger nach Details zum Vorhaben und einem Bedarf auf die zukünftigen Entwicklungen im Stadtteil zu reagieren (Sorgen, Bedenken, Wünsche). Eine realistische Chance sich einzubringen wurde vorerst nicht gesehen, ebenso wenig gab es ein Verständnis der Bewohnerinnen, Bewohner, Unternehmen und Initiativen im Stadtteil aktiv an den Veränderungen mitwirken zu können. Nach einem Ausweiten des Bearbeitungsgebietes von vor.ort rückte der Stadtteil als Ganzes in den Fokus und das lokale Wissen wurde durch vor.ort sichtbar gemacht. Eine Sammlung entstand. Nun gibt es einen Pool an Themen, die den Stadtteil betreffen und Auswirkungen auf die neue Bebauung haben. Über Öffnungszeiten von vor.ort, gemeinsame Spaziergänge und Stammtische wird diese Sammlung gepflegt und ist jederzeit auf der Projektwebsite www.smartcitygraz.at verfügbar.

Als eine weitere Aktivität des Stadtteilmanagements wurden die Handlungsfelder der Smart City Graz Strategie überarbeitet, da sich gezeigt hat, dass eine informelle und alltagsnahe Sprache für die Auseinandersetzung mit den Menschen im Stadtteil unabdingbar ist. Die ursprünglichen Planungsvisionen wurden somit hin zu den realen Lebenswelten der Bewohnerinnen und Bewohner transformiert:

- Leben im Quartier (öffentlicher Raum/Grünraum),
- Wohnen (innovativ und vernetzt),
- sanfte Mobilität,
- Veränderungen im Quartier (die dynamische Stadt) und
- urbane Vielfalt (Sockel- und Erdgeschoßzonen).

Die Planung der konkreten Beteiligungsformate orientiert sich an diesen Themenfeldern und wird nach dem tatsächlichem Bedarf (wie intensiv werden Fragen an das Stadtteilmanagement herangetragen, welche Themen sind brisant) und nach der Taktung der Planungsschritte des Gesamtprojekts vorgenommen. Dabei ist es wichtig geeignete Dialogformate zu entwicklen. Dies soll für das Temenfeld „Mobilität“ beispielhaft näher erläutert werden:

Fragen und Bedenken der Bewohnerinnen und Bewohner zur zukünftigen Verkehrssituation wurden zunächst sehr allgemein an das Stadtteilmanagement herangetragen und die Antworten, im Rahmen von großen Informationsveranstaltungen, ebenso allgemein behandelt. Dadurch entstand der Eindruck, nicht wirklich gehört zu werden. Vor.ort lud die Menschen im Stadtteil daher ein, ihre konkreten Anliegen oder spezifische Verkehrssituationen inhaltlich zu benennen, räumlich zu verorten und per Mail, Postkarte oder persönlich zu übermitteln. Diese Fragestellungen wurden an die Expertinnen und Experten der Verkehrsplanung der Stadt Graz weitergegeben und im Vorfeld eines speziellen Stammtisches zum Thema Mobiltät behandelt. Bei der Veranstaltung selbst gab es zwei kurze Impulsreferate zum Thema Mobilität, im Anschluss wurden die vorab gesammelten Fragen und Anliegen von den Expertinnen und Experten beantwortet bzw. offene Fragen gemeinsam diskutiert. Durch die Darstellungen der Zusammenhänge zwischen örtlichen Begebenheiten und globalen Tendenzen fanden sich die Teilnehmerinnen und Teilnehmer am Ende der Veranstaltung auf Augenhöhe wieder und diskutierten über ihr persönliches Mobilitätsverhalten und über Möglichkeiten, vorherrschende Muster zu durchbrechen. Dieser vorgeschaltete Zwischenschritt in der Planung des Mobilitätsstammtisches trug wesentlich zu seinem Gelingen bei.

Offene Fragen werden vom Stadtteilmanagement kontinuierlich aufgenommen – während der regelmäßigen Öffnungszeiten, über Website/E-Mail oder über verschiedene Beteiligungsformate (Stammtisch, Informationsveranstaltungen, aufsuchende Beteiligung). Die gesammelten Fragen werden bearbeitet und die Antworten wiederum ausgesandt. Weiters werden Protokolle und Reflexionen regelmäßig per Newsletter gestreut und auf der Projekt-Website veröffentlicht. Durch Kontinuität der verschiedenen Beteiligungsformate und der beteiligten Personen (Bewohnerinnen und Bewohner, Vertreterinnen und Vertreter der Stadt, Investoren, Unternehmer und Initiativen) kann wechselseitiges Vertrauen aufgebaut bzw. gestärkt werden – das Verhältnis „Bürgerin oder Bürger zur Stadt“ (wir und die) entwickelt sich sukzessive zu „Mensch trifft Mensch“.

Im Stadtteilmanagement werden regelmäßig niederschwellige Lern-, Dialog- und Kooperationsformate ausprobiert. Rund um das Stadtteilmanagement vor.ort entstehen Beete und es gibt Sitzmöglichkeiten, die den Menschen aus dem Stadtteil zur Verfügung stehen. Besprechungen mit den unterschiedlichsten Akteuren werden vorrangig vor Ort durchgeführt, Begehung der Flächen, Spaziergänge im Stadtteil und das gemeinsame Erleben einzelner neuralgischer Punkte im Stadtteil werden forciert. Mit der aufsuchenden Beteiligung werden Siedlungen zu Veranstaltungsorten und es entstehen unmittelbare Beteiligungsprojekte vor Ort (Reaktivierung von Spiel- Aufenthaltsräumen, gemeinsames Gart‘ln, Reparieren von Siedlungs- / Viertelrädern etc.).

Innerhalb der aufsuchenden Beteiligung von vor.ort werden Nachbarschaftsportraits erstellt. Gemeinsam mit den Bewohnerinnen und Bewohnern werden Qualitäten der Siedlung benannt und visualisiert. In der Auseinandersetzung mit dem eigenen Lebensraum entsteht Identifikation und Kraft für Veränderung. Ideen für die Siedlung werden formuliert und dann gilt es zeitnah in die Umsetzung zu gehen – wer hat Ressourcen, Talente, Zeit? Um nicht zu lange in der Planung zu verweilen werden Prototypen entwickelt und Experimente gestartet. Durch die gemeinsame Aktivität wächst die Gruppe an Beteiligten und es steigt der Wille sich in Projekte einzubringen.

Um mit Bewohnerinnen und Bewohnern und Unternehmen über Zukunft sprechen zu können, muss es im Stadtteil auch eine Auseinandersetzung mit der Vergangenheit geben. Wie war es hier einmal? Ein Rückblick und ein Abschliessen von Gewesenem, um ankommen zu können in der Gegenwart. Erst dann ist ein Nachdenken über Zukunft und ein Zulassen der Transformation in den Köpfen und Herzen möglich. Welche Qualitäten werden in der Gegenwart vermisst? Sind diese Qualitäten eventuell in die Zukunft zu übertragen? Diese Fragen stellt sich das vor.ort Team gemeinsam mit den Menschen im Stadtteil und versucht die Themen zu übersetzen und in Auslobungsunterlagen zu integrieren. In jedem Handlungsfeld (Leben, Wohnen, Mobilität, Transformation, Urbane Vielfalt) wird der Verlauf des Beteiligungsprozesses dokumentiert, vom Informieren, über ein Erfahrbarmachen bis hin zu konkreten Maßnahmen und Verhaltensänderungen.

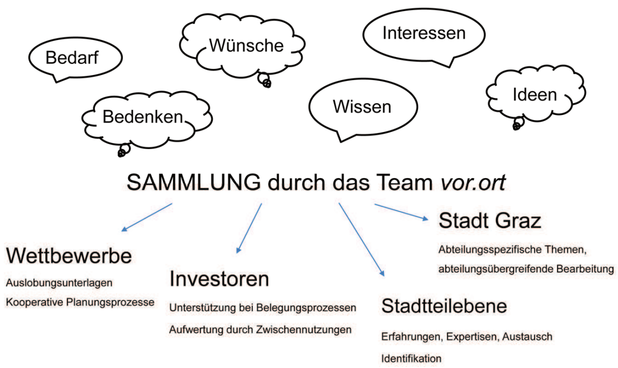

Abbildung 6: Ergebnisverwertung der gesammelten Themen und Anliegen

4 CONCLUSIO

Die Erfahrungen mit der Anwendung von „Open Innovation“ und „Living Lab“ Ansätzen in Stadtentwicklungsprozessen sind durchaus vielversprechend. Die beiden Casestudies haben gezeigt, das es durchaus Unterschiede gibt, je nachdem in welchem Kontext ein Projekt stattfindet. So sind in der

Zusammenarbeit mit privatwirtschaftlichen Auftraggebern kurze Entscheidungswege hilfreich, um schneller neue Formate und Interventionen ausprobieren zu können. Hier kann eine Öffnung von Entwicklungsprozessen wichtige Impulse in der Entscheidungsvorbereitung geben, die Letztentscheidung fällt naturgemäß häufig im kleinen Kreis der Auftraggeber.

In der Zusammenarbeit mit Stadtverwaltungen bzw. im Kontext größerer Forschungskooperationen ist gelegentlich mehr Überzeugungsarbeit zu Beginn erforderlich, auf der anderen Seite wird durch längere Projektlaufzeiten eine tiefergreifende Auseinandersetzung mit Lab-Ansätzen möglich.

Abschließend sollen ein paar wesentliche Erkenntnisse und „lessons learnt" zusammengefasst werden:

- Wirkungsvolle Beteiligungsprozesse erfordern ein Commitment der Entscheidungsträger aus Politik, Verwaltung und (Bau)Wirtschaft sowie ein gewisses Maß an Ergebnisoffenheit, um überhaupt engagierte Menschen für die meist unbezahlte Mitarbeit gewinnen zu können. Der Rahmen und Gestaltungsspielraum für Beteiligung müssen von Beginn an abgesteckt und transparent gemacht werden. Je früher Beteiligung ermöglicht wird, desto größer ist im Regelfall dieser Spielraum und desto größer ist die Bereitschaft, sich konstruktiv einzubringen. Eine zu späte „Pseudo-Beteiligung" führt fast ausschließlich zu Frust, Kritik und manchmal auch zu einem aktivem Blockieren und Verhindern von Vorhaben.

- Es ist unmöglich, den Ausgang von Beteiligungsprozessen vorherzusagen. Dies erfordert zugegebenermaßen einen Vertrauensvorschuss und echte Kommunikationsbereitschaft bei den Entscheidungsträgern. Die Erfahrungen mit ernst gemeinter Beteiligung in Stadtentwicklungsvorhaben sind jedoch fast ausschließlich positiv hinsichtlich der Qualität und Akzeptanz der Ergebnisse und auch hinsichtlich der Beziehungen zwischen Stadtverwaltung, Bürgerinnen und Bürgern.

- Ein großes Potenzial liegt in der Erprobung und Weiterentwicklung neuer Dialog-, Lern- und Kooperationsformate sowie in niederschweligen Orten und Räumen an denen sich Menschen aus unterschiedlichsten Bereichen informell und auch zufällig treffen können. Hier zeigen die Erfahrungen aus denasestudies, dass Inspiration als Quelle für Innovation am leichtesten ermöglicht werden kann.

- Der Bereich der Impact-Messung von „Living Lab" Ansätzen wirft aktuell noch die größten Fragen auf. Es ist schwierig, die direkten Auswirkungen eines Stadtteilmanagements auf die Akzeptanz der Bewohnerinnen und Bewohner oder die Identifikation mit den Veränderungen im Stadtteil messen zu wollen. Ein Ansatz könnte sein, beispielsweise die Zahl und Qualität von Einwendungen bei Bebauungsplanverfahren im Vergleich zu ähnlich großen Stadtentwicklungsprojekten als eine Messgröße heranzuziehen.

- Nicht jedes Projekt, das sich „Lab" nennt, folgt auch tatsächlich den Grundprinzipien. Andererseits gibt es viele Initiativen, die nach diesen Grundsätzen handeln ohne sich „Lab" zu nennen.

Stadtentwicklung ohne Beteiligungs- und Mitgestaltungsmöglichkeiten für Menschen ist ein Irrtum. Es gilt die vielen kleinen „Pflänzchen" einer kooperativen Planungskultur, die vielerorts auftauchen, wertschätzend zu pflegen und wachsen zu lassen, damit Städte zukünftig bessere Lösungen für die Herausforderungen des 21. Jahrhundert finden können.

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Participative Foresight for Smarter Cities: From Vision Seeds to the Development of Scenarios

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1 ABSTRACT

Recently, the smart city concepts have gained increasing importance in current energy and city planning. Various smart city projects which have been realized show that a systemic, integrative approach is crucial. However, in the projects the delineation of boundaries for integrative planning and the realization of systemic local solutions are challenging as the prevailing conventional planning tools and routines are limited. They usually propose top-down and short-term approaches with limited interactions with the stakeholders and limited interdisciplinary research (in particular involving areas of sociology).

To tackle these challenges, a Swiss-Russian cooperation aims to **enhance the existing planning routines** by developing and testing systemic tools for **multi-level stakeholder participation processes** as well as for **future-oriented thinking in city development**. For this purpose, two Swiss and two Russian cities were selected, namely Winterthur, Zurich, Moscow and Kazan. These cities will be examined from the smart cities perspective with current and future applications at different implementation levels. Ideas and instruments will be developed to support their **ongoing or planned smart city projects** at district or city level by introducing participative and long term perspectives.

In a series of workshops, participants' visions, goals and interests will be elicited, compared with each other and contrasted with available data applying participative foresight methods and group model building techniques. Tools such as a GIS and a system dynamics simulation model will be developed to support the planning process, allow the integration of data and serve as a test-bed for proposed solutions. The systemic intervention and participation techniques will be continuously monitored and systematically evaluated. Moreover, a **stakeholder-based scenario development** process will be applied to envision future developments towards a smarter city and to distil roadmaps for the most desirable scenarios.

Selected city processes in Switzerland and Russia among them Winterthur and Zurich, Moscow and Kazan which are all closely linked to the Smart City concept, will be supported by tailored **vision-building**, **scenario development**, **system thinking techniques** and simulation tools. In a first step, the prevalent situation concerning planning processes and instruments in the participating cities will be addressed with a specific focus on smart city objectives and current ongoing projects (e.g. stakeholder involvement, integrating smart energy concepts such as smart housing, smart grids, micro hubs in ongoing city and district planning and implementation processes). Moreover, we will analyse which planning processes and instruments are actually used to steer future energy provision and city development in participative and integrated manners, such as the interdepartemental management teams in the city of Winterthur spreading vision-seeds to come up with a variety of smart city scenarios.

Keywords: Participative Foresight, Scenario Development, Smarter Cities, Stakeholders, Vision Seeds

2 INTRODUCTION TO THE PARTICIPATIVE FORESIGHT APPROACH IN SMART CITIES

In recent years, the concept of "smart cities" gained increasing importance as several initiatives, networks and projects were realized (Caragliu et al. 2011). However, the concept and its targets are still diffuse, and it is rather unclear how it can be implemented in the current administrative planning routines of cities. Many smart city projects still focus on single measures in the areas of mobility or smart housing and fail to provide systemic local solutions (Moser et al. 2014). In addition, smart city projects have shown that a systemic, integrative view is demanding and that the participation of the local stakeholders and the incorporation of their knowledge can be improved – for instance through vision-building, scenario development towards smart cities, and the realisation of their respective roadmaps.

Finally, there might be different barriers and drivers, which hamper the implementation of smart city concepts. To tackle these challenges of smart city approaches, a joint research project of ZHAW and HSE aims to develop services and tools for systemic planning and implementation. To this end, a variety of smart city processes at different stages will be selected within the scope of the proposed project. Through vision-building, scenario development (cf. fig. 1) and roadmapping, system thinking methods and the implementation of GIS and system dynamic simulation tools, the authors would like to improve the outcomes of smart city projects.

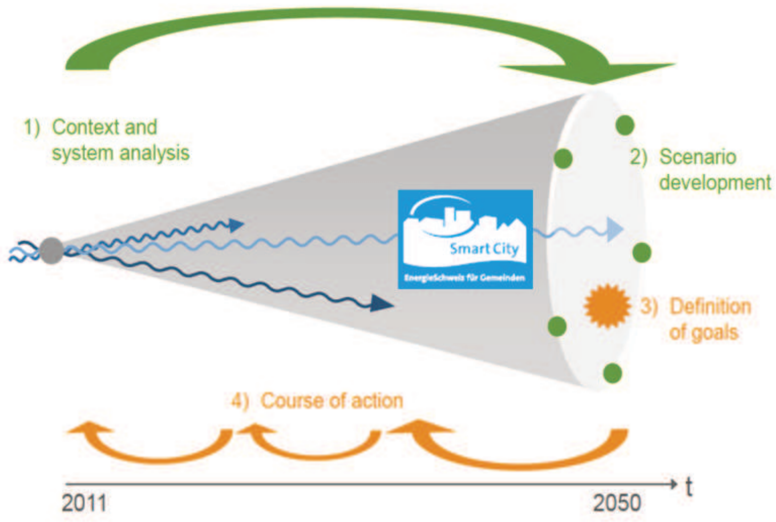

Fig. 1: Scenario development towards smarter cities (scenario trumpet from Bernath et al., 2012)

Therefore, the project has three main goals:

(1) to deliver integrated planning principles (incl. vision-building, scenario development, system-dynamic modelling, roadmapping) for policy-making support through participative foresight;

(2) to empower stakeholders and to support the planning and implementation of projects at the local level to advance the integration of comprehensive smart city solutions;

(3) to derive scientific, profound conclusions about promising approaches for implementing smart city concepts (policy formulation) in existing planning and implementation routines.

Carabias et al. (2012a, 2013) see strategic and technology foresight as a means to manage inclusion of different stakeholders' perspectives in providing solutions, to steer and adapt innovation systems in response to grand challenges, and to support the development of smart specialisation strategies to generate robust Science & Technology and innovation agendas in a globalised era.

We want to explore and compare if foresight has the potential to function as a means to face politics and not turning away from critical issues that will determine and influence our future. The research will investigate if foresight can in fact provide some room for articulation to address even complex and technologically sophisticated issues. Furthermore, the identification of best practice models from empirical evidence will support other foresight practitioners to contribute to more transparency in the debate of critical future issues, such as the progressive development towards smarter cities.

2.1 Empowering of stakeholders and process support

When visioning and developing scenarios for smarter cities, therefore designing and applying group model building moderation techniques together with stakeholders (i.e. representatives of research community, city administrations, local energy suppliers, companies, NGOs and the local inhabitants), important systemic solutions should be identified and visualized. In a series of workshops, participants' goals and interests will be elicited, compared with each other and contrasted with available data applying group model building techniques. Facilitators guide the stakeholder group through the workshops and monitor the process without intervening on the content level. Tools such as a GIS-model and a system dynamics simulation model will be developed to support the moderation, allow the integration of data and serve as a testbed for proposed solutions (smart solution simulation lab). A first version of a system dynamics simulation for the transition of regional energy systems (called TREES) is currently under development at the ZHAW.

2.2 Derive profound conclusions

The single interventions and the process advancement will be continuously monitored and evaluated. The research consortium will meet and discuss intervention design, results and process improvements in separate workshops. At the end of the project, the pros and cons of the future-oriented and system thinking approaches will be evaluated from the point of view of the different stakeholders. Different dimensions of impacts will be considered for the evaluation: effects on the individual, group, organisational and methodological level (Rouwette et al. 2002). The evaluation results will highlight benefits and limitations of system thinking approaches for Smart City planning processes and similarities to other transition processes (Ulli-Beer, S. 2014a/b) and will be disseminated through publications and presentations at events.

2.3 Deliver integrated planning principles

The project will devise **services** and **tools** for an integrative approach for Smart City planning. An **implementation roadmap** supporting a participative and integrative perspective on Smart City urban planning will be developed. It will provide information for major stakeholders in a user-friendly manner. For example, changing roles of different stakeholders within a changing environment of a Smart City will be discussed and new business models for specific applications will be highlighted. It will be based on the overall research results and learning from all cases and projects. Fig. 2 depicts the envisioned smart city process.

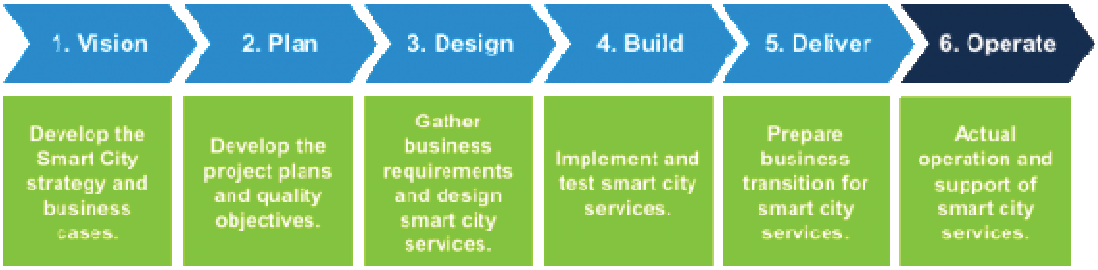

Fig. 2: Smart City Process and project procedures (EPIC, 2011)

APPLIED METHODOLOGY

The research methodology will include desk research, participative foresight, incl. scenario development, modelling and simulation, local case studies, futures analyses, roadmapping, stakeholder workshops and survey, expert validations.

Desk research: Literature and Internet research will be conducted to screen current and planned policy as well as recent academic and practitioner-oriented publications, investigating the development of smart cities through the combination of most appropriate action areas and elements from behaviour change programmes, business initiatives, policy measures, strategies, concepts, and technologies. Based on this, the scenario development for smarter cities will be prepared with the identification of the relevant subsystems and impact variables but also the indispensable stakeholders.

Case studies: The case studies will serve, amongst other, as empirical basis to refine the framework for ideal-type participative foresight for smarter cities. For the local exemplary case studies, a short period of field research will be undertaken, consisting of interviews with local stakeholders; attendance at meetings and events; and analysis of relevant documents, promotional material and websites in order to identify also important context factors.

Case studies of specific projects identify a variety of rationales amongst participants, whilst policy interest suggests a more instrumental concern for facilitating additional, larger-scale sustainable energy transitions. Bottom-up, community-based projects deliver energy savings and behaviour changes that top-down policy instruments cannot achieve, due to the greater local knowledge and engagement they embody (Hielscher et al., 2011).

Scenario development: A scenario can be defined as a description of a possible future situation, including the path of development leading to that situation (cf. fig.3). Scenarios are not intended to represent a full description of the future, but rather to highlight central elements of a possible future and to draw attention to the key factors that will drive future developments. Many scenario analysts underline that scenarios are hypothetical constructs and do not claim that the scenarios they create represent reality.

Stakeholder Validation: Project findings shall be evaluated / validated by stakeholders (representatives from policy, practice, industry, and academia) participating in expert surveys creating awareness of the importance of broader drivers and barriers behind the implementation of low carbon technologies and smarter cities. Additional expert validation will be ensured through stakeholder workshops and interviews to elicit visions for smarter cities. Moreover, surveys are already a way of disseminating project findings and usually initiating the knowledge transfer.

Roadmapping: The roadmap methodology itself is based on four key questions: (1) what is changing in the domain of smart cities; (2) what is the future vision for smart cities based on the developed scenarios; (3) what are the challenges and gaps to be addressed for realizing the vision; (4) what are the niches of novel solutions to the envisaged gaps and challenges. The innovation roadmap methodology is based on Könnölä (2007) and considers four dimensions of upcoming trends: technological changes, business changes, policy changes, and societal changes.

2.4 Comparative case-study approach

In order to develop, test and evaluate such system thinking approaches and tools, a comparative case-study approach has been chosen. Selected city processes in Switzerland and Russia among them Winterthur and Zurich, Moscow and Kazan which are all closely linked to the Smart City concept, will be supported by tailored vision-building, scenario development, system thinking techniques and simulation tools. The following case-studies will be supported and analysed:

2.4.1 Case-study Winterthur with smart city projects

- A simulation platform (based on the TREES-model) will be refined and applied in order to analyse new promising business models and new roles of energy suppliers of smart cities, taking into account the changed business environment of utility companies. This applied research activity supports the planning of future smart cities projects focusing on smart energy solutions in Winterthur.
- The Thalgut-Quarter in Winterthur is a residential area of 260 apartments initiated and managed by three different social housing cooperatives. Most of the buildings are low or three-stories high and were built in the 1950s. Accordingly, there is a need for smart retrofitting. Currently, an initial design plan was developed.
- Analysis of smart metering data to determine the factors explaining the levels of electricity consumption and load profiles. Exploring the role of social interaction in triggering active participation in energy conservation and behavioural change.

2.4.2 Case-study Zurich with an initial project set-up

- The city of Zurich supports the implementation of a 2000 Watt society. So far the concept of smart city has been initiated but has not yet fully taken up. With the participative foresight approach the smart city activities shall get a boost.
- IBM Switzerland and the utility ewz are interested to move towards a smarter city of Zurich.
- ZHAW is involved in setting up the process, introducing to the concepts of smart city and participative foresight.

2.4.3 Case-study Moscow with smart city projects

Smart city applications in Moscow have four main pillars:

- Quality of Life: In the areas of healthcare, education and social protection (techn. sensors)
- City Management: To achieve public service quality and promptness. For instance, smart traffic management system with intelligent parking using a dynamic pricing system depending on the congested zones and times, monitoring the state of the municipal facilities
- IT Infrastructure: Provision of equal broadband access to the modern ICT environment and creation of favourable conditions for the development of the local ICT industry

- Media and Advertising: Enhancement of the level of information availability to public; city information products popularization and quality upgrade

2.4.4 Case-study Kazan with smart city projects

Kazan is one of the largest and industrial cities of Russia. The city aims to be an international business hub with ideal living and working conditions. Kazan has recently started a large Smart City project on a 598 ha area with 220 investment projects. Being one of the examples of holistic and urban planning, the project is designed with sustainability and modern infrastructure solutions, including a 88 ha of parkways and waterways, water reuse and infrastructure systems.

Among the future potentials for smart city applications identified by the HSE for Russia include:

- Autonomous and/or alternative sources of electric & heat energy generation in cities (micro grids)
- Smart (innovative) motorways built with nano-particles in asphalt for increased grip, durability under extreme weather conditions, and lower noise
- Technologies to improve microclimatic and ecological conditions for living, working, production and storage
- Smart navigation and time management technologies for public transport
- Smart and environmentally friendly food packaging and pneumatic transport of solid waste

3 CONCEPTUAL APPROACH

3.1 … to participative planning and implementation

The first project step will address the prevalent situation concerning planning processes and instruments in the participating cities with a specific focus on smart city objectives and current ongoing projects (e.g. stakeholder involvement, integrating smart energy concepts such as smart housing, smart grids, micro hubs in ongoing city and district planning and implementation processes). The following research questions shall be addressed: Which planning processes and instruments are actually used to steer future energy provision and city development in participative and integrated manners? What are their strengths and limitations? An overview on challenges of integrated planning of smart energy futures and smart city development approaches is expected.

Close contact will be established with relevant meta-evaluation and information exchange programmes on a regional, national and European level.

3.2 … to integrative modelling and simulation for smarter cities

In the second step integrative planning support tools will be developed such as system dynamics models in order to visualize important interactions of systemic solutions, target states and different implementation pathways, also highlighting major drivers and barriers of smart city districts development patterns. The systemic understanding of the stakeholders, the multi-dimensional and multi-level (district) development objectives will be represented in the modelling and simulation tools. In an iterative process, the inputs of the stakeholder workshops from other WPs and case-studies will be utilized to improve the use of and further develop the simulation tools in Winterthur, Zurich, Moscow and Kazan. The modelling tools enhance the understanding of decision-making criteria and goal conflicts. The result of this process will provide the stakeholder with data supporting the decision-making (including information on financing structures and future business models). Research questions comprise: Can system thinking approaches, spatial modelling and simulation of city districts support smart city planning and implementation projects? How should such tools be applied and improved to enhance stakeholder involvement? At the end of this step an integrative modelling and simulation of city district development will be completed.

3.3 … to scenario development: validation of steps towards a smarter city

The purpose of the third project step is to evaluate the conceptual model and context-tailoring measures determined in previous project activities by exploring the realities of an established or planned smart city. Stakeholder workshops will help to validate the findings from previous research on a specific local level. The exemplary case studies in the field will make it possible to detect the relevant barriers and the drivers along

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the paths towards implementing a smarter city, such as in conjunction with local planning processes, socio-economic framework conditions, and scenario development for future smart solutions while acknowledging the influence of context factors.

Different scales of case study (cf. Stauffacher et al., 2012; Scholz et al., 2002) will be considered that can either be rolled out at local scale, or that can be replicated across a city or are larger scale projects that will have a regional impact (e.g. smart metering). Amongst other, the exemplary case study will serve as empirical basis to refine the framework for ideal-type participative foresight for smarter cities. To sum up, the case study will allow for a comprehensive analysis of how drivers and barriers interfere in the development towards smarter cities.

Moreover, paths for smart city scenarios will be explored to shed light on future uncertainties and options. Today a scenario can be defined as a description of a possible future situation, including the path of development leading to that situation. Scenarios are not intended to represent a full description of the future, but rather to highlight central elements of a possible future and to draw attention to the key factors that will drive future developments (cf. fig. 3).

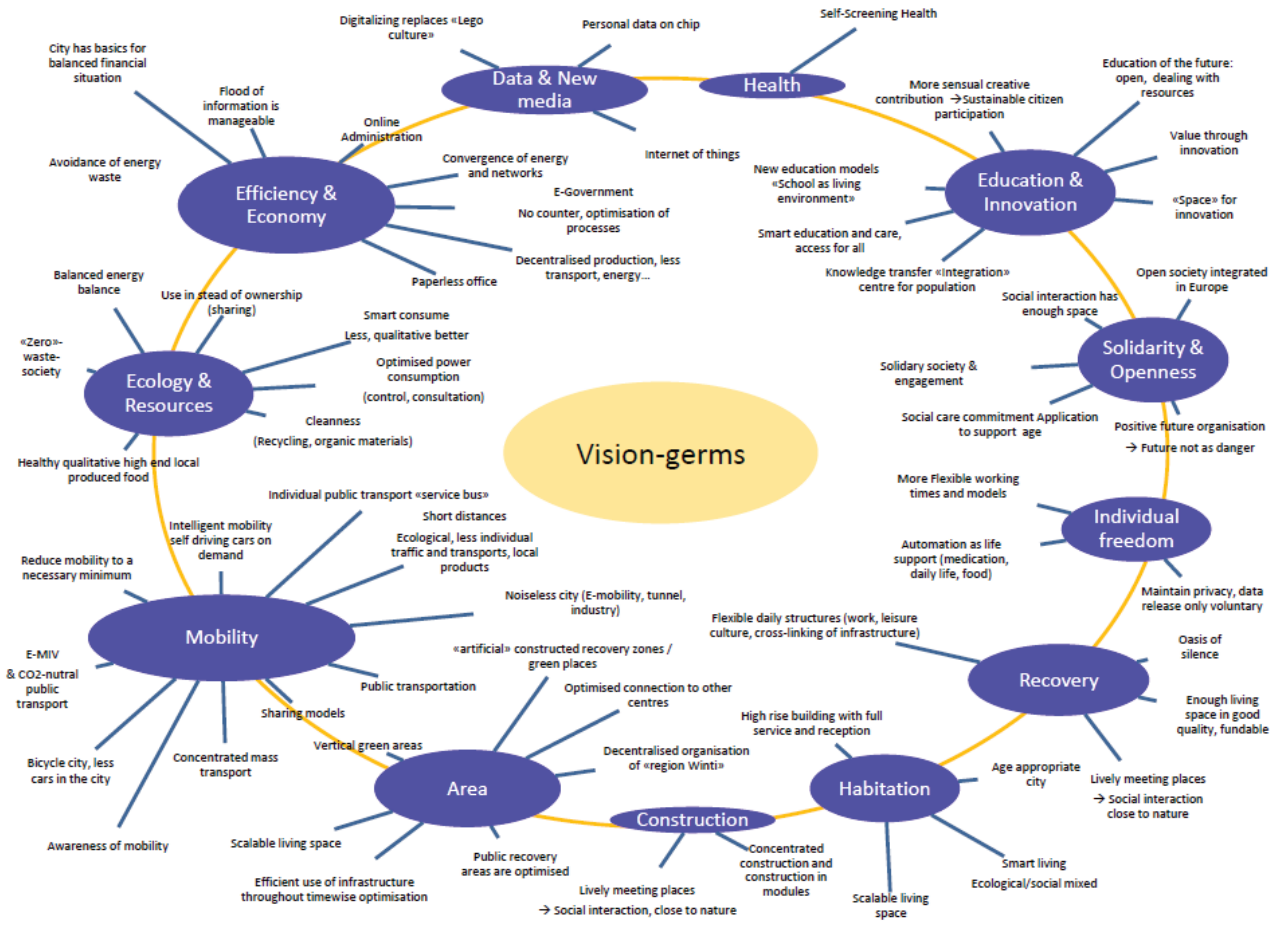

Fig. 3: Vision-germs for Smart Cities discussed in a city management group (own picture)

As final product of this project step an over-all case-study report will be delivered on the support to cities that take pioneering measures to progress towards a smarter future, describing the developed scenarios and its assessment against plausibility and desirability.

3.4 … to roadmapping towards smarter cities

This working step will address the strengths and limitations of the chosen system thinking approach with regards to systemic smart city planning and implementation, considering different planning and implementation levels and objectives. Recommendations will highlight new elements concerning urban planning routines and the role of participative foresight and modelling. A scientifically sound evaluation of the chosen approaches will be the basis of this analysis. The main insights will support the development of a generic implementation roadmap that will be illustrated with project examples.

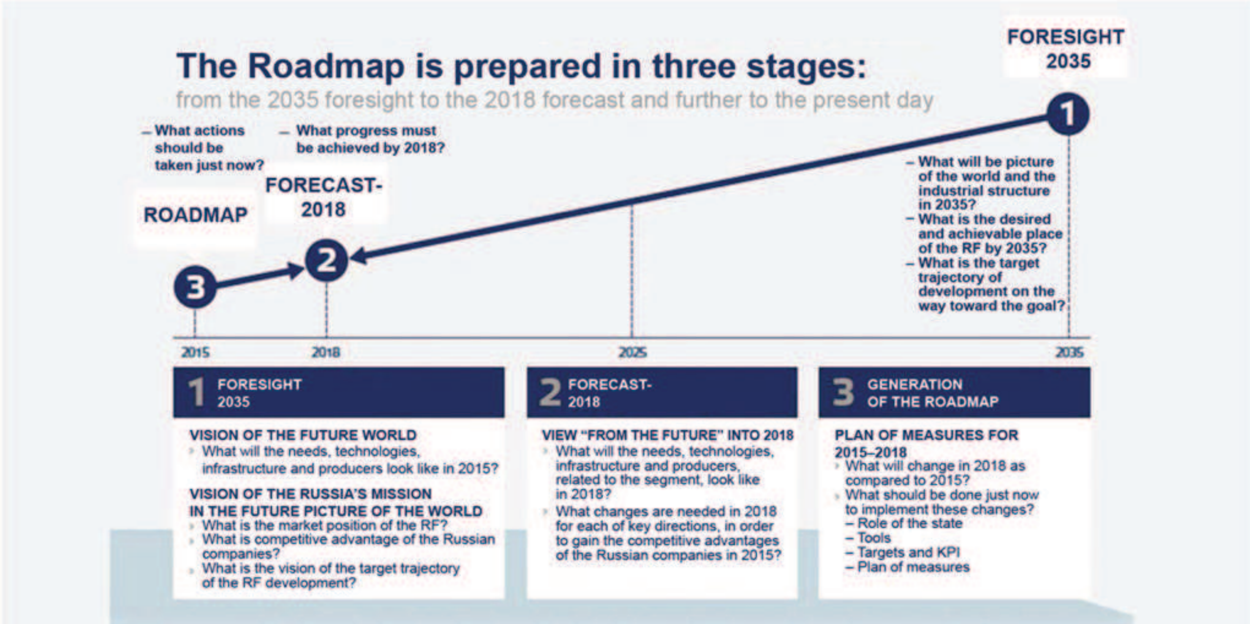

Fig. 4: Roadmapping approach proposed by the Russian National Technology Initiative (2016)

The roadmap will provide systemic visual presentation of key areas of smart-city development taking into account challenges and windows of opportunities, as well as a set of potential alternative innovation trajectories of "smart city" development in the four selected cities. Recommendations for implementation will include the decision-making criteria, financing structures and promising business models.

Therefore the following research questions will be addressed: What are the strengths and limitations of system thinking approaches and tools for planning and steering smart city projects? What are the lessons learnt from each case-study? Finally, stakeholder recommendations on urban and energy planning routines, and on implementation of roadmap are expected.

Successful transfer of smart practices requires an understanding of the cultural conditions for and barriers to the transfer of practices from one context to another. This working step aims to provide such understanding by combining practical experiences from the case-studies. Context is therefore defined in the broadest possible sense. It entails, among others, culture on the level of a country or city, culture on the individual level of people's specific positions and ways of life. By looking for those practices that have worked pretty well, one tries to understand exactly how and why they might have worked, and evaluates their applicability to one's own situation.

Investigating the regional framework conditions, strategies, concepts, and context factors will result in recommendations on appropriate policy measures facilitating the development of smarter cities and for decision makers on how to design an effective roadmap towards a smarter city.

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🏆 *reviewed paper*

Planning of Smart Government of Belgrade

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1 ABSTRACT

Today cities are becoming ever more complex systems with vast amounts of data flowing through various channels of our societies. By adding layers and layers of complexity, we as individuals become more disoriented in the vast amount of available information, possibilities and choices. It is only when we are able to structure this information and data into meaningful patterns, can we find ways to understand and cope with the issues at hand. Whether it be seeking employment, better education, cultural events or trying to solve complex issues at a larger scale, similar principles apply. Cultivating a community and bringing people together represents one of the most important aspects of how we choose to use these tools/technologies to make an impact on cities and the globe. The process of building a web application/digital platform should be based on MVP – Minimum viable product, which means that the product should be put into function as soon as possible and tested with minimum investments in time and money. The reason for this is also a better way to find a path to potential users and to make corrections early on, to get rid of needless categories, or to add and develop new applications for the platform. The first phase of the project includes making a map with hyperlinks, pinpoints and other tools which ensures the efficient mapping of start-ups, collaborative spaces, cultural events, etc, so that users can easily search and get information.

Authors of new platform - students of Master class named "City and Design" at the Faculty of Architecture University of Belgrade, under the menthoring of Prof. Dr Eva Vaništa Lazarević represent newgrowing young specialists; those who will be responsible for the development of cities in the 21st century, new soft leaders which should be soon incorporated in planning of smart government of Belgrade.

Keywords: Belgrade, modelling, planning, Serbia, smart governance

2 SMART GOVERNANCE FOR NEW PLANNING[1]

Striving for a single EU market, which Serbia is entering in the years to come - means guaranteeing labour mobility in the era of crisis, reducing barriers for the entry and exit of companies and eliminating unjustified restrictions for business and professional services. For EU public administrations there is intention to improve digital exchanges between administrations and enterprises as well as citizens, to rolling-out E-procurement EU wide, to promote the use of public sector information, to open public data and to implement trans european services. In a word to develop EU wide on line service and to modernise public administration.

Working together even closer – we are all coping with today's complexity and pace of changes in a context of constrained resources which requiers integrations of diverse insights, experience and expertise, cooperation from different organisations. Though, the main topic of smart governence is to tailor workflows to citizens and businesses which need extensive process overhauls across administration but also, in Serbia, to battle against a coruption and to work under the absence of strict EU laws, not yet implemented in practice.

Although, there is in fact a high level of E-environmnet in Serbia, thanks to globalization & fast implementation of digital Era as well as the presence of smart and inteligent highly educated people. In Serbia we can endeed notice a "Silicon Valley Syndrom" as it was once in Dublin or Tel Aviv - but, unfortunately, with a significant exodus of educated young people to abroad. That younger generation is in fact a real auditorium for smart governence, and a gap between generations can be easily concluded as a

[1] Abecasis, Margarida: "Smart Government means being enteroperable"; E-Government Conference, Nicosia Cyprus, 2012.

problem. Big data, however - has no limits – so there is intention to achieve a full level of smart goverenence in Serbia, especially and primarily in the context of social data.

3 SOME RAW MODELS

Planning of the smart cities must be oriented on a practical application of adaptive management and integrated development. In the context of overall economic and environmental crisis a detailed analysis of the potentials and needs of existing urban infrastructure, public spaces and its users is needed. There is a growing recognition among city leaders in the developed economies that smarter approaches represent a goal to address the challenges which confront society, to improve the efficiency of public service delivery, the sustainability of the urban environment, and the quality of life in our cities. Furthermore, these cities are using smart concepts to enhance their locational competitive advantage, promoting their sustainable and smart credentials to attract new business and talent. It can be achieved with smart advertising, creating more opportunities and building stronger communities. The advertising message aims to be detected, understood, remembered and to direct to a specific type of behavior characterized by specific types of functionality. One of the most important instruments and tools that advertising message uses is a mechanism of persuasion. Each advertisement is in fact the message: it has a sender (company, which owned released and acclaimed product) and the recipient - the public, as well as the transmission channel, which is called advertising medium. In smart cities advertising medium can be mobile application, internet sites, programs etc.

By simulating city in virtual reality, with interactive maps found on your phone, you can easily access all needed data for your planned activities. Jean Baudrillard[2] shows that media simulation and staging the event is a key to "historic triumph of the West." Postmodern for Baudrillard means that "civilization has overcome its boiling point, it is now getting cold."[3] It survives, and many things are taking place, but nothing is happening any more. There are no more events, and if they take place, then it's just a simulation of them. By simulating real city in virtual reality we have to be careful not to be trapped by it. With an integrated vision and mapping, all the massive information generated by the city (residents, services and infrastructure) in real time, providing valuable information for citizens, Smart cities are improving their quality of life and generating wealth.

From some raw models of Smart cities we selected those ones which could be a basis for the suiting and adjustment:

(1) Singapore city (fig.1) is building a Smart Nation that will function beyond the capabilities of Smart City. It is the only country thus far with a national impetus to leapfrog the smart city concept and build a Smart Nation. Their strategy is to establish an ultra-high speed, pervasive, intelligent and trusted infocomm infrastructure and to develop a globally competitive infocomm industry. This platform will create additional jobs, and their goal is to be #1 in the world in harnessing infocomm to add value to the economy and society.

Figure 1. Singapore

(2) New York as the oldest „Smart City“ in the world – government of this city began to develop computer controlled system of the city in the early 1990es. Today, two smart platforms are working simultaneously in

[2] Baudrillard, Jean: “Transparency of Evil”, (orig. “Prozirnost zla”), Svetovi, Novi Sad, 1994.

[3] Logroño, capital of La Rioja, has been chosen as “the best city to live in Spain” by Merco Ciudad 2010 research, managing by Justo Villafañe, Professor of the Complutense University of Madrid. Besides, it is ranked among the Best Ten Spanish Cities for studying and enjoying.

NY – Cisco and City 24/7. Furthermore, in NY computer program was developed a platform to fight street crime so now this metropolis has become the safest city in the United States.

(3) Amsterdam is the first smart city in Europe. Since 2000 companies such as Philips, Cisco, IBM, computerized almost all spheres of activity of citizens. A smart city is filled with data streams. Smart meters read how much energy people use; cameras follow cars on the highway; mobile operators can follow their users constantly; and banks know exactly who buys what, where and when. Amsterdam Smart City (ASC) is positioned as a partnership between businesses, authorities, research institutions and the people of Amsterdam. Under the initiative, the Amsterdam Metropolitan Area has been set up as an urban living lab that allows businesses to both test and demonstrate innovative products and services.

(4) Karamay (fig. 2) is the first smart city in the Xinjiang Uyghur Autonomous Region of China. The distinctiveness of the Smart Hub concept is focus on the integration of all the devices into a single information network, and continuously informing the citizens about all aspects of city life. For example, each bus stop in the city is equipped with a computer screen, which shows the movement of all buses in the area. Road traffic is monitored with the help of thousands webcams, and each one of them can be connected by mobile phone.

Figure 2. Karamay, China

Figure 3. Seoul

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(5) Smart Seoul 2015 (fig. 3) takes a slightly different approach by being more people-oriented or human-centric. With this latest strategy, Seoul aims to implement as many smart technologies as possible and also to create a more collaborative relationship between the city and its citizens. Eun-pyeong u City project (district of Seoul): smart city connections enable residents in the district to receive practical information via smart devices on their living room walls. In the interests of residents' safety, intelligent CCTV cameras installed on every street corner automatically detect people trespassing on private premises. If a person with a disability or an elderly person carrying a location detecting device leaves Eun-pyeong or pushes an emergency bell on the device, their location is automatically sent to their guardians via text message. The city's high-tech street lamps reduce energy use, broadcast audio and provide residents with wireless Internet access. A digital newsletter provides news, the bus schedule and other practical information to residents and visitors. Finally, the city's u-Green service monitors factors such as water and air quality through a network of sensors, transmitting this information directly to the Media Board and the devices in citizens' living rooms.[4]

(6) Another example is SmartAppCity, which was piloted in Spanish city Logroño,[5] brings together all the city services, boosting the commercial sector, generating value to citizens and improving the quality of life. In this application, city shops and businesses will offer their products and services and government will open data to serve citizens. SmartAppCity is the application that brings together all the city services and information on cloud, boosting the commercial sector and generating value to the residents, tourists, public administration and local businesses; facilitating interaction between different agents and generating added value for decision-making and citizen participation.[6]

As we can see, there are endeed some excellent smart international practices that Belgrade can follow and learn from, adjusting the goals and methods to actual conditions in order to preserve cultural identity, as well as the concept of the existing modern city, its user groups, aesthetics and philosophy, the potentials to preserve the physical structure, but also to recognize ways for reprogrammation as a part of the continuous and sustainable planning process.

4 PROPOSAL FOR SMART GOVERNANCE IN BELGRADE: BELAPPGRADE PLATFORM

In the age of the forth industrial revolution and intensive digitalization of the world, architecture and urbanism will have to respond to these newly established challenges. These technologies are changing the way we live and work, how we learn and communicate, and they also represent new tools that can be used to make an impact in our world. The power of internet brought us the opportunity to scale and spread our ideas, products and services throughout the world. Big data and data mining are giving us opportunities to collect and analyze vast amounts of data, thus giving us an insight into the factual state. Predictive analytics enables us to form new patterns or models and apply them accordingly to improve our cities.

For cities to attract top talent and foster creativity, they have to adopt a set of strategies that will insure the influx of creatives and engineers. Some of these include efficient administration which is able to serve citizens and satisfy their needs, open policies of inclusion and participatory processes, opening the data for analysis and experimentation, enabling a network of collaborative and cooperative spaces, making an ecosystem for innovation and entrepreneurship, creating incentives and tax breaks for newly established enterprises, better connectedness with the world, diversifying community etc. Within these frameworks entrepreneurship, creativity and innovation can be developed. Another part of this equation is a cultural dimension. Culture represents a way to bring people together, to nourish intelectual, emotional and spiritual sensibility, which are directly connected to innovativeness and creativity. A city must also be a cultural hub in order to be an entrepreneurial hub, offering its residents vibrant life and interesting content.

Traditional architectural practice has not yet shown the capacity to adapt quickly and integrate new technologies into its business model. It is especially true for the practice of urban planning and design. Considering that big data, data mining, predictive analytics and various other technologies will have a vast impact on how we think and plan our cities, we have to find new ways to integrate these methods into our

[4] https://itunews.itu.int/en/4148-Smart-Seoul.note.aspx

[5] Logroño, capital of La Rioja, has been chosen as "the best city to live in Spain" by Merco Ciudad 2010 research, managing by Justo Villafañe, Professor of the Complutense University of Madrid. Besides, it is ranked among the Best Ten Spanish Cities for studying and enjoying.

[6] https://eu-smartcities.eu/sites/all/files/docs/best-practice/smartappcity_english.pdf

practices and use them as tools to enhance our living environment. We, as architects and urban planners, have to define new frameworks and work within them to achieve our common goals.

belappgrade
Create playful future.

Figure 4: BELAPPGRADE logo.

This is what propelled a group of students from the Faculty of Architecture and the Faculty of Electrical Engineering from the University of Belgrade to initiate a project called Belappgrade. (fig. 4)

The aim of this project is to create a digital platform in the form of a web application that maps different places in the city such as startups, collaborative spaces, cultural events, public art etc. Our mission is to promote entrepreneurship, innovation and creativity in Belgrade, the capital of Serbia. In order for us to start and develop this project, we had to adopt an entrepreneurial mindset and form an interdisciplinary team of students that was able to tackle all the issues that emerged. We used entrepreneurship as a modality through which we created a sustainable framework and dynamic process of creation, so that we could realize our project efficiently. We applied the principles of Lean Startup6 and based a product on MVP – Minimum viable product, which stands for a product built with minimum investments in time and resources and put into action as soon as possible to be tested. The digital platform was made with high levels of flexibility and adaptivity so that it can be easily changed to fulfill the users' requirements. The potential users of this app are students, job applicants, organizations, companies, and other individuals interest in these topics. Since it is not always possible to predict who the exact users of our application will be, it is reasonable to assume that changes are inevitable. The concept of an open platform can take significant amounts of data and information, and allows a participation of different companies, organizations and partners, as well as a gradual integration of all important aspects. The application consists of two major categories: Startups and Culture. These reflect the core values that we've adopted in promoting the city and informing our users. Within the category of Startups you can find subcategories that include mapped companies, collaborative spaces, events such as conferences and meetups, and job offers. All of the startup companies in the city are mapped and contain basic information about them, along with contact info, addresses and links to their profiles on social networks. Collaborative spaces include entrepreneurial and innovation hubs which serve to provide spaces work teamwork, offices and workshops. Events include conferences, meetups and workshops. Companies can also register, log into their profiles and post job offers to potential job seekers in the job offers category. In this category user can click on the name of the company, search for a suitable job, and then apply with a CV template through our web application.

Figure 5. Belgrade, Serbia

In Culture category subcategories are divided between cultural events that include workshops, exhibitions and gatherings, public art which includes different kinds of performances, urban art, graffiti etc. There is also a possibility for organizers of these events to add them to the platform by clicking on ADD EVENT, and then filling a form with description and info, and sending it to the administrators.

This platform offers great opportunities to connect physical places to potential users and inform them about possibilities and activities. Integration of different options, filters, criteria on an interactive map, has the objective to empower users with wider range of opportunities and make a quest for information much easier. We aspired to achieve a balance between providing good quality service by preserving the initial goals on one hand, and on the other making an interesting interactive usage so that platform can stay active for a long period of time.

5 CONCLUSION

We are seeing major transformations that are occurring in Europe and the rest of the world. Migrations are changing the face of Europe, mobility is becoming more common everyday, densification and resource consumption are developing fast. Information technologies are changing the way we live, work and communicate with each other. It is in these circumstances that we have to create new frameworks for action and use our knowledge and skills to make a positive impact in the cities we live in. We must find ways to use and integrate technology and innovations as tools in the process of urban planning, urban design, city management etc. Smart cities require smart people who are able to coordinate and articulate transformations on ecological, economic and socio-cultural level.

With the growing population of today’s cities one of the most important aspects will be efficient integration of these people into the system. Also, precise information will provide a strong feedback to the administration and urban planners and it can, thus, be used to inform the decisions made by these actors. The systems that insure a good feedback channels are able to build frameworks that enable participatory processes and more democratic distribution of resources.

In the world of rapid transformation and changes, what other way to cope with the issues than to use the resources and technologies available to all of us in order to understand at first, and then act accordingly to provide solutions to the problems and enhance our living environment. Concepts such as big data and predictive analytics enable us, among other things, to distinct relevant information from vast amounts of data and recognize meaningful patterns. And it is only when we are able to detect meaningful patterns and organize them into well structured models, we can make informed decisions and integrate these conclusions into our plans, concepts, models of development, designs etc.

The progress that was made in the last few decades in the areas of information technologies, but also in other areas, should be seen as a great opportunity to incorporate them and form interdisciplinary teams of experts that will contribute with their unique set of skills and knowledge. Transcending the boundaries of each profession individually so that we can get the best results will be one of the priorities in the near future and it should be embraced as a possibility to secure a good position for our knowledge and skills as architects and urban planners in the ever changing world.

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Figure 1. http.//learstream-events.com/gsf-conference-singapore
Figure 2. http://www.atkinsglobal.com/~/media/Images/A/Atkins
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Figure 4. logo of the student’s asociation
Figure 5. http://partytrail.com/belgrade-serbia/

reviewed paper

Portable Streets: Smart Urban Solution

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1 ABSTRACT

Throughout the last few decades, smartness has witnessed several forms and approaches. "A smart city is an urban area that creates sustainable economic development and high quality of life by excelling in the urban environment, society and economic conditions" (UNECE 2014). In relevance to an interview with Jaime Lerner " Green cities on the cheap: Low-cost solutions for a sustainable world"; Lerner mentioned "when we realized that 75 percent of car emissions are related to the cities, we realized we can be more effective when we work with the concept of the city. It's through cities that we can have better results". He although mentioned to what he called "portable streets", to create an informal and spontaneous market street life. There are a number of different routes through which smart urban solutions form could potentially be achieved. The paper will review several solutions in relative to low-tech smart urban solutions; as a step which might make in moving urban development closer to a smart urban form. As an effective study, the paper will discuss some examples in order to highlight the importance of "portable streets". This paper therefore, investigates the advantages of this approach as a sustainable and smart urban solution. The result of this research will be found in a number of recommendations on several levels.

Keywords: Low-tech, Portable Streets, Smart Cities, Sustainable Development, Urban Solutions

2 INTRODUCTION

The Idea of sustainable urban development has been seminal and highly significant among intellectuals and policy makers in the 1990s.[1]

" The city is not only a space where structures are placed and where life is lived. Indeed, the city is a vibrant and powerful force for development and it is clear that it exerts a tremendous impact on wellbeing at the global, regional, national and local levels."Joan Clos, Executive director UN-Habitat.[2]

Cities are the new hot spots of global environmental change, the leading growth centres of population, consumption, resource use and waste. In cities, everything is closely connected. So problems tend to multiply – and so can solutions. Cities have massive leverage over their ecological footprints, major impacts on biodiversity via habitat loss, pollution, contribution to climate change, over-exploitation of species' populations, and introduction of invasive species. Cities have the option of making smarter choices for housing, transport, energy, green space, water, and waste. Cities must lead the clean energy revolution to combat climate change by supporting renewables, efficiency, smart metering, and green retrofits.[3]

From several viewpoints, city engineers and technology companies view the city as a complex system with multiple layers. Architects and nongovernmental organizations (NGOs) see the city in terms of people, social inclusion, and a sense of space. Government leaders, on the other hand, view the city in terms of economic growth and new or improved city services supported by policy initiatives designed to effect change. Regardless of their viewpoint, most agree on a common vision: make cities smarter and more sustainable.[4]

3 PROBLEM

Cities and communities around the world face intractable challenges, including: Increased populations: More than 50 percent of the world's population lives in cities, placing massive pressure on city infrastructures (transportation, housing, water, power, and city services). Polarized economic growth, Increased greenhouse-gas emissions (GHGs): GHGs are forcing cities to develop sustainability strategies for energy generation and distribution, transportation, water management, urban planning, and eco-friendly (green) buildings. Decreased budgets: The economic climate continues to place huge budgetary constraints on cities, which are

[1] CEDERIC PUCH: "Sustainable Cities In Developing Countries" ,pp. 1-4. UK, USA, 2000
[2] "Smart Solutios for Slums", Corcaid Urban Matters, 2014
[3] "Urban Solutions for A Living Planet", Learning Cases, pp. 2, WWF Summary, WWW.PANDA.ORG
[4] GORDEN FALCONER, SHANE MITCHELL: "Smart City Framework: A Systematic Process For Enabling Smart+Connected Communities", pp. 2-3, Cisco, September 2014

becoming limited in their ability to respond to these pressures. Some scalable solutions that take advantage of information and communications technology (ICT) can be mitigated to increase efficiencies, reduce costs, and enhance quality of life. Cities that take this approach are commonly referred to as Smart Cities, or Smart+Connected Communities (S+CC), a concept highly discussed and often debated in urban planning and city policy circles worldwide.There are number of factors hindering adoption of Smart City solutions: scaling of newer technologies is unproven; technology challenges the existing status quo in how cities are run; and technology is not well-understood across city sectors. However, the main barrier to adopting such solutions is the complexity of how cities are operated, financed, regulated, and planned. Smart Cities, however, present an opportunity to integrate physical city infrastructures—from utilities, transportation, and real estate to city services.[5]

A number of academic studies also explore the fundamental issues of realizing Smart City visions. One recent study, “Understanding Smart Cities: Integrative Frameworks,”13 states the need and the dynamics to consider in developing Smart City strategies. These reports indicate that the debate is no longer about why a Smart City initiative is good for a city or what to do (which available options to choose), but instead about how to implement Smart City infrastructures and services, including the importance of a common language and a structured approach to implementation.[6]

The need to reduce humanity’s ecological footprint to a sustainable level is now an emergency, and to stop the rapid global loss of biodiversity. Cities are now the main growth centres of population, consumption, and resource use, as well as waste. This makes them the new hot spots of global environmental change. More than half the world’s population lives in cities. They are responsible for more than 70% of global greenhouse gas emissions. In 1800, only 3% of humanity lived in cities. At present almost all population growth takes place in cities. According to UN projections, 70% of humanity will be living in cities by 2050. Networks of cities are setting more ambitious goals for greenhouse gas emissions than their governments. Cities are taking independent action, often with innovative solutions, pushing governments to follow. In a survey of 100+ learning cases by WWF, there are cities transforming transport, creating walkable and livable environments with better air quality. There are cities protecting nature, taking advantage of ecosystem services vital for water supplies, food security, adaptation to climate change and resilience. We find cities that use waste as a resource, sponsor sustainable consumption through green purchasing, and develop urban farming. There are cities investing in smart grids, and in energyefficient housing. And there are cities promoting renewable energy with regulations, subsidies, and tax relief.[7]

4 SMART CITIES AND SMART URBAN SOLUTIONS

The Idea of sustainable urban development has itself been developed since the mid-1990s. By the late 1990s it is recognized that the scope of this is simultaneously in the economic, the social, the political and the environmental. From a perspective of historical and developmental change, this frequently means that ‘sustainable development’ is in a continuing state of flux that expresses outcomes of the dialectic between the economic, the social, the political and the environmental. To sum up, we can describe the idea of sustainable development as a range of different patterns of growth and social change that are environmentally and socially better than alternative patterns.[8] But as it is mentioned in the research problem; Cities and communities around the world are now facing challenges which needs smart solutions in many levels in order to lead cities to be smart.

4.1 Defining Smart Cities

There is no unique definition for a smart city. The interpretations and definitions used by different interest groups, stakeholders and regions vary. The impression is often that a smart city is the same as a digital city, and sometimes its meaning is close to that of a sustainable city. While most human activities take place in cities, almost anything can be included within the smart city concept. Smart cities can be seen as systems

[5] GORDEN FALCONER, Shane Mitchell: “Smart City Framework: A Systematic Process For Enabling Smart+Connected Communities”, pp. 2, Cisco, September 2014

[6] GORDEN FALCONER, Shane Mitchell: “Smart City Framework: A Systematic Process For Enabling Smart+Connected Communities”, pp.9, Cisco, September 2014

[7] “Urban Solutions For A Living Planet”, Learning Cases, pp.3, WWF Summary, WWW.PANDA.ORG

[8] CEDERIC PUCH: “Sustainable Cities In Developing Countries” ,pp. 1-4. UK, USA, 2000

with flows of energy, materials, services, people and financing. Moreover, urban planning is closely related to the economic and social metabolism of communities. Identification, integration and optimization of different energy, transport and data flows in city planning and city management are crucial to creating sustainable smart environments.[9]

Although the term smart city is not focusing on single aspects, a further definition requires identifying certain characteristics for the evaluation. Although the term "Smart City" is not very widely used yet in spatial planning literature or urban research, it is still possible to identify various aspects as a basis for further elaboration. As conclusion the term is not used in a holistic way describing a city with certain attributes, but is used for various aspects which range from Smart City as an IT-district to a Smart City regarding the education (or smartness) of its inhabitants. To sum up, there are several fields of activity which are described in literature in relation to the term Smart City: industry, education, participation, technical infrastructure, various 'soft factors'. It should be emphasized that we are currently only able to draw a picture of the present state of a city. Still, the path of development is decisive for a smart city and should be considered in further research that builds on time-series data.[10]

According to Transform (EU FP7 TRANSFORM) a Smart Energy City is defined as follows:

"The Smart Energy City is highly energy and resource efficient, and is increasingly powered by renewable energy sources; it relies on integrated and resilient resource systems, as well as insight-driven and innovative approaches to strategic planning. The application of information, communication and technology are commonly a means to meet these objectives. The Smart Energy City, as a core to the concept of the Smart City, provides its users with a liveable, affordable, climate-friendly and engaging environment that supports the needs and interests of its users and is based on a sustainable economy."[11]

Also according to Caragliu (2009): A city is smart when investments in human and social capital and traditional (transport) and modern (ICT) infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance. As it can be seen, the Smart Energy City has been defined very concrete. This because there has been a need to measure the level of "smartness" and at the same time there has been a need to find some key elements which are crucial for becoming a Smart Energy City; These 8 key elements are:[12]

- Resource system integration
- Access to energy services
- Resilience
- Energy Efficiency
- Renewable Energy
- Active and engaged users
- Sustainable Economy
- Smart Governance

4.2 Smart Urban Solutions

Three new global trends in urban development the 21st century has brought it. The first trend, which has emerged against the background of an international consensus on the need to adopt low-carbon lifestyles on a global basis in response to the threat of global warming, is toward "low-carbon cities" that reduce the amount of CO_2 (carbon dioxide) emitted by urban activity. The second, a consequence of the economic progress happening in the emerging markets of Asia, particularly China, as well as in South America and elsewhere, is the concentration of population in cities and the associated new construction of large cities. The

[9] MIMOAIRAKSINEN, Matti Kokkala, "Smart City – Research Highlights", pp. 6-8, VTT Research Highlights 12,pp.6-8, VTT Technical Research Center of Finland Ltd, 2015

[10] "Smart Cities Ranking of European medium-sized cities", Final Report, pp. 10-11, Center of Regional Science, Vienna UT, October 2007

[11] of Smart Energy City, Becoming a Smart Energy City, TANSFORM report, pp. 4-5, August 30, 2013

[12] Work Package 1: Final Version, TANSFORM report, March 3, 2015

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third is the trend toward health-focused urban development in response to the aging of urban populations in Japan and other developed economies which emphasizes medical and welfare considerations and seeks to eliminate intergenerational disparities.[13]

Innovative and smart solutions are available in some cities while in others the uptake is low because the impacts of these solutions have not been objectively verified and there is a lack of confidence that the solutions can also be applied in other contexts and cities. The development of smart solutions in cities is largely dependent on procurement decisions made by city administrations and local governments. Public procurement plays a key role in creating demand for innovative and smart solutions to urban challenges. Conventional approaches to public procurement are not favourable for sourcing innovative products and solutions from technology supplier firms and service providers. The complexity of the current major societal challenges, in urban centres, demands the wide-scale deployment of solutions and services based on accurate and timely information. This will allow cities to move towards a sustainable transformation while spending less public resources and improving services offered to its citizens. The implementation of a common performance measurement framework based on a set of relevant indicators, open data applications and decision-support user-interfaces enables stakeholders to learn from each other, create trust in solutions, and monitor progress. Urban planning is traditionally perceived as a complex and time-consuming process. Unclear plans, possible misunderstandings and decision-making without stakeholder participation may cause complaints and delays even in long-prepared projects. New visual smart city planning solutions for illustrating urban projects are needed.[14]

5 CONCEPT OF PORTABLE STREETS

According to originally appeared in The Dirt. Jaime Lerner mentioned “Every time we try to create a solution, we have to have a good equation of co-responsibility with the public. That means it’s not a question of money and it’s not a question of skill; it’s how do we organize the equation of co-responsibility? We need to work with low-cost solutions” Lerner added “Some places in some cities have become decayed. There’s no life. When that happens, it’s very difficult to bring back life because people don’t want to live in a place like that. However, the moment we bring street life, people will want to live there again. That’s why we designed the portable streets. On a Friday night, we can deliver a portable street and remove it Monday morning. We can put a whole street life in front of a university or any place, bringing street life back"[15] Lerner also discussed his “portable street” concept, a configurable, moveable piece of hardware that enables storefronts to be set up quickly. Inspired by the many bouquiniste of Paris, his portable streets are being tested in Cracolandia, a “tough” part of Sao Paulo, in an effort to bring back street life.[16] The concept of the portable streets is based on the fact that a large portion of today's cities exists in informality, and that it is necessary to find ways to integrate the formal and the informal sectors. This piece of urban furniture allows accommodating street vendors with quality and comfort, adding a new element to the urban landscape.[17]

Fig. 1: portable street prototype of Jaime Lerner

[13] MICHINAGA KOHNO, Yoshihiro Masuyama, Nobbuyuki Kato, Akihito Tobe, “Hitachi’s Smart City Solutions for New Era of Urban Development”, pp.79, Hitachi Review Vol.60, No.2, 2011

[14] MIMOAIRAKSINEN, Matti Kokkala, “Smart City – Research Highlights” VTT Research Highlights 12,pp.10-20-21-30, VTT;L Technical Research Center of Finland Ltd, 2015

[15] http://dirt.asla.org/2011/03/07/interview-with-jaime-lerner/

[16] https://dirt.asla.org/2012/01/27/jaime-lerner-a-city-is-like-a-family-portrait/

[17] http://www.jaimelerner.com/ruaportatil-en.html

5.1 Portable Streets as a Low Cost Urban Solution

The major attraction of any city is its people, its life and vitality. This is clear as the benches with the best view of public life are always the first ones to be occupied; we can see this in the fact that the cafe chairs all over the world are oriented towards the pavement, towards the passers-by. And when choosing between walking in an empty, deserted street or in a busy street, most poeple by far choose to walk through the busy street, where there is a greater variation of experiences along the way and a greater sense of security.[18] Converting streets into pedestrian zones has become very popular. A project “San Candido a piedi", found better solutions to the pedestrian in public spaces. Creating constant interventions to the city to make it safe, sidewalks and pedestrian paths contribute to pedestrian security.[19]

It is important here to mention that a Market street can be a sustainable design solutions; it was selected as a project topic in the ECOWEEK sustainable design solutions in Copenhagen 2013.

Based on many literature review and projects; it can be proved that streets solutions can bring life to people and to decayed urban places. Altmarkt, Cottbus, Germany in previous time was used as a parking lot, which was not an efficient use. Festivals and activities, brought life to it as most poeple choose to walk where there is a greater variation of walking, buying, interact. Fig: 2, represents photos which shows activities and festivals in Altmarkt; it can be seen that people of the city went to a pleasant place, it’s not now just a street or a big space but a street or space for Walking, sale, purchase, and thus reviving the old trade market. These products are made by people and it represents a kind of commercial activity, taking into account the necessity of being more sustainable while taking note that walking is elemental for mobility.

So here what was meant here is to achieve a range of urban benefits at lower costs, where the ceremony is held or upon the street for a night, for example, or a full day to bring life to the street or to the place creating an informal and spontaneous market street life.

Fig. 2: Night Shots for Altmarkt in Case of Festivals and Activities.

Portable Streets approach indeed is not only a monthly or weekly festival; but a weekly activity for maybe two days also not in square but in such decayed streets. Portable Street approach is based on moveable pieces and furniture easy to integrate with streetscape. Infact it is found previously in some examples like bouquinistes of Paris, also it is be found in arabic countries like Syria and Egypt.

"Cairo University sidewalk" could represent a simple example of portable street, it is a sidewalks bookstore which it's main activity is bying books, but as well it does,nt depend on any pieces but just puting books on the sidewalks.

Fig. 3: Examples of sidewalks bookstore in Egypt and Syria

It is important here to mention to the advantages of this approach:

- As Portable Street is a quick and easy solution to make a better life in the street in wich is found.

[18] MALCOM MOOR, Jon Rowland, “Urban Design Futures” pp. 70, Routledge, USA, 2006
[19] http://landarchs.com/how-to-reduce-vehicular-impact-in-a-city/

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- It brings life and activities to decayed streets and urban places which serve in the urban development of the city without costs.
- It des'nt need any procedures, insurance or ay birocratic processes to be done.
- It could be oriented to various kinds of products which can represent a source of trading for the street residents.
- It does'nt influence on traffic mobility as it depends on pedestrian mobility.
- It serves in and develops the social interaction between the street residents.

6 CONCLUSION

Cities and communities around the world are facing intractable challenges. The need to reduce humanity's ecological footprint to a sustainable level is now a must. Cities are now the main growth centres of population, consumption, and resource use, as well as waste. Urban planning is traditionally perceived as a complex and time-consuming process. Unclear plans, possible misunderstandings and decision-making without stakeholder participation may cause complaints and delays even in long-prepared projects. New visual smart city planning solutions for illustrating urban projects are needed. Some places in some cities have become decayed, there's no life. The idea of Portable Streets can be a low-cost urban solution. However, the moment we bring street life, people will want to live there again. That's why the portable streets can be designed. A Portable Street can be easy and quick to be delivered and removed in one day. It can be a smart solution to put a whole street life in any place, it can be an innovative urban solution to transform transport, creating walkable and livable environments with better air quality.

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Putting Life to Smart City Project Portfolios (The Role of Innovation in Smart Cities)

Stefan Fazekas

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1 ABSTRACT

What if you'd find most of fascinating resources for your smart me up project in a way you never would have had access to by regular means?

What if you'd be found by smart me up projects you never would have though of in terms of your skills and other resources being needed there urgently?

Being found by and recommended to projects rather than searching incomplete databases for hours and longer is the future habit for resource owners!

Being proposed to suitable resource owners rather than communicating via all channels with high costs and weak results is the upcoming scenario for project sponsors and managers!

And resources will contribute to each initiative by taking money or even in-kind because it's cool and good for the image and/or great to contribute something important to the society in a useful manner and being recognized for by many stakeholders.

So therefore the paper will introduce www.makerSQR.com as a means to match projects and resources via context-sensitive, self-learning and multi-language matching in order to fulfill the above promise.

It will also highlight www.helloSQR.com as brand new mobile app, allowing community building based on shared and skill based interests of people.

Keywords: community building, democratization, matching, project portfolio, resource management

2 SMART CITY INITIATIVES ON THE GLOBE

2.1 Some basic observations

During several Web research nights it was easy and astonishing as well to find more than 900 Smart City projects around the globe and proud to say, that many of them are to be found within Europe. Of course the Asian and Indian room puts much emphasis on such engagements and US honestly admits to be behind in this case and catches up like hell while claiming, that their number of metropoles is limited compared to the size of the continent, however the metropoles are not ;)

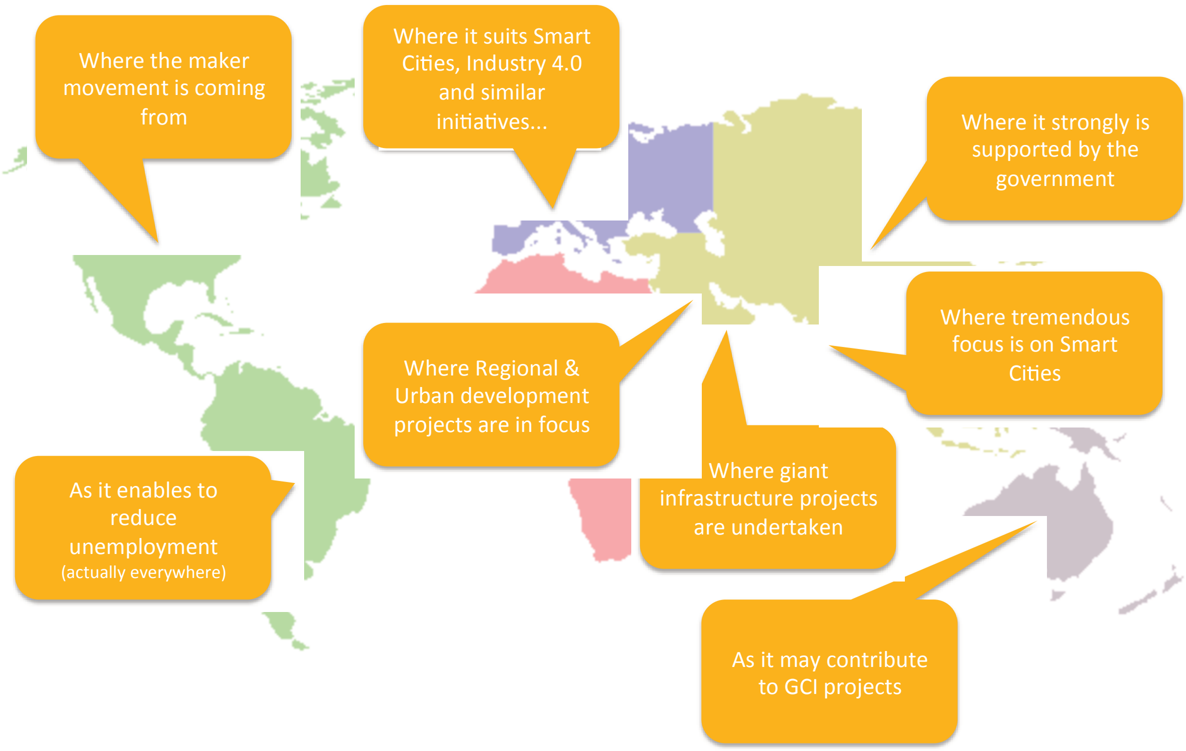

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Fig. 1: Corner stones of Smart City initiatives per geographical region

2.2 Scope and Sponsors

Government as sponsor of Smart City initiatives intends to combine industry and citizens to making related projects happen.

Industry could join in as sponsor as well and some citizens are makers in difference disciplines.

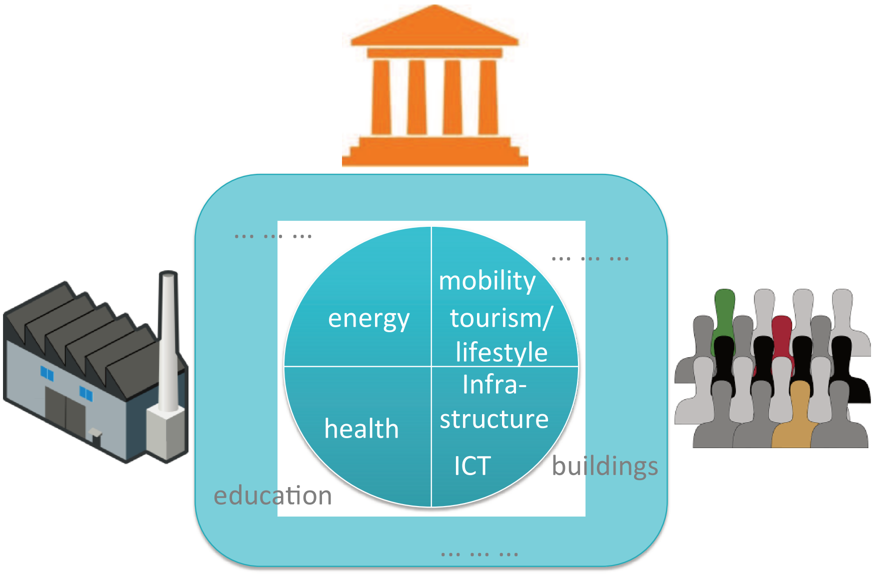

Fig. 2: Scope and sponsors of Smart City initiatives

2.2.1 Project Portfolio

Each Smart City undertaking defines its project portfolio according to the targets as set out to be achieved during the course. This bunch of projects deserves sponsoring from city government or industry or luckily from both sides.

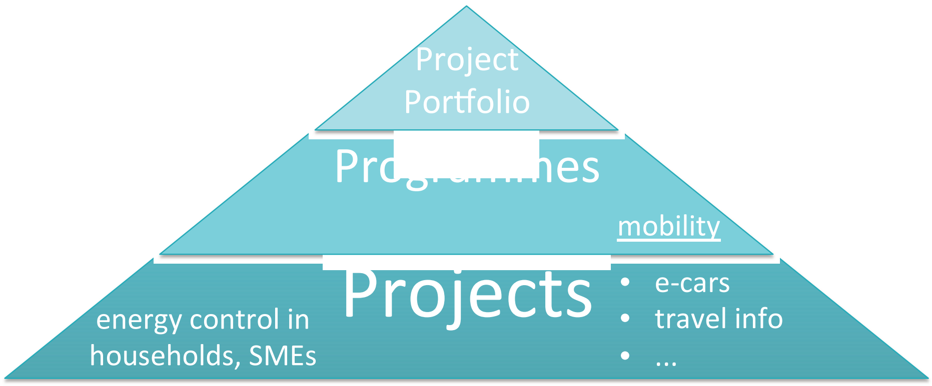

Fig. 3: Project pyramide

Each project looks for proper staffing. On one hand, institutional resources are identified in the starting phase and soon it's becoming clear, that there's more to come. Successful involvement of corporate and individual resources – called citizens ☺ - is the name of the game – also in order to ensure high acceptance of project objectives and outcomes.

Irrespective of the target areas, scope and focus of Smart City programmes, be it on energy, mobility, infrastructure, buildings, health, education, tourism/lifestyle, ICT and many other domains of daily living, the question is always on looking for candidate resources to make the dreams come true.

Proper resources, both non-human and especially skilled human ones are definitely hard to find in order to guarantee success per project.

2.2.2 europeansmartcities

University of Technology Vienna updates on a yearly basis their benchmarking base of finally 90 cities between 300.000 and 1 million inhabitants from 21 countries. The following illustration shows an excerpt of three cities compared amongst each other and versus average pattern in the spider web.

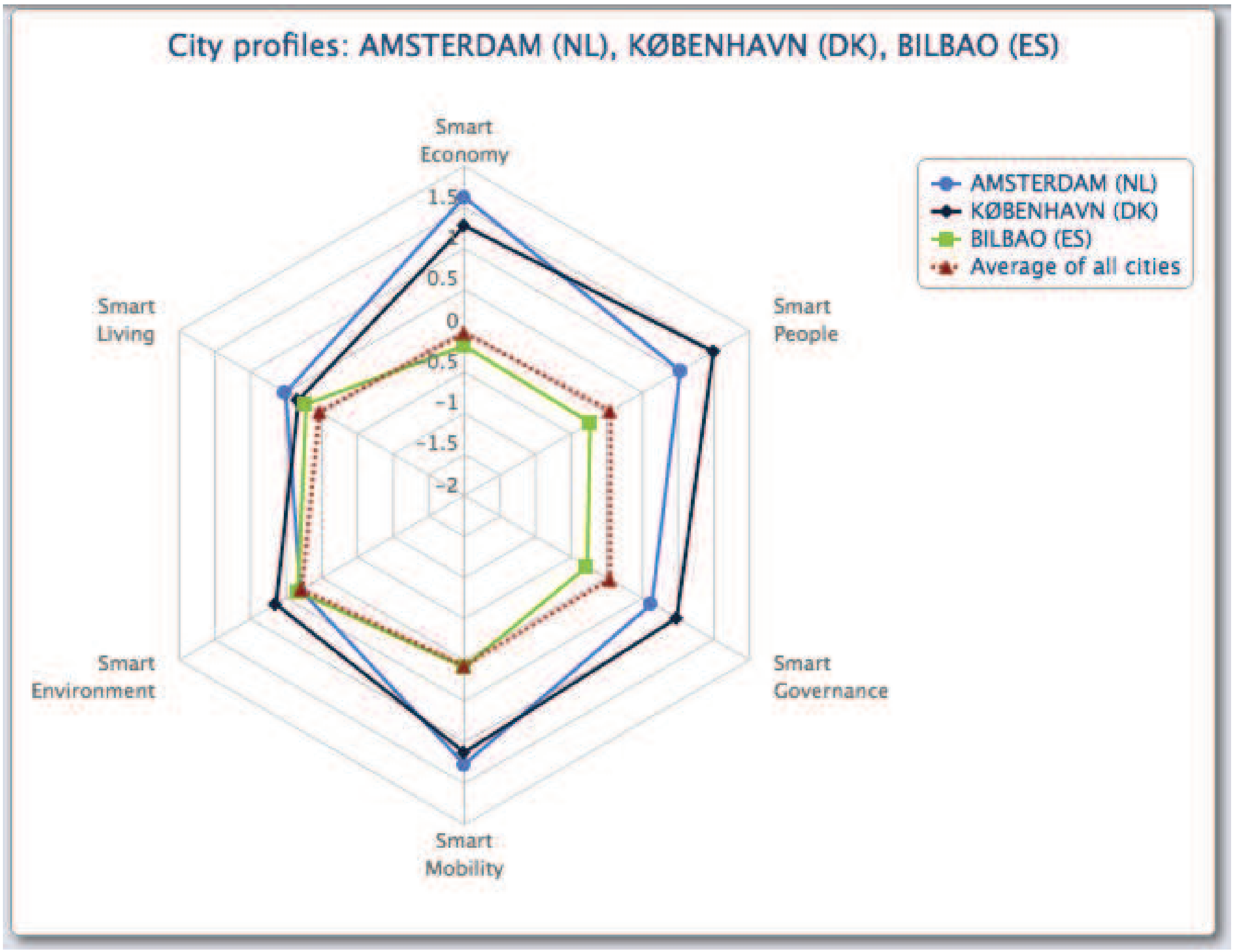

Fig. 4: Benchmarking European Smart City initiatives

3 THE MAKER SCENE AND MAKERSQR

3.1 The maker scene

Maker Movement Numbers:

- 135m US adults are 'makers' doing craft activities
- by 2017 50% of IoT solutions will be provided by startups no older than 3 years (gartner)
- maker fueled businesses pump $29bn into economy per year
- by 2017 3D printing market will hit $5.7bn (forbes)
- crowd funding: >$5bn total ever, $93bn by 2025 (world bank)
- Maker Faire: 131 events worldwide (2014), x10 visitors since 2009
- 550+ Fab Labs in 40 countries // Techshop expanding to Europe
- President Obama hosts Maker Faire White House (2014) & 'Week of Making' (2015)
- More Facts:

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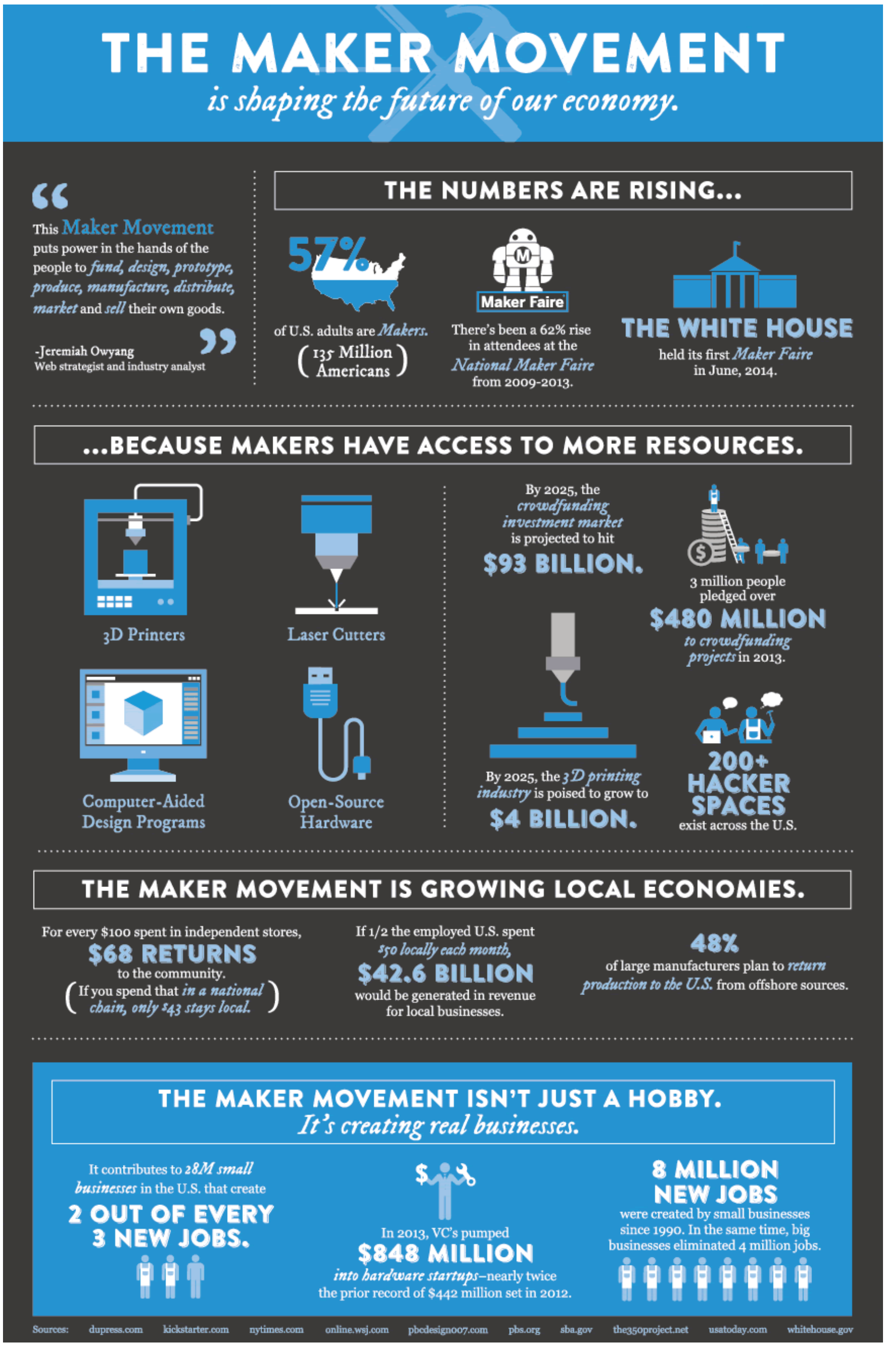

3.2 makerSQR

3.2.1 mission & objectives

People: Enable every curious human to collaborate on innovation and creation of knowledge.

Innovation: Appoint 'impact by innovation' as new status symbol.

3.2.2 Fields of makerSQR application in general

The service is offered / will be offered by aiming at three areas of application and smart me up initiatives are one of them.

A: Prosumer - collaboration with the hidden gems

Market:

- maker, do-it-yourself, open research communities
- private enthusiasts, tinkerers, inventors, hobbyists
- students // recovering academics

- unemployed people
- retired people, increasingly ageless and connected
- mooc customers // gain advantage from new skills
- non-mainstream sciences

Product:

- freemium pricing model: Content is public (free) or private (paid)
- no geographical limits with matching and visibility.

B: Enterprise - adopt the spirit of the maker movement to the corporation

Market:

- corporate innovation process optimization (tools & methods for ideation mostly don't care about succeeding processes like sourcing)
- enterprises seeking easy 'soft start' into open innovation
- enterprises seeking new way of sourcing beyond limits of vertical organizations and employee skill sets
- (open) science & research labs
- $1.6 trillion (2014) global r&d market

Product:

- saas or on premise
- classify specific content as public or private, enables open innovation sourcing in any grade from internal use only to fully public
- matching service includes classified content
- on premise data security: no sensitive data outside company infrastructure.

C: Regional - make cities and regions even smarter

Market:

- smart city / region initiatives & councils for local economy boost
- local communities
- governments // disaster recovery (fema) // cdc
- universities // schools
- all makerSQR prosumer audiences with significant local focus and desire for individual gui design

Product:

- global scope, local focus
- optional limit for geographical availability
- individual gui design // selectable subdomain
- matching service includes content outside region.

‚Talent is not universal but it is widely spread. Give enough people the capacity to create, and inevitably gems will emerge.' – Chris Anderson

3.2.3 Market Place – the SQaRe for makers

Several stakeholders benefit from being part of the makerSQR content base; Smart Cities are in focus of the makerSQR service offering.

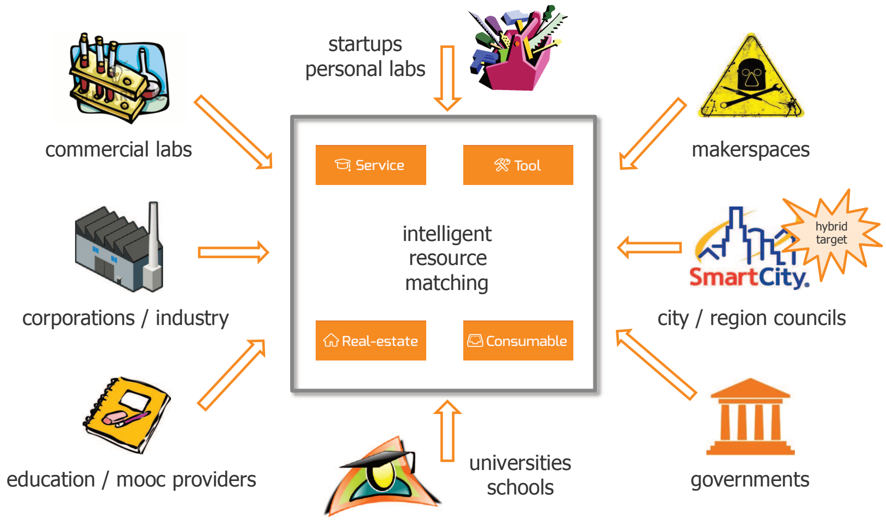

Fig. 6: The makerSQaRe (market place and mathematic meaning)

3.2.4 Business Process

Matched projects and resources directly start their negotiations; haven worked together, produced outcomes may become part of the lab which leads to content registrations of such results as resources for further projects.

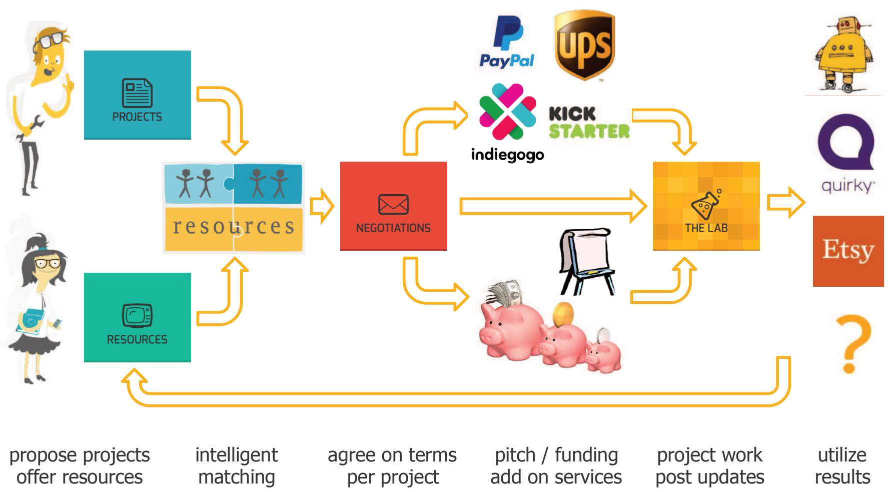

Fig. 7: The makerSQR business process

3.2.5 Project Cycle Scope

The makerSQR functionality covers planning and financing of projects being published on the portal for finding resources via the matching algorithm and money via campaigns to be formed.

Fig. 8: The makerSQR project cycle scope

3.2.6 Corporations meet Makers

Famous brands meanwhile showing up at maker faires due to increased professionality of the crowd as demonstrated by their exhibition objects.

Fig. 9: Impressions from maker faire bay area and NYC

4 SMART CITY INITIATIVES SUPPORTED BY MAKERSQR

4.1 Focus Areas in Smart Me Up Initiatives

The table lists some topics of municipality responsibilities to be in focus of a Smart City initiative.

Candidate focus areas	Description of focus areas in a city (addressable by SC init.)
General Administration	Main office/agency, personnel, statistics, controlling, press, ...
Finance	Treasury, tax, real estate, defense, ...
Public Safety	Legislation/justice, insurance, fire brigade, police, ...
Education	Schools, universities, life-long-learning / adult education
Health Care	Organizations/institutions/persons, facilities, rules and processes to improve and maintain health of population
Social Affairs	Service (documents, IDs, information etc.), labor affairs, immigration / integration, leisure time / culture
Colonization	Area development (regional/spatial planning for structured usage in terms of environmental, economical and social opportunities), housing, building supervision and maintenance, garden & parks
Technical Infrastructure	Innovation and asset management for demand oriented supply, buildings and BIM, parks, places, ...
Energy and Water Management	Energy supply, alternative energy, quality of water, water supply, sewage
Traffic & Transportation	Individual traffic, public transport, data traffic
Environment Protection	Waste management, climate protection, sustainability, disaster management
Tourism	Development plan, investments, marketing
Internationalization	Support – outgoing, support – incoming, public relations, legislation
Business Development	Municipality strategy oriented actions to enable/support further improvement and innovation in related areas

Fig. 10: Focus areas of municipalities

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4.2 Smart Programmes and potential contribution by makerSQR

4.2.1 … in Smart Cities

makerSQR supporting Smart Cities (SC)

- companies/academia with their SC related projects and resources in one place
- more intensive matching of initiatives
- amongst companies by also focusing on SME
- and with skilled students, employees, unemployed and retired persons
- plus non-human resources as offered by organizations and citizens
- people growing to smart citizens

4.2.2 … as well as in Smart Regions / Districts

makerSQR supporting Smart Regions (SR)

- Regional development programs by maintaining core competencies of the respective region or helping to let evolve a new regional identity by
    - supporting clusters
    - backing concepts on improving mobility within the region
- Re-animation of industry zones by
    - enabling zone management to become even more attractive as place to be
    - linking companies within the industry zone with further candidate partners.

4.2.3 Hooking up with suitable, complementary services – i.e. housing

"iwondo" is the first smart online platform in Austria enabling people looking for new space to rent, search the internet for available postings, investing a great deal of time and energy - often with less than satisfying results. As affordable rentable space is becoming increasingly scarce in metropolitan areas all over the globe, tenants are frustrated due to the intense competition for a single apartment, while landlords have a hard time picking out candidates that meet their expectations. It is getting more and more usual for potential tenants to submit applications including not only "hard facts" concerning the real estate but also personal information in the hope of appearing in a favorable light. This has created a real estate market that brings about a lot of unnecessary trouble for both sides – tenants who are forced to write one application after another and landlords who are flooded by a countless number of submissions.

"iwondo" has been developed to revolutionize the system in place by giving searchers a one-time opportunity to present themselves in their own words and to choose which information they wish to display. A specially designed smart algorithm matches the searchers' profiles with the best-fitting objects. The apartments cannot be viewed by just anyone who happens to stumble across the platform; rather, future tenants are selected by the smart "iwondo" algorithm and presented with the ideal choice for their purposes. Especially in growing cities and congested urban area, the "iwondo" principle will be path-breaking in saving both tenants' and landlords' time as well as money. In the context of Smart City solutions "iwondo" increases the overall efficency of the real estate brokerage.

"iwondo" is currently a fully accessible online service with a growing user base. Setting up a profile is free of charge for the tenants. Landlords will be paying a monthly fee for unlimited access to the platform's database and a commission for every matched object rented or sold via "iwondo" real estate platform.

Although currently designed to meet the requirements of the Austrian market, the potential of "iwondo" has been recognized by real estate professionals from other European countries, who have voiced their interest in this revolutionary Smart City product solution.

4.3 Intelligent project : resource matching

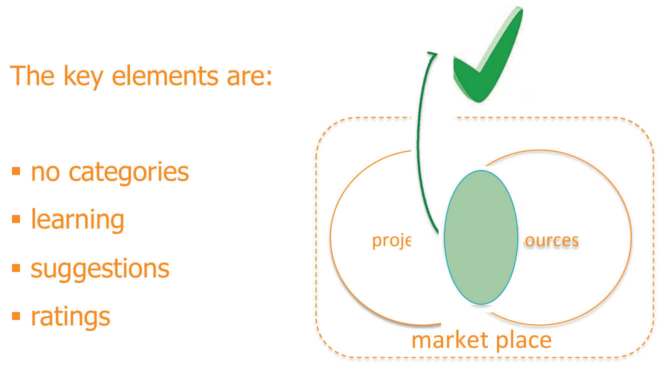

Fig. 11: intelligent matching algorithm

The makerSQR matching algorithm

- requires no categories // has no focus on traditional mainstream
- delivers context sensitive matching results
- continuously learns about user's topics of interest
- considers ratings in various criteria
- still allows personal touch & recommendations
- is adjustable with personal preferences
- collects metadata on topics, demands, locations, ……
- is accessible via api for partner & white label services
- is designed to achieve cross language matching in future.

5 CURRENT STAGE OF MARKET ENTRY

5.1 Geographical dissemination

- US: helloSQR was at Launch Festival San Francisco March 2016, makerSQR with US investors, UC of Berkeley, Singularity Univ., major automotive producers, initial Smart City projects may support Palo Alto, San Jose, Fremont
- EU: helloSQR to be introduced and used during major events like Pioneers Festival and European MakerWeek, makerSQR in cooperation with makerspace of BMW Group Munich / UnternehmerTUM, with organizations in transportation sector; Smart Region projects addressed via applications for public funding as consortium member in cooperation with universities and R&D organizations; Smart City projects may concern Hamburg ;) as first European metropole going with makerSQR and having started with Cisco at Smart Port
- Further geographical regions to be approached according to investments into makerSQR Inc. and/or based on opportunities as given via multipliers and international organizations as strategic partners – i.e. incubators, accelerator programmes, transportation sector, etc.

5.2 Content

Smart programs ask for content generation and in this case overcoming the classical chicken-egg syndrome regarding content on b2c respectively b2b side first vice versa.

5.2.1 helloSQR

Apart of having Smart City projects in focus of makerSQR due to government, corporates, NPOs, education sector, related projects and inhabitants in one place, we enable individuals to form communities of inspiring and interesting people via an Intelligent Networking Companion called helloSQR. It finds relevant people based on professional and personal interests who are currently around and suggests who to say "hello" to.

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Decision makers of smart city initiatives may recommend this service as an initial/additional step prior to applying makerSQR as the content base for intelligent matchings between members of such communities and projects of the smart city project portfolio to support staffings and even foster innovation leading to

5.3 Incentive Model for Smart Regions/Cities/Districts

First movers will be incentivised via benefits accrued during the growth phase as per our go-to-market process. Such benefits could origin from discounted usage of future payable services, portions out of revenues/ebit gained on total international business.

Because of strongly networked matching transactions within and between regions, enterprises, organizations, further entities and resources, we assume it makes sense to having initial partners participating on the overall business success rather than trying to relate to separated segments - more to come!

6 CONCLUSION

‘The reality is that most of the world’s smartest people don’t have the right credentials. They don’t speak the right language. They didn’t grow up in the right country. They didn’t go to the right university. They don’t know about you and you don’t know about them. They’re not available, and they already have a job.’

Chris Anderson, Author of ‘Makers – The New Industrial Revolution’

‘If at first, the idea is not absurd, then there is no hope for it.’

Albert Einstein

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🏆 *reviewed paper*

Rationale of Smart High-rise Regulations

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1 ABSTRACT

Through systematic analysis of the evolvement of high-rise regulations in European and American cities, this paper attempts to summarize some rationale in hope of setting a theoretical foundation for smart high-rise regulation. The study suggests that the development of high-rise regulations are driven by the economic, environmental, and social impact of high-rises on surrounding neighborhoods. Some concluding key points consist of; 1) high-rise regulations should be context specific; 2) high-rise regulations should comprehensively consider the impact and interaction of high-rises on the surrounding environment; 3) high-rise regulations should encourage the development of high-rise clusters rather than individual high-rises, in order to effectively increase density, and facilitate urban growth and renewal; 4) high-rise regulations should emphasize on creating a vibrant inner city rather than shaping urban morphology; 5) high-rise regulations should give more attention to the street level rather than traditional top-level of high-rises; 6) high-rise regulations should be scientifically formulated by the use of data processing technology such as GIS. The goal of smart high-rise regulations is to create a sense of belonging for residents, a unique urban experience, and an interactive neighborhood environment.

Keywords: Urban Planning, High-rise, Rationale, Regulations, Smart

2 INTRODUCTION

High-rises are striking buildings that can be seen from far away, thus attract a great deal of attention. Huxtable enthusiastically praised high-rise as “not only the building of the century, also the single work of architecture that can be studied as the embodiment and expression of much that makes the century what it is... No other building type incorporates so many forces of the modern world, or has been so expressive of changing belief systems and so responsive to changing tastes and practices... The tall building probes our collective psyche as it probes the sky”. (Huxtable, 1984) McNeill claims the high-rise as “an extremely complex spatial phenomenon”, (McNeill, 2005) which resonates with Fazlur Khan’s argument, “designing high-rise structures is as much an engineering challenge as it is a social and political concern” (Khan, 1965). This study aims to explore the rationale of regulations that restrict or direct high-rise development from multifaceted perspectives, in hope of providing some theoretical basis for policy making in terms of permitting or rejecting high-rise projects. Studying the rationale of high-rise regulations requires a thorough comprehension of what specific features should be taken into consideration, in other words, establishing logical qualifiers to justify high-rise construction. Previous research have provided examples of some of these features such as land-use, density, visibility, urban experience, inner city revitalization, cultural preservation, and so forth. In order to identify the key features of high-rise regulations, it is helpful to look back to understand how high-rise is planned and designed, and how it has evolved historically. Even for a single proposed high-rise project, various stakeholders engage in complex interplay in order to satisfy each other’s optimal interests. This interplay of political powers in high-rise development originated as early as 1916 in the context of the New York City Zoning Ordinance, one of the milestone legislations in the U.S. In commercial real estate development, zoning “pits the individualism of American capitalism against deeply rooted notions of communal public good”. (Poindexter, 1998) It is the planner’s obligation to systematically analyze the benefit related to all stakeholders as well as the impact of high-rises on the surrounding social and physical environment. In order to more objectively and inclusively study the rationale of high-rise regulations, the past experience from the high-rise development must be reviewed and scrutinized. Retrospect to the historical evolvement of high-rise regulations in European and American cities, this paper attempts to summarize some rationale in hope of setting a firm theoretical foundation for smart high-rise regulation. Since a substantial amount of the world’s tallest buildings are located outside the western world, some scholars argue that “in debates over the future of urban form, existing western-biased theories and models are of questionable relevance” (McNeill, 2005). Nevertheless, a) high-rise regulations were originated from Europe and North America, and have been evolved and improved over the longest period; b)

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most systematic research on high-rise regulations, especially from theoretical perspective, are contributed by European and American scholars.

3 CONCEPTS AND MISUNDERSTANDINGS

Urban economics theories suggest that low-density development comes with additional cost such as the cost of infrastructure to support dispersed urban regions, the cost of housing for lower paid workers, and the cost of energy consumption from private automobile. In light of these costs, high-rise development was proposed in order to achieve the ideal sustainable and compact urban form. Particularly, the goals of high-rise development were to reduce residents' dependency on the automobile, encourage active transportation and use of public transport, and reduce energy consumption through shared amenities. Along with these goals came questions and skepticism of the high-rise proposal such as: how high of a building could be defined as "high-rise"? Will high-rise development lead to higher density and growth of land value? Under what circumstances will the sustainable use of transport be supported by high-rises?

3.1 How high is high-rise?

It is difficult to set standards for the height of buildings that can be deemed "high-rise" since the concept of "high" is not only place-specific, but also time-specific. For example, a building classified as "high-rise" in the 1920s could be regarded as "mid-rise" by today's standards. The standard for defining a building as "high-rise" also varies internationally. For instance, only one building within the Europe Union was listed as one of the top 100 tallest buildings in the world. The Shard of London was listed as the 87th tallest building, according to The Skyscraper Center of CTBUH (Council on Tall Buildings and Urban Habitat). As a relative term, the different standards of "high-rise" lead to the diverse policies that regulate building height and locations worldwide. In addition, the definition of height needs to be standardized and presented clearly since height can be measured in many different ways: architectural height, floor-to-ceiling height, floor-to-floor height, and so forth.

3.2 High-rise = high density?

High-rise development is widely considered as the most effective way to achieve urban densification. However, is that true in every case? To answer the question of whether or not high-rise construction necessarily leads to high density, Zandbelt illustrated the relationship between high-rise and high density though the cases of Bergpolderflat and Montevideo in Rotterdam (Zandbelt, 2012). The block where Bergpolderflat is located has a lower Floor Space Index than its surrounding blocks. As the tallest residential tower in the Netherlands at the time, the base of Montevideo takes up almost five times as much space as the tower itself. Therefore, height is not always positively associated with density. Based on empirical research of height and density, Zandbelt further concluded that, "the base of the building must be much larger than the tower on top of it" and "only the cluster of high-rises have a degree of density" (Zandbelt, 2012). With respect to the higher density of workplace associated with the cluster of high-rise office buildings, Christopher Alexander and others proved that high-rise structures do not necessarily accommodate higher residential density due to tower separation rules (Alexander, 1977).

3.3 Does high-rise generate high land value?

The price of land is not simply determined by the amount of construction, but by the complex content of the structure, purpose and value of the projects, as well as the micro and macro-economic environments. High-rise building construction and maintenance costs are more expensive than those of low-rise buildings. In the Netherlands, the feasibility of high-rise is strongly supported by low-rise revenues. Homogeneous-looking high-rise projects could be heavy financial burdens for developers especially when the market is saturated. In addition to costs, vacancy rate is another issue that should be taken into consideration. Whether or not the project could get governmental commitment should be comprehensively considered prior to the construction of high-rise projects. Ghost towns in China exemplified this issue quite well. Without the services and facilities the tenants expect to experience along with a declining job market, the high residential buildings in Ordos, Kangbashi, and other Chinese cities had high vacancy rates and were a heavy financial burden for developers (Donald, 2012).

3.4 Environmental performance of high-rises; good or bad?

Based on the research of Van den Dobbelsteen, Colaleo, and others, the energy consumption of high-rises could be high when considering all the transport and service required to support high-rises functioning well (Van den Dobbelsteen et al, 2007). More materials than necessary, such as concrete, are required to be used to deepen the foundation of high-rises (Colaleo, 2003). However, the expected service life and use of space should not be ignored when assessing environmental performance of high-rises. Mixed and intensive use of the surface favors high-rises, as tall buildings allow us to avoid excessive spatial claims outside the city. Newman and Kenworthy's research demonstrated that dense development through high-rises could support sustainable use of transport, for instance, significant reduction of gasoline consumption (Newman & Kenworthy, 1989 & 2001). High-rise buildings could considerably facilitate dense development in order to pursue a sustainable lifestyle. However, it is noteworthy that high-rise does not necessarily lead to high density. The impact of high-rises on the quality of the surrounding environment and daily life of residents should be taken into consideration. High-rises could block views, light, and sunshine, while the channel between tall buildings could increase wind velocity, which would increase the difficulties for pedestrians or cyclists, thus impeding the initiation of green transportation.

4 INCENTIVES, ARCHETYPES, AND USES OF HIGH-RISE DEVELOPMENT

4.1 Incentives of high-rise development

Markus Appenzeller argued that it was the, "scarcity of land, technological advance, and ego of investors and architects" that jointly triggered the mass high-rise development in Chicago (Appenzeller, 2012). Today, the incentives of high-rise development have become more complex, as Oral Buyukozturk categorized as, "scarcity of land in urban areas; increasing demand for business and residential space; economic growth; technological advancements; innovations in structural systems; desire for aesthetics in urban settings; concept of city skyline; cultural significance and prestige; human aspiration to build higher" (Buyukozturk, 2004). Despite the change in incentives associated with high-rise development over time, the essential motivations for high-rise development have remained similar. Due to differences in culture and demographics, high-rise developments in North America, Europe, East Asia, and the Persian Gulf have been stimulated by various combinations of the aforementioned incentives.

4.2 Three archetypes and the evolution

To understand why high-rise development in different regions is so distinct, it is important to realize that high-rise buildings are rooted in and have evolved through different urban culture. According to Appenzeller, European high-rises are characterized as iconic and have been placed in key locations such as churches and palaces over centuries. In contrast, American high-rises are presented in the form of agglomeration of skyscrapers, typically occupying one or more city blocks, such as those comprising the collective silhouette of New York City (Appenzeller, 2012). Le Corbusier advocated a third type of high-rise that contained a mix of uses in one tower. Appenzeller categorized these three types of high-rises as the American high-rise, an aggregation of skyscrapers; the European high-rise, an independent iconic tower; and the inventions of Le Corbusier (Appenzeller, 2012). Based on this classification, he further analyzed the evolution of the three archetypes around the world over the past 70 years. For example, with its unparalleled height, the Burj Khalifa was solitarily erected from a "barely existing urban culture" in the Persian Gulf, as a representative mutation of the European high-rise (Appenzeller, 2012). Interestingly, it also serves as a mixed-use tower with the intention of lifting the public accessible space into the sky. In East Asia, with a long existing urban culture and enormous demographic pressure, the high-rise become an unavoidable option. Though mixed-use high-rises agglomerate together into building complexes, the iconic project can be observed as well. The collective hybrid is regarded as the combination of all three archetypes of high-rises. In order to cater to the desire of a growing number of people moving back to center cities, all three types of high-rise development have been proposed and constructed in Europe. Representative examples include La Défense in Paris, De Rotterdam complex in The Netherlands, and the central business district around Liverpool Street Station in London. Numerous examples of high-rise development around the world have demonstrated that an individual skyscraper does not necessarily lead to a compact urban form, however, composition of high-rises may do so.

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4.3 The uses of high-rises

What are the use of high-rise buildings? Originated from the tall office buildings in Chicago and New York City, a substantial number of today's high-rises are apartment blocks, hotels, and mixed use complex. It is not unusual to see skyscrapers for residential use worldwide, especially in East Asia. The high-rise apartments can "range from cramped, cheaply constructed forms of social housing to luxury condominiums" (McNeill, 2005). Besides tall office buildings and apartment complex, many high-rises are occupied by hotels, including some world-famous high-end brands such as the Ritz-Carlton, with their lofty aerial perspectives as a commercial selling point. McNeill argues that there is "a growing tendency among developers and policy-makers to favor mixed-use developments, where office, hotel and residential uses are shared within one building". (McNeill, 2005)

5 EUROPEAN APPROACHES TO HIGH-RISE REGULATIONS

5.1 Motivations of high-rise development in Europe

Unlike American or Asian cities, high-rise development in Europe was not "driven by comprehensive building height policies, but was a by-product of mass social housing delivered after the Second World War" (Nicolaou, 2012). Many high-rises in Europe are in the form of individual landmarks located in urban centers. The demand for high-rise development in Europe was primarily stimulated by, according to Nicolaou, "developing an international image with commercial demands and increase urban density in consistent with the policies on sustainability" (Nicolaou, 2012). The challenges experienced by planning authorities were reflected in ensuring the feasibility of high-rises, and integrating the scale and particularities of the planned high-rise projects within the existing environment.

5.2 Collective effect of high-rise development – the debate

High-rise supporters passionately praise the prominent benefits driven by high-rise development, including the intensification of space and expansion of infrastructural capacity, global positioning and branding, positive change of urban morphology, and catalytic rejuvenation of economic base. Opponents of high-rise development provide their reasons for confining high-rise construction such as inefficiency of energy performance, expensive rental and maintenance costs, lack of development flexibility, restraining vitality and activity inside of the building rather than encouraging them outside, detrimental psychological impact of nonhuman scale, and cold blank walls from tall buildings. Thus, it is difficult to measure the collective effect of high-rise development. For instance, expansion of infrastructural capacity might bring congestion, and the fact that judgment of urban image is quite subjective based on individual perspectives rather than objective and clear.

McNeill's systematically analysis of the impact of high-rises provides a holistic view. In terms of the positive effect of high-rise development, on the one hand, high-rises allow "the kind of logistical access required to sustain urban clusters, and often house some of the 'light institutions' deemed significant to the functioning of the contemporary economy, which has been central to the relaxation of planning controls on tall buildings" (McNeill, 2005). On the other hand, "contemporary high-rises selectively connect together the most favored users and places, both within and between cities" (McNeill, 2005). From the perspective of the social impact of high-rises, "these buildings have tiny footplates but huge aggregate impacts on the city or metropolitan area". (McNeill, 2005) Speaking of the role high-rises played on urban morphology, McNeill argues that the invention and growth of high-rises since last century have caused some perceived damage to the existing skylines of many cities. However, as mentioned before, this is really a subjective matter based on individual perceptions.

5.3 The characteristics of high-rise regulations in Europe

Unfortunately, very few authorities have established mature strategies or tested high-rise policies. Since the 1960s and 1970s, construction of tall buildings in Europe was driven by housing policy and public sector reconstruction programs. Many high-rise projects at the time failed due to lack of comprehensive market analysis and effective approaches of management in regard to high-rise development. Contemporary high-rise developments are driven by private sector demand for higher density and profit. High-rise regulations are composed of relatively weak policies and very little "post occupancy" evaluation research (Nicolaou, 2012). The change of high-rise development in Europe is also reflected in the change of geographic location.

Tall commercial buildings are mostly proposed in urban centers, while tall residential buildings are proposed everywhere. Nowadays, some commercial high-rises are being proposed in marginal office locations or in small cities and towns. The spatial change of high-rises in Europe is similar to their counterparts in Asia. However, Asian high-rises do not have as many alternatives as the European ones for location selection due to the tremendous population pressure, while the spatial distribution of European high-rises presents more of a “haphazard nature of demand” (Nicolaou, 2012)

Compared to the sophisticated and comprehensive zoning ordinances and building policies in North America and Asia, high-rise regulations in Europe emerged after the war in a less substantive form of “design prescriptions” (Nicolaou, 2012). A substantial number of policy-makers from European cities viewed high-rise development as isolated insertion rather than comprehensive transformation of urban form. As a result, high-rise projects continue to be assessed without consideration of their adjacent similar projects (Nicolaou, 2012). Yet another issue is the debate of historic preservation and management of high-rise development. High-rise policy research commissioned by the Mayor of London suggested that, it is the cultural value of the city’s historic districts that caused the high value of land, in turn with the high demand for larger and taller development. However, Nicolaou argues that the city failed to provide integrated and valid evidence to support high-rise development in the area close to its historic district (Nicolaou, 2012).

The high-rise regulations and policies in Europe can be characterize as more reactive than proactive from a position of “why not” passively adopting policies related to other regions rather than thoroughly understanding “why” high-rise projects should be promoted in order to achieve sustainable growth in the long run (Nicolaou, 2012). The concerns among European policy makers and planners emphasize how to balance the desire of a new city image in order to express economic boom and the impact of high-rise development on existing urban nature, especially when the high-rise projects cause drastic changes in low-rise cities. Nicolaou argued that most skyscrapers in London only meet part of the tenants’ expectations such as mixed use and enhanced sense of place (Nicolaou, 2012). Rarely a specific skyscraper could be endorsed as an ideal model that fulfills all expectations of tenants.

5.4 Recent tendencies of high-rise development in Europe

What conclusions can be drawn from high-rise management in Europe? Due to the traditional urban culture, a large number of European high-rises serve as urban icons. Previous research has suggested, for most housing models, density increases with height up to a point of around 20 floors (Nicolaou, 2012). Beyond that, high-rises need to space out in order to achieve similar energy performance. Hence, increasing density on a citywide scale depends on the comprehensive management of building height, rather than incremental consideration of individual building. The role high-rises play in urban renewal remains unclear. Successful urban regeneration seems triggered by high-rise development, usually associated with other significant prerequisites. Either the high-rise project is part of a long-term master plan, or it is endorsed by strong political and public support. Buchanan argued that economic transformation is more related to infrastructure improvement with the help of high-rise development rather than tall buildings themselves, implying that it is the catalytic effect of high-rises that plays a critical role in urban revitalization (Buchanan, 1998).

The branding value of high-rises have changed over time. With the non-innovative “universal” design of high-rises are spread through out the world, architects, planners, and policy makers increasingly concern about their cities losing uniqueness and attractiveness with the development of high-rises. Some cities are shifting their emphasis on high-rise development to public space improvement in order to attract more tenants (Nicolaou, 2012). Efficiency assessment of residential high-rises usually concentrates on estate revenue and occupation rate. However, the failure and demolition of many residential high-rises constructed and commissioned by the public sector in 1970s indicate the significance of comprehensive management and consideration of psychological needs of inhabitants prior to any kind of construction (Nicolaou, 2012). Recent trends of workplace design for modern industries show the preference “towards large floor plates that encourage seamless communication and enhance flexibility for expansion or contraction of operations” (Nicolaou, 2012). Similarly, regulations of residential high-rises should encourage creating communities that facilitate social interaction. McNeill points out that “public access to rooftop bars, restaurants, viewing platforms or gardens is now seen as being an important issue in skyscraper planning permission, although security concerns are often used to thwart this” (McNeill, 2005) Thus, the issue of “access and positioning of the public at various points in the high-rises is often controversial” (McNeill, 2005).

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6 CASE STUDIES OF AMERICAN AND EUROPEAN HIGH-RISE REGULATIONS

6.1 Setback formula and incentive zoning: New York City Zoning Ordinances of 1916 and 1961

In the earliest decades of high-rise development, regulations focused on the characteristics of building itself in terms of the design (e.g. the setbacks), degree of comfort for occupiers (e.g. light, air), and the related economic benefits. Adler discussed the economic advantages of setback principles by calling for some regulation to assure access of light and air to the rooftops, and equally important, to the streets and into the rooms of the lower stories, since "the experience of real estate agents shows that high rentals can be obtained only for well-lighted offices…" (Adler, 1892) However, according to Hoffmann, "there is no reason to believe that the setbacks of high-rises were motivated by any consideration of public street amenities." (Hoffmann, 1970)

It is noteworthy that L. Sullivan pioneered the sociological studies of high-rises by providing the solution of setback principle and analyzing the rationale of setbacks. Sullivan's essay "The High Building Question" (Sullivan, 1891) argues that the rationale of setback is dominated by the interplay of interest and rights of the individual owner of land and public welfare. "A sense of public welfare control the individual owner in terms of his willingness to maximize the rental space by restricting the area as the building progresses upward" (Sullivan, 1891). By further exploring the corresponding behavior of the individual owner based on his human nature, Sullivan highlights the significance of both maintaining public welfare and holding the freedom of thought and action of the individual sacred.

Considerably influenced by the setback principle, the 1916 New York City zoning system emphasizes both land use and bulk restrictions. The system combined three land use districts of housing, commerce, and industrial activities, five height districts, in which buildings could not be higher than a certain multiple of the width of the street (from one to two-and-a-half), and five area districts, with requirements for the minimum size of yards and courts and the maximum percentage of the lot covered (Willis, 1986). The complex interplay of different political powers was reflected in the 1916 zoning ordinance, since it was made of "combined efforts of urban reformers and city planners, allied with wealthy real estate owners who wielded the requisite political clout" (Willis, 1986). Stakeholders include the Committee on Building Heights, the Commission on Building Districts and Restrictions, as well as real estate and business owners. The planners and politicians who wrote the laws were motivated, "not by a vision of an ideal city, but by practical, political, and economic issues of urban reform" (Willis, 1986). The 1916 zoning law aimed to solve primary urban issues of the time including "overbuilding and congestion in lower Manhattan, clash of interests (and classes) on Fifth Avenue, the protection of property rights, and real estate conflicts". (Willis, 1986) Aesthetic value was another subject under consideration. The "setback style" bonus paid specific attention to "creating strong, sculptural massing and the subordination of ornament, and an expression of contemporary American society" (Corbett, 1927). According to Munro, the 1916 zoning ordinance was designed to "help public administration by making it more orderly, diminishing its difficulties, and reducing needless outlays" (Munro, 1931).

Despite the revolutionary enlightenment of the 1916 zoning ordinance on high-rise regulation, criticism was extensively raised for racial hatred and the class bias inherent in the ordinance. To address these predicaments, approaches of government intervention were proposed as decreasing allowable population and building densities through limitation of the expansion of skyscraper districts and more stringent restrictions on the height and bulk of buildings. The 1961 Zoning Resolution followed the approach of incentive zoning, by "setting floor-area ratios (18) and 20% density bonuses for creating public plazas, later extended to other urban amenities" (Weiss, 1992). The allowable population density was reduced while the lot coverage of high-rises was increased in the 1960s compared with the 1916 zoning law. The density bonuses of the 1961 zoning resolution permitted more flexibility in the structure of high-rises in order to accommodate the desire of developers (Weiss, 1992). However, a cost-benefit analysis demonstrated that the benefit from taking advantage of the density bonus is much larger than the cost of plaza construction, forty-eight times, according to Kayden. (Kayden, 1978) This led to the construction boom of taller and bulkier high-rises. The regulations, particularly the issue about density level and governmental intervention, have been discussed and debated ever since. Specific use of density bonus in specific districts was encouraged and added in the 1961 regulation. More restricted and complicated regulations were initiated in many American cities based on the zoning ordinance originated from New York City.

6.2 From incremental to comprehensive regulation – high-rise regulations in London

The approaches of high-rise management applied by cities in the UK and in continental Europe are distinctive (Nicolaou, 2012). Policies in Frankfurt and Paris confined high-rise development projects outside the traditional city center by prescriptive zoning regulations in order to preserve the historic morphology of city center. For example, "La Défense was invented to provide relief from the pressure to construct high-rise buildings in the center of Paris" (Bosselmannn, 2012). Contrastingly, Greater London Authority (GLA) took a very different approach to manage high-rise development by "offering loose zoning ordinances and avoiding restrictive building height regulations" (Nicolaou, 2012). Apart from the considerations of high-rise management similar to other European cities, policy makers in London take into consideration maintaining the city's role as one of the international financial capitals. This explains why the building height restrictions in London are not as stringent as other European cities. Similar to the planning theories, the different regulation patterns adopted by London and Paris or Frankfurt can be categorized as "incremental" (London) and "comprehensive" (Paris or Frankfurt). By allowing high-rise development in London's historic CBD, GLA attempted to present London's economic vitality and cultural diversity through the city's varying skyline. Driven by speculative investment, large numbers of high-rise projects are more individual-based rather than serving as part of some comprehensive master plan, along with constant revision and reposition during the development period. From the beginning of the 2000s, high-rise regulations and policies became more coordinated, but still not as specific or detailed as some other cities in continental Europe or North America. In regards to the administrative process, high-rise regulations were established based on individual projects within each London borough's administrative boundary (Nicolaou, 2012). Building heights in different boroughs were regulated in an uncoordinated fashion. The transformation of London's view management policy from the London Strategic Views Framework to the London View Management Framework shifted emphasis from preservation of the view of central London area and famous landmarks within it (such as St Paul's Cathedral and the Palace of Westminster), to the inclusive organization of high-quality views for the whole city and the experience of the viewers (Nicolaou, 2012). The most recent View Framework considered the respective impact of foreground, middle ground, and background of urban morphology based on the experience of viewers (Nicolaou, 2012). The Supplementary Planning Guidance (SPG) gives further detail on certain policies found in the London Plan. Besides the view management in the City of London, "planning permissions for tall blocks are often only being granted with the barest provision for car parking, putting additional pressure on existing underground links" (McNeill, 2005). This expresses the comprehensive consideration of the relationship between high-rises and the capacity of surrounding infrastructure (e.g. street and underground). The development of high-rise regulations in London indicates the significance of comprehensive intervention in order to avoid arbitrary growth of skyline configuration.

6.3 Visibility management of high-rises in The Hague

In order to support more objective policy-making procedures with respect to the visual impact of high-rises in The Hague, several advanced GIS methods including mapping, scatter plots, and viewsheds were applied to project the growth of building height and assess the visibility of high-rise clusters. During a public hearing, a photo-montaged impression, released by the municipality, falsified the visual impact of the planned high-rises near the Central Station by reducing its actual size. (van der Hoeven & Nijhuis, 2012). The municipality's predicament of maintaining balance between high-rise development and preservation of the integrity of the established skyline is reflected in its effort to hide the actual visual impact of proposed high-rises. The high-rises draw the greatest attention in regard to visibility, thus specific regulations are required to manipulate the visual impact of high-rises. A comprehensive GIS-based viewshed method was applied to analyze the visual impact of high-rise clusters in The Hague (van der Hoeven & Nijhuis, 2012). A number of important influential parameters were selected and measured to improve the accuracy of visual analysis of high-rises such as "the apparent contrast between the high-rise and its background, the angular size of the high-rise, the contrast threshold at the level of luminance, and the meteorological optical range at different weather conditions" (Nicolai, 1971; Duntley, 1948; Middleton, 1952).

6.4 Shifting emphasis on street level and urban experience in Rotterdam

In the 1990s, high-rise policies and visions were initiated in the City of Rotterdam when high-rises were recognized as tools for densification and mixed-use in the inner city, expression of modernity and economic success, as well as significant components of the urban skyline. Nevertheless, without a restricted limit of

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building height, the skyline of the city grew higher but lack of diversity. (Arends, 2012). The development of high-rise regulations of Rotterdam from 1990s to 2010s illustrated the shift from emphasis on the high-rise itself and its role in shaping urban morphology to the contribution of high-rises on creating a vibrant, interaction-friendly inner city. Instead of the conventional focus on the top-level of high-rises, the street level of high-rises was given particular attention to create a desired "city lounge" experience (Arends, 2012). Understanding the impact of high-rises on the street level requires interdisciplinary knowledge. The impact on the street level was measured by the experience of pedestrians. As a result, more transparency and public functions in the lower part of a high-rise were advocated. The limit of 200 meters building height and a flexible maximum floor space in Rotterdam were considered the most economically feasible, as it ensures the sustainable growth of new high-rises while restricting over-full development. Various "sun-spots" have been designed for compensation of shadows cast by high-rises (Arends, 2012).

7 CONCLUSION

This study attempts to contribute to the exploration of accountability of high-rise development. The experience from the development of European and American high-rise regulations are reviewed and analyzed. Some tendencies are noteworthy during the evolution of high-rise regulations. The zoning resolution of New York City initiated the approach of incentive zoning instead of flat building height restrictions. The transformation of London's view management policy shifted emphasis from preservation of the view of landmarks in the central London area to the inclusive organization of high-quality views for the whole city and the experience of the viewers. The development of high-rise regulations of Rotterdam from the 1990s to the 2010s exemplified the shift from emphasis on the role of high-rises in shaping urban morphology to the contribution of high-rises on creating a vibrant, interaction-friendly inner city. Instead of the traditional concentration on the top-level of high-rises, the street level of high-rises was given particular attention to create a "city lounge" experience. Through this study, it becomes clearer that the development of high-rise regulations is driven by incentives as economic, environmental, and social impact of high-rises. Specifically, the economic impact of high-rises continues to serve as a major determinant when assessing the feasibility of high-rise projects. The collective visual impact of high-rise clusters is gaining more attention than those of individual high-rise. Environmental and social influence of high-rises is given more and more considerations, such as creating a sense of belonging, a unique urban experience, and an interactive neighborhood.

The study hopes to offer some inspiration for establishing reasonable qualifiers to justify high-rise development in developing countries as well. Similar to the history of developed countries, urbanization in developing countries was associated with the increase in excessive automobile use and urban sprawl, and the resulting social fragmentation and environmental deterioration. Differentiated from the developed countries, some developing countries face enormous pressure from overpopulated cities. High-rise development was thus proposed and practiced as a solution in order to ease the pressure from these problems. The ideal of a 'universal' high-rise style popularized by the modernist movement have been criticized by architectural theorists, urban planners, and social historians. Instead, for developing countries which adopt high-rises as symbols of national modernization, there is a tendency of the integration of "standardized western production methods with a locally sensitive design vocabulary" in recent years (McNeill, 2005). Accordingly, regulations of high-rises should be more context specific in order to better accommodate vernacular physical and social environment in developing countries. For example, regulations of high-rises in tropical areas might function more effectively by incorporating climate concerns to provide "appropriate environmental solutions to the problem of the high-rise in the tropics" (Papadakēs, 1992). Regulations of high-rises in earthquake-prone areas could pay more attention to issues related to structural safety, disaster prevention and evacuation. Through literature review, the existing studies of high-rises by researchers from developing countries primarily concentrate on technical perspectives such as high-rise structural design (Ding et al, 2014) or building seismic vulnerability (Wu et al, 2013). This study aims to supplement the discussion about high-rise development from theoretical perspective of accountability.

Over one hundred years ago, when high-rises first thrived in American cities, Louis Sullivan envisioned the future form of high-rise cities, boldly ahead of its time. (Sullivan, 1896; Hoffmann, 1970) Through his study and practice in Chicago, he sought for a "true normal type" for all high-rises and believed high-rises need to express "a sentiment of largeness and freedom". (Sullivan, 1896) Echoing with Sullivan's profound insight of sustainability of high-rises depending on whether it is the living form of utterance, an art “of the people, by the people, and for the people” (Sullivan, 1896), high-rise development should be regarded as an opportunity, not a necessity, that it could only be justified and regulated for the right reasons, and the reasons are ever human-centered. This is the law.

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Raumerfassung und Raumwahrnehmung – aktuelle Techniken und potenzielle Einsatzgebiete in der Raumplanung

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1 ABSTRACT

Zur Analyse und Bewertung städtebaulicher Situationen stellt die, vom Planer durchgeführte, klassische Bestandsaufnahme in der Regel immer den ersten Schritt dar. Bei der Ortsbegehung werden Einzelfotos oder Panoramas aufgenommen, um die Situation festzuhalten und sie später mit anderen Personen diskutieren zu können. Fotos haben allerdings den Nachteil, dass sie die Situation nur statisch und aus einer Perspektive heraus erfassen können. Mit Street View machte Google den nächsten Schritt und ermöglicht ein Navigieren durch die Fotopanoramas von Straßenzügen (Google 2016). Kugelpanoramen wie Photo Sphere Camera lassen dagegen beispielsweise das Umsehen auf einer Platzsituation zu (Perez 2014).

Nun stellt sich die Frage, ob sich dieses Feld der Panoramaforschung auch um dynamische Komponenten erweitern lässt. An dieser Stelle setzt der vorliegende Beitrag an und behandelt aktuelle Techniken zur optischen Erfassung räumlicher Situationen. Neben der Aufnahme von 3D-Videos, interaktiven 360-Grad-Videos und den Möglichkeiten des Nachbaus in Form digitaler Modelle, werden auch die Darstellungsmöglichkeiten mit Virtual Reality-Methoden im Hinblick auf ihren Beitrag zur Raumwahrnehmung und ihre potentiellen Einsatzgebiete im planerischen Kontext untersucht.

Keywords: 360-Grad-Videos, Raumerfassung, Raumplanung, Raumwahrnehmung, Virtual Reality

2 STAND DER FORSCHUNG

Bevor auf die neuesten Entwicklungen im Bereich der Aufnahmemöglichkeiten räumlicher Situationen eingegangen wird, behandelt dieser Abschnitt den aktuellen Stand der Forschung. Der aktuelle Stand der Panoramaforschung, sowie ein kurzer Abriss der Ergebnisse eigener oder unter Beteiligung absolvierter abgeschlossener Projekte im Bereich der Augmented Reality (AR) und Virtual Reality (VR) bilden die Grundlage für die darauf aufbauenden Inhalte des vorliegenden Papers.

2.1 Panoramaforschung

Das Feld der Panoramaforschung lässt sich dem Forschungsbereich der Raumwahrnehmung zuordnen. Unter anderem werden neue Techniken dahingehend untersucht, wie gut sich reale Situationen abbilden lassen, wie hoch der Immersionsgrad dieses virtuellen Erlebnisses ist und ob der Betrachter nach dem Erleben der virtuellen Welt ein Verständnis für den repräsentierten realen Raum bekommt. Die Forschung setzt bei den Abbildungsmöglichkeiten einzelner Fotos an und beschäftigt sich mit dem Sichtfeld des Menschen. In der Literatur gibt es bisweilen mehrere Ansätze um das menschliche Sichtfeld anhand technischer Parameter zu definieren. Die Diskussionen um ein möglichst natürliches Panoramaerlebnis drehen sich dabei um die sichtbare vertikale Höhe des Panoramas sowie dessen horizontalem Winkelbereich.

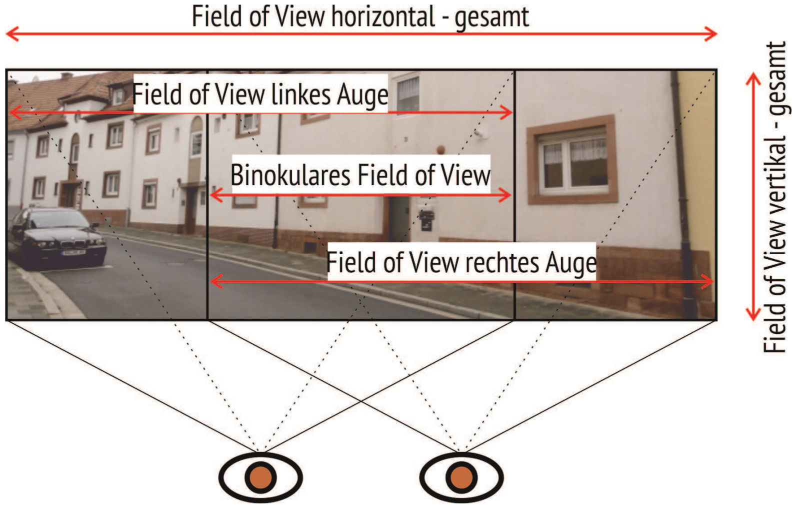

Abbildung 1: Menschliches Sichtfeld

Für die horizontalen Werte definiert Henson zwei Schlüsselbegriffe des menschlichen Sehens: Die binokulare Sicht und das Sichtfeld (oder: Field of View; kurz: FOV) (Henson 1993). Das binokulare Sehen wird durch einen Winkel von 120° abgebildet (Zube et al. 1974), das Sichtfeld des peripheren Sehens dagegen durch einen horizontalen Winkel von 180° (Daniel & Boster 1976). 360°-Panorama-Aufnahmen gehen darüber hinaus und berücksichtigen eine erste dynamische Komponente: Menschen schauen zur Raumwahrnehmung nicht nur geradeaus, sondern drehen sich zur Erkundung ihrer Umwelt um. Was den vertikalen Aspekt der Diskussion um Panoramas angeht, dreht sich die Kritik vorwiegend darum, dass die Abbildungen durch die Aufnahme großer Distanzen oftmals zwar einen großen horizontalen Winkel zeigen, die Höhe des menschlichen Sichtfeldes dabei aber vernachlässigt wird. Für den vertikalen Winkel des menschlichen Sichtfeldes schlagen Gibson (1979) und Barfield et al. (1995) einen Wert von 135° vor.

Im Vergleich dazu, bilden Digitalkameras mit einem vertikalen Winkel von 60° einen wesentlich kleineren Bereich ab (Yuhan et al. 2015: 93). Zur Lösung dieses Problems schlägt Ulrich (1981) die Kombination zweier Panoramen übereinander vor. Eine Beispielrechnung von Yuhan et al. (2015) zeigt dagegen, dass eine Überlagerung zweier Panoramen nicht in jedem Fall notwendig ist: Bei der Verwendung einer Kamera mit 60° vertikalem Aufnahmewinkel und einer Höhe von 1,6 Metern kann bei einer Distanz von 10 Metern zur Aufnahmeszenerie eine Höhe von 14 Metern erfasst werden. Demnach wird bei dieser Aufnahmedistanz erst dann eine zweite Panoramaaufnahme zur Überlagerung benötigt, wenn Objekte mit einer größeren Höhe als den erfassbaren 14 Metern gezeigt werden sollen (Yuhan et al. 2015: 93).

2.2 Augmented Reality

Direkt übersetzt bedeutet Augmented Reality „erweiterte“, „verbesserte“ oder „überlagerte Realität“. Bei diesem Verfahren wird die Realsituation durch die Überblendung zusätzlicher Informationen angereichert. Dabei kann es sich um einfache Textinformationen, Audio- oder Videodateien bis hin zu 3D-Modellen handeln. Zur Umsetzung einer AR-Visualisierung werden grundsätzlich immer vier Elemente benötigt, dabei handelt es sich um ein Aufnahmesystem, eine Trackingeinheit, eine Rendereinheit und ein Anzeigesystem. Mit integrierter Kamera, GPS, Beschleunigungs- und Lagesensoren, softwareseitigen Erweiterungen in Form von Apps und hochauflösenden Displays bieten Smartphones mittlerweile alle diese Eigenschaften, so dass sich auch mit diesen „Kleinstcomputern im Hosentaschenformat“ (Streich 2011) AR-Szenarien umsetzen lassen (Zeile 2011). Projekte wie „Talking Places“ (Hesch 2011), „Location Based Audio“ (Dörrzapf 2012), „Baukultur mit allen Sinnen entdecken und erleben“ (Biwer et al. 2013 und Broschart et al. 2013) und „Augmentierter Bebauungsplan“ (Broschart, Zeile 2013) zeigen die vielseitigen Einsatzmöglichkeiten von AR-Systemen in der Stadtplanung und Architektur auf. Ständige technische Entwicklungen und Neuerungen erweitern den Anwendungsbereich im Feld der Raumplanung zudem stetig (Reinwald et al. 2013).

Bei einer Kategorisierung der Techniken hinsichtlich des umsetzbaren Detaillierungsgrades wird dagegen schnell klar, dass sich mit AR-Systeme zwar viel, aber gewiss nicht alles visualisieren lässt. Insbesondere wenn die zu überlagernden Inhalte auf das Endgerät gestreamt werden müssen, kann bereits die Verbindungsqualität des mobilen Internetnetzes eine entscheidende Limitierung bedeuten. Wird diese Grenze dagegen aufgrund der Hardware-Konfiguration des Endgerätes oder der technischen Limitierungen der mobilen AR-Methoden erreicht, können weitere Details eventuell mit desktopbasierten VR-Anwendungen umgesetzt werden (Broschart 2013:62f.).

2.3 Virtual Reality

Virtual Reality wird mit virtueller Realität übersetzt und zeichnet sich gegenüber der Augmented Reality dadurch aus, dass keine äußeren visuellen Einflüsse auf den Betrachter einwirken, d.h. der Nutzer sich in einem von der realen Welt abgeschotteten virtuellen Raum bewegen und umsehen kann. Um die Möglichkeit des Umsehens zu realisieren, müssen einige Parameter beachtet werden: Um die Tiefenwahrnehmung umzusetzen, verwenden gängige VR-Systeme eine stereoskopische Darstellung. Aufgrund dieser Side-by-Side-Anzeige steht allerdings nur ein Teil des vor den Augen des Betrachters platzierten Bildschirms zur Verfügung und schränkt Auflösung und Sichtfeld ein. Mit den Modellen der Oculus Rift lassen sich auf diese Weise horizontale Sichtfeldwinkel von 110° (DK1) bzw. 100° (DK2) zeigen und so zumindest den Teil des binokularen Sehens nahezu simulieren (Dübner 2014). Zur Erhöhung des Immersionsgrades sind

Erweiterungen der visuellen Eindrücke um Aspekte wie einer Beeinflussung des Audioerlebnisses oder haptische Steuerelemente denkbar.

Mit Oculus Rift, Samsung Gear VR, Sony PlayStation VR oder Microsoft HoloLens, steht eine ganze Reihe technischer Systeme auf dem Markt zur Verfügung oder kurz vor Marktstart, die noch auf ihre potentiellen Einsatzmöglichkeiten in der räumlichen Planung getestet werden können. Mit Google Cardboard gibt es zudem eine Low-Budget-Variante zur Umsetzung eines VR-Systems: In eine Brillenhalterung aus Pappe wird ein Smartphone eingesetzt, die integrierten Beschleunigungssensoren ermöglichen dann das Umsehen bei einer Kopfbewegung. Während sich die Bedienkonzepte zum Teil wesentlich unterscheiden, zeigen erste Tests mit einer Oculus Rift eine Gemeinsamkeit all dieser Systeme: Die Modellierung der virtuellen Welt erfordert einen enormen Arbeitsaufwand, insbesondere wenn ein hoher Detaillierungsgrad umgesetzt werden soll (Dübner 2014). An dieser Stelle wirft sich die Frage auf, ob es auch andere Möglichkeiten zur Erfassung real existierender, räumlicher Situationen gibt, um diese mit so vielen Details wie möglich abzubilden und im VR-System erlebbar zu machen.

3 ERFASSUNGSTECHNIKEN

Die Idee, bei einer Bestandsaufnahme nicht mehr ausschließlich Einzelfotos oder Panoramaaufnahmen zu erzeugen, sondern auch dynamische Komponenten zu nutzen, wirft die Frage auf, welche Techniken zu dieser Art der Raumerfassung nutzbar sind. Ist das Ziel, die bauliche Umgebung so realistisch wie möglich abzubilden, so stehen heute einige Möglichkeiten zur Verfügung, die hierbei Anwendung finden können. Im folgenden Kapitel werden einige dieser Möglichkeiten vorgestellt.

3.1 SketchUp und Kubity

Klassische Anwendung zur digitalen Modellierung einer zu erfassenden Örtlichkeit stellt das Programm Google SketchUp dar. Dieser Abschnitt behandelt sowohl die Möglichkeiten der Modellierung einer baulichen Umgebung mit SketchUp als auch die der virtuellen Erkundung des fertiggestellten Modells mit der App Kubity.

3.1.1 3D-Modellierung mit SketchUp

Das kostenfrei verfügbare Programm „SketchUp Make“ erlaubt es, 3D-Modellierungen am Computer herzustellen. Neben Gegenständen und einzelnen Gebäuden können auch ganze Plätze, Straßenzüge oder Stadtteile am Computer nachgebaut werden. Um die bauliche Umgebung so gut wie möglich im Modell abzubilden, ist es nötig, vor Ort zu sein und diese direkt nachzubauen oder diese vor der Modellierung umfassend durch Bild- oder Videoaufnahmen zu erfassen. Um den Detaillierungsgrad so realistisch wie möglich zu gestalten, ist es außerdem möglich, nachgebaute Fassaden mit Originalbildern zu versehen sowie Pflanzen, Gegenstände oder auch Menschen in das digitale Modell einzufügen. SketchUp kann aber auch dazu genutzt werden, um einfach Manipulationen durchzuführen. So ist es leicht, neue Gebäude einzufügen, andere wegzunehmen oder deren Gestaltung anzupassen. Auch die Simulation des Sonnenstands und die dadurch resultierende Verschattung sind möglich. Je realistischer der Detaillierungsgrad allerdings sein soll, desto schwieriger und zeitaufwendiger ist auch die Modellierung. Um die Realität wirklich exakt nachzubauen, ist daher eine umfassende Bestandsaufnahme nötig. Winkel, Dimensionen, Abstände oder Gebäudehöhen müssen in einer Bestandsaufnahme genau ausgemessen und erfasst werden, um das Modell perfekt anzufertigen. Nicht nur das Erfassen dieser Grundlagendaten nimmt viel Zeit in Anspruch, auch das Modellieren der erhobenen Daten ist zeitaufwendig.

3.1.2 SketchUp-Modell erkunden mit Kubity

Ist ein SketchUp-Modell fertig gebaut, so gibt es mehrere Möglichkeiten, dieses Modell anzusehen. Neben der Ansicht am Computer ist es unter anderem möglich, statische Bilder zu exportieren. Die App Kubity erlaubt es dem Betrachter, das SketchUp-Modell zu erleben und sich darin umzusehen. Hierfür lädt der Nutzer das SketchUp-Modell auf der Kubity-Homepage hoch und kann es durch das Scannen eines QR-Codes in der App auf dem Smartphone erkunden. Kubity erzeugt einen 3D-Effekt und ist für die Virtual-Reality-Brille Google Cardboard ausgelegt (Google Play Store, 2016). Der Betrachter kann sich im Modell umsehen und bewegen. Somit ist ein Erkunden des Modells von jedem denkbaren Standpunkt und aus allen Blickwinkeln möglich. Die Dynamik dieser Raumerfassung entsteht nicht durch das SketchUp-Modell als

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solches, sondern durch die Erkundungsmöglichkeiten dessen im Zusammenspiel mit der App Kubity und einer Virtual-Reality-Brille.

Neben der zeitaufwendigen Modellierung mit SketchUp ist auch eine dynamische Bestandsaufnahme mit Videokameras denkbar. Um den Bestand hierbei möglichst realistisch abzubilden, sind 3D-Videos und 360-Grad-Videos sinnvoll. Die folgenden Abschnitte befassen sich mit den Möglichkeiten der dynamischen Bestandsaufnahme mit 3D-GoPros und der 360-Grad-Kamera Kodak PIXPRO SP360.

3.2 3D-Videos mit GoPro

Durch 3D-Videos erhält der Betrachter das Gefühl, mittendrin im Geschehen zu sein. Auch im Falle einer Bestandsaufnahme kann der Planer sich dieses Gefühl zunutze machen. Mit der heute verfügbaren Technik ist es nicht mehr nur teuren Filmproduktionen vorbehalten, 3D-Videos zu drehen. Mit zwei GoPro-Kameras kann jeder 3D-Videos selbst drehen. Hierfür ist zusätzlich eine Halterung nötig, welche die Linsen beider Kameras in einen bestimmten Abstand zueinander bringt und es somit ermöglicht, die beiden Einzelvideos aus den perfekten Blickwinkeln zu filmen. Neben der Halterung ist ein Verbindungskabel notwendig, welches Aufnahmestart und –ende beider Kameras synchronisiert. Die Kameras filmen und speichern beide Videos zunächst unabhängig voneinander auf den jeweiligen Speicherkarten. Die Videos erhalten im Dateinamen eine spezielle Bezeichnung, sodass die Videos den Kameras zuzuordnen sind. Die Videos der linken Kamera sind demnach an einem „L“, die der Rechten an einem „R“ erkennbar. Um ein 3D-Video zu erhalten, ist eine Nachbearbeitung nötig. Mit der Software „GoPro Studio“ bietet GoPro eine kostenlose Software zur Filmbearbeitung an, mit welcher auch 3D-Videos erzeugbar sind (Computerbild, 2016). Bei 3D-Filmen lässt sich grundsätzlich zwischen verschiedenen Varianten unterscheiden. Da bei der Aufnahme mit den GoPro-Kameras der 3D-Effekt erst durch die Nachbearbeitung und das Zusammenfügen der Videos entsteht, ist es für die Dreharbeit irrelevant, in welcher 3D-Variante die Ausgabe des fertigen Videos geschieht. Die Durchführung der Dreharbeiten bleibt also gleich, egal, in welcher Variante das spätere 3D-Video erstellt werden soll. Die beiden nächsten Abschnitte beschäftigen sich mit zwei der möglichen Varianten von 3D-Videos. Zunächst wird das anaglyphe 3D-Video thematisiert, danach folgt das 3D-Video im Side-by-Side-Format.

3.2.1 Anaglyphes 3D mit GoPro

Anaglyphe 3D-Videos bestehen aus zwei überlagerten Bildern, welche unterschiedliche Farben besitzen. Eines der Videos ist rot, das andere blau. Diese beiden werden überlagert, sodass mithilfe einer rot-blauen 3D-Brille ein dreidimensionaler Effekt entsteht. Vorteil dieses Verfahren ist, dass für den Betrachter mit einer günstigen rot-blauen 3D-Brille auf allen denkbaren Bildschirmarten ein dreidimensionales Erlebnis möglich ist. Nachteil ist allerdings, dass die Farben des Originals nicht naturgetreu erkennbar sind und die Qualität des Videos daher leidet. Auf Abbildung 2 (links) ist zunächst ein Standbild aus einem der beiden unbearbeiteten Videos dargestellt. Zum Vergleich dazu zeigt Abbildung 2 (rechts) ein Standbild aus einem anaglyphen 3D-Video. Deutlich zu erkennen sind rote und blaue Streifen, welche aus der Überlagerung der beiden Videos resultieren. Darüber hinaus ist an anderen Stellen erkennbar, dass die Farben und die Qualität des Bildes durch die Bearbeitung nicht mehr optimal wiedergegeben werden.

Abbildung 2: Ansicht im Original (links) und nach der Bearbeitung als anaglyphes 3D-Video (rechts)

3.2.2 Side-by-Side 3D mit GoPro

Das Side-by-Side 3D-Video kommt ohne farbliche Veränderungen aus. Stattdessen werden zwei Videos zusammengefügt, sodass der 3D-Effekt hier nicht durch die Überlagerung von Videos entsteht, sondern durch die spezielle Anordnung dieser. Side-by-Side 3D-Videos zeichnen sich dadurch aus, dass die Videos „Seite an Seite" angeordnet sind. In der Praxis kann diese Darstellung beim GoPro Studio durch einfaches Auswählen erreicht werden. Sind andere Videoprograme im Einsatz, so ist das Erstellen solcher Videos durch das Halbieren der Videobreite möglich. Die Höhe der Videos bleibt unverändert. Auf den Vorgang des Halbierens der Videobreite erfolgt anschließend eine Anpassung der Position der beiden Videos. Da beide Ausgangsvideos zu einem Video zusammengefügt werden sollen, müssen das Video der linken Kamera am linken Bildrand und das der rechten Kamera am rechten Bildrand ausgerichtet werden. Es entsteht ein Video, welches in der Breite zweigeteilt ist und scheinbar zweimal das Gleiche nebeneinander zeigt – solange der Betrachter es auf einem normalen Bildschirm ansieht. In Abbildung 3 ist zu sehen, wie ein solches Side-by-Side 3D-Video aussieht.

Abbildung 3: Ansicht Side-by-Side 3D-Video

3.3 Aufnahmen mit der Kodak SP360

Neben dreidimensionalen Videos sind auch andere Erfassungsformen für eine dynamische Bestandsaufnahme denkbar. Die Kodak PIXPRO SP360 ist eine Kamera, welche mit einem Ultraweitwinkel und einer gekrümmten Linse einen Blickwinkel von 360° mal 214° einfangen kann. Die Kamera ist in folgender Abbildung dargestellt.

Abbildung 4: Kodak SP360

Je nach Weiterbearbeitung mit der kostenlosen PIXPRO360-Videobearbeitungssoftware und der Ausrichtung der Kamera sind Weitwinkelaufnahmen, Kugelpanoramen und interaktive Videos möglich. Soll

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beispielsweise eine Platzsituation dynamisch aufgenommen werden, können mit dieser Kamera ganz neue Möglichkeiten genutzt werden. Durch Positionieren auf dem Platz kann mit einem Kugelpanorama die gesamte Fläche aufgezeichnet werden. Das unbearbeitete Bild der Kamera ist in der folgenden Abbildung 5 dargestellt.

Abbildung 5: Unbearbeitetes Kugelpanorama

Durch die Weiterbearbeitung des Videos ist es möglich, dem Betrachter das Gefühl zu vermitteln, mitten auf dem Platz zu stehen. Der Betrachter sieht einen Ausschnitt des Bildes und kann sich durch Drehen des Smartphones oder durch die Mausbewegung im Video in alle Richtungen umsehen und den Platz auf diese Weise erkunden.

4 VISUALISIERUNG UND EINSATZ IN DER RAUMPLANUNG

4.1 Visualisierung mit VR-Techniken

Um die Vorteile der Aufnahmen mit dem GoPro 3D-System und der Kodak PIXPRO SP360 voll ausnutzen, ist es nötig, die Videos auf einer Virtual-Reality-Brille anzusehen. Der Betrachter kann somit den 3D-Effekt erleben oder sich in dem 360-Grad-Video nach Belieben umsehen. Das Google Cardboard und die Oculus Rift sind zwei Beispiele für solche Brillen. Es folgt eine kurze Beschreibung beider Varianten.

Das Google Cardboard ist eine einfache Virtual-Reality-Brille. Diese besteht aus einem Gehäuse aus Karton oder Plastik, zwei Linsen, einem Fach für das Unterbringen des Smartphones und einem Gurt als Kopfhalterung. Entsprechend günstig ist das Cardboard in der Anschaffung. Zudem veröffenlicht Google die Bauanleitungen des Cardboards und ermöglicht es Privatpersonen und Unternehmen, Cardboards sowohl für privaten als auch für den kommerziellen Zweck herzustellen (Google, 2016). Hinter den Linsen in Blickrichtung des Betrachters findet das Smartphone in einem speziellen Fach Platz. Über das Smartphone findet die Wiedergabe des gewünschten Videos mithilfe der Cardboard-App statt. Die App Cardboard passt das Video, welches beispielsweise über die Videoplattform Youtube gestreamt wird, an die Betrachtung durch das Google Cardboard an. Sieht der Betrachter Videos im Side-by-Side-Modus an, so erzeugt die Kombination aus Smartphone und den beiden Linsen im Cardboard einen 3D-Effekt. Beim Betrachten von 360-Grad-Videos auf dem Google Cardboard bewegt sich die virtuelle Blickrichtung im Video entsprechend der tatsächlichen Blickrichtung des Betrachters. Durch das Bewegen des Kopfes bewegt der Betrachter das Video mit, was die Bewegungssensoren des Smartphones ermöglichen.

Neben dem Google Cardboard stehen auch weitere Virtual-Reality-Brillen zur Verfügung. Die Oculus Rift ist eine dieser VR-Brillen. Während das Cardboard auf ein Smartphone zur Erzeugung eines Bildes angewiesen ist, benötigt die Oculus Rift Zugriff auf einen Laptop oder Computer. Darüber hinaus verfügt die Oculus Rift zwar über einen eigenen Bildschirm, über den der Betrachter das virtuelle Ambiente erlebt, die Daten erhält die Brille hingegen extern von einem Laptop oder Computer. Diese VR-Brille bietet dem Betrachter mit 100° bis 110° ein Field of View, was leicht unter dem natürlichen Field of View von 120°

liegt. Wie auch beim Google Cardboard passt sich die abgebildete Umgebung, basierend auf den Kopfbewegungen des Betrachters, an.

4.2 Potenzielle Anwendungsbereiche

Die potenziellen Anwendungsfelder für die Raumplanung sind vielfältig. An erster Stelle ist die Bestandsaufnahme vor Ort in der täglichen Arbeitspraxis zu nennen. Diese nimmt eine bedeutende Stellung in der täglichen Planungspraxis ein. Der Vorteil von dreidimensionalen Aufnahmen liegt in einem besseren Raumgefühl für Planungen. Zusätzlich bieten gerade virtuelle Modelle die Möglichkeit, Situationen nochmals „zu begehen". Andererseits ist der Erstellungsaufwand solcher Modelle im Gegensatz zu Foto- bzw. Filmaufnahmen sehr viel höher. Eine interessante Zwischenlösung bietet hier nun die 360°-Filmaufnahme, die anhand eines Weges die Betrachtung verschiedener Sichtwinkel zulässt. Eine Untersuchung über die Anwendbarkeit innerhalb von Planungsprozessen ist in Planung, war aber bei Drucklegung noch nicht abgeschlossen.

Neben dem naheliegenden Aspekt der Bestandsaufnahme sind die vorgestellten Technologien auch ein interessanter Aspekt in Bezug auf die Vermittlung von Planungsinhalten in der direkten Kommunikation zwischen Fachleuten und Laien. So lassen sich solche Techniken hervorragend auf Workshops innerhalb von Informationsveranstaltungen während der Bürgerbeteiligung verwenden. Auch die Möglichkeit auf viele der Technologien online zuzugreifen und Informationen über Planungen auch außerhalb von Events und Öffnungszeiten von Behörden zu beziehen, ist für die Transparenz, Akzeptanz und Kommunikation ein bedeutender Faktor. Gerade das Erleben von Neuplanungen aus der „First-Person-View" (FPV) kann ein interessanter Zusatzaspekt in der Vermittlung von Planungsabsichten sein. Diese Art der „Echtzeitplanung" (Zeile 2010) ist mittlerweile eine anerkannte Methode in Planungsprozessen.

Im Zusammenhang mit dem Forschungsthema „Raumerfassung und Raumwahrnehmung" bieten die oben genannte Technologien eine neue Möglichkeit, Raumeindrücke rein optisch, jenseits der Fotografie, aber mit einem dreidimensionalen Eindruck zu präsentieren. Anders als bei Testläufen in der Stadt oder auch der Natur werden hier nur optische Eindrücke präsentiert. Taktile, olfaktorische und auch akustische Faktoren können die Wahrnehmung hinsichtlich einer positiven als auch negativen Bewertung beeinflussen. Durch die reine Fokussierung auf optisch wahrnehmbare Faktoren kann eine Laborsituation geschaffen werden, die es zukünftig erlaubt, ästhetische Merkmale losgelöst von externen Einflussfaktoren zu untersuchen. In Kombination mit den Methoden und Technologien der Humansensorik zur Messung von körperlichen Reaktionen auf bestimmte urbane Umgebungen (Zeile et al. 2015) kann dieses Set-up eine Messung zur gestalterischen Qualität bestimmter Umgebungen ermöglichen. Diese Experimente sind in Vorbereitung.

4.3 Gesetzliche Rahmenbedingungen und Datenschutz

Die Aufnahme städtebaulicher Situationen mit den o.g. Techniken wird teilweise kontrovers diskutiert, gerade die Diskussion um „Blurmany", also Verpixelung von Immobilieneigentum im Google Dienst „Street View" muss hier noch einmal ins Gedächtnis gerufen werden (vgl. hierzu Zeile 2011:2.9). Jedoch weist die Bestandsaufnahme mit den oben vorgestellten Technologien einige Ähnlichkeiten auf: auch hier werden - jenseits der reinen Fotografie - mit technischen Hilfsmitteln und teilweise aus überhöhter Perspektive Aufnahmen von Situationen im Straßenraum erstellt. Werden die Aufnahmen nicht nur behörden-/bürointern genutzt werden, sondern sind diese auf einer Onlinepräsenz verfügbar oder auch bei einer Bürgerversammlung der Öffentlichkeit präsentiert, so sind folgende Parameter zu beachten:

„Der § 59 UrhG gestattet Aufnahmen von Gebäudeansichten, die von öffentlich zugänglichen Orten aus sichtbar sind – eine Verwendung von technischen Hilfsmitteln oder das Überwinden von Hindernissen zur Erlangung der Aufnahmen ist ohne Einwilligung des Rechteinhabers nicht zulässig" (Althoff 2010:96). Weiterhin gilt für Gebäude die Unterscheidung, ob sie Werke der Baukunst sind oder der Kategorie der Funkions-/ Zweckbauten angehören. Somit sind folgende weiter Paramete zu beachten (in Anlehung an Homann 2009:196ff, Althoff 2010:95ff und Zeile 2011:2.9):

Als Werk der Baukunst werden nur die Gebäude bezeichnet, die eine notwendige Schöpfungshöhe und Individualität aufweisen. Stehen diese Gebäude im öffentlichen Raum, so gilt eine Ausnahmeklausel, die die Verwendung der Aufnahmen erlaubt. Für Funktions- und Zweckbauten gilt die Klausel des Urheberschutzes von Baukunstwerken nicht. Weiterhin darf nur eine Aufnahme von Bildern auf öffentlich zugänglichen Wegen, Straßen oder Plätzen vorgenommen werden (Homann 2009:197) und „bei Werken der Baukunst reduziert sich die Privilegierung letztlich auf die Straßenfront der Baulichkeiten“ [ebd.]. „Die normale Digitalkamera in der Hand des Planers sollte dementsprechend für eine Bestandsaufnahme problemlos einsetzbar sein“ (Zeile 2011:2.9), wie jedoch die Aufnahme mit den neuen Consumer-Produkten zu bewerten ist, die eventuell auch als „technische Hilfsmittel“ angesehen werden, bleibt abzuwarten. Da diese Produkte mittlerweile Massenware sind, ähnlich wie Smartphones, müsste der Gesetzgeber für diese schon spezielle Nutzungsverbote aussprechen.

Die Wahrung der individuellen Persönlichkeitsrechte an einem Bild sind einzuhalten, die sicherste Variante ist hier die Verpixelung der Gesichter. Das Urhebergesetz formuliert dazu: Bei personenbezogenen Aufnahmen „ist es nicht erforderlich, dass überwiegende Kreise der Allgemeinheit den Betroffenen identifizieren können, es genügt vielmehr die Erkennbarkeit durch einen mehr oder minder großen Bekanntenkreis. Ist der Abgebildete erkennbar, dürfen nach §22 KunstUrhG Bildnisse grundsätzlich immer nur mit Einwilligung des Betroffenen verbreitet oder öffentlich zur Schau gestellt werden“ (Homann 2009:62). Für die Aufnahme von Personen auf öffentlichen Plätzen hat der Gesetzgeber jedoch auch Ausnahmen zugelassen. Personen, die in der Masse untergehen und nicht besonders heraus gestellt sind, dienen diese„Personen als Beiwerk neben einer Landschaft oder sonstigen Örtlichkeit“ (Homann 2009: S.193) und es greifen die Ausnahmetatbestände nach §23 Abs.I Nr.2 und Nr.3 KunstUrhG, eine Einwilligung der abgebildeten Personen nicht erforderlich (Althoff 2010:94).

5 FAZIT

Zur Erweiterung der klassischen Bestandaufnahme um dynamische Komponenten stehen mit der SketchUp-Modellierung und der Erfassung über 3D- und 360-Grad-Kameras mehrere Möglichkeiten zur Verfügung. Mit diesen ist es möglich, die klassische Bestandsaufnahme mit statischen Bildern, durch lebendige und realistische Aufnahmen zu ergänzen. Die Modellierung mit SketchUp ist mittlerweile schon im Planungsalltag etabliert, weißt jedoch einige Nachteile, wie der benötigte zeitliche Aufwand, auf. Die Komplexität des zu erfassenden Bestands führt zu der Notwendigkeit einer sehr zeitaufwendigen und detaillierten Bestandserfassung. Der somit aufgenommene Bestand wird am Computer nachmodelliert. Um diese zeitaufwendige Methode zu verkürzen und die Ergebnisse realer visualisierbar zu machen, kann auch die Erfassung über 3D- und 360-Grad-Kameras Anwendung finden. Statt in detaillierter Arbeit den Bestand zu vermessen und digital nachzubauen, erfolgt hierbei ein Abfilmen des Bestandes. Hierdurch reduziert sich der Zeitaufwand, trotz der notwendigen Videobearbeitung, um ein vielfaches. Die Ergebnisse der Erfassung verbessern sich zusätzlich, da die Realität später nicht nachgebaut dem Betrachter präsentiert wird, sondern die tatsächlich gefilmte Umgebung dargestellt ist.

Erfassungstechnik	Vorteile	Nachteile
Kodak PIXPRO SP360	Erfassung als Kugelpanorama möglich	Qualität Aufnahme/Auflösung
	Interaktive Blickwinkel möglich	
	Mittendrin-Gefühl	
GoPro 3D	Dreidimensionale Betrachtung	Kein individuelles Umsehen möglich
	Mittendrin-Gefühl	VR-/3D-Brille zum Betrachten nötig
SketchUp-Modell	Veränderungen leicht umzusetzen	Komplexe Modellierung
		Hoher Zeitaufwand

Tabelle 1: Vor- und Nachteile der Erfassungstechniken

Zur Simulation des menschlichen Sichtfeldes weisen die betrachteten Techniken zum Teil erhebliche Unterschiede auf. Je nach Anwendungsbereich muss es sich bei diesen technischen Limitierungen aber nicht zwingend um Nachteile handeln, sondern sie bieten hiermit andere Möglichkeiten der Betrachtung gezielter Fragen der Forschung in der Raumwahrnehmung. An dieser Stelle knüpft auch der Bereich der sensorischen Messung an, bei der unter anderem der Immersionsgrad, d.h. der Realismus der erlebten virtuellen Realität, erforscht werden soll. Von dieser Kombination aus VR-System und psycho-physiologischer Messung werden objektive Einblicke in das subjektive Empfinden der Probanden beim Erleben der virtuellen Welt erwartet. Bei diesen Messungen handelt es sich ebenso um weiteren Forschungsbedarf wie bei der notwendigen Betrachtung technischer Neuentwicklungen, mit denen das VR-Set-Up parallel verbessert werden soll.

6 AKTUELLE ENTWICKLUNGEN UND WEITERER FORSCHUNGSBEDARF

Für die kommenden Jahre sind weitere Kameramodelle angekündigt, die die Möglichkeiten der Raumerfassung bereichern könnten. Besonders interessant für diesen Einsatzzweck kann die VUZE Camera sein. Diese Kamera soll dreidimensionale Rundumaufnahmen erzeugen (Vuze, 2015) und somit die vorgestellten Möglichkeiten der Raumerfassung, welche mit dem GoPro 3D-System und der Kodak PIXPRO SP360 einzeln durchführbar sind, in einer Kamera vereinen. Interessant ist auch das Projekt „Smart Helmets" von BRG Sports, welches im Herbst 2016 unter anderem in Fahrradhelme integrierte 360-Grad-Kameras auf den Markt bringen will (Pinkbike, 2016). Bei dieser Technik ist vor allem die Aufnahmeposition der Kameras interessant, welche in etwa der Blickhöhe von Menschen beim Begehen der realen Welt entspricht. Weiterer Forschungsbedarf besteht in der Durchführung der Raumerfassung. Hier gilt es zu testen, ob auch eine mit einer Kamera ausgestattete Drohne oder ein entsprechend ausgerüstetes Auto, ähnlich den von Google beim Projekt Street View eingesetzten Fahrzeugen, als Hilfsmittel zur Bestandserfassung nutzbar sind. Auch die Begleitung eines Planungsprojekts, von der Bestandsaufnahme bis zur planerischen Konzeption, kann für die weitere Forschung interessante Aspekte liefern und der Prüfung der Alltagstauglichkeit dieser Raumerfassungsmethode dienen. Zudem ist es denkbar, mit einer solchen Erfassung eine Laborsituation für Messungen der Raumwahrnehmung zu schaffen. Da die urbane Situation, welche Probanden in den Videos erleben, für eine große Anzahl von Probanden gleich wäre, kann hier die Möglichkeit bestehen, Messwerte zu erhalten und vergleichbar zu machen.

Alle diese Ansätze dienen zur Erstellung von städtischen, digitalen Umgebungen, die es ermöglichen sollen, in Zukunft Gestaltphänome unabhängig von externen Einflüssen wie Angst vor Verkehr, Gerüchen, Menschenmassen oder anderen Faktoren zu untersuchen. So wären auch Architekturentwürfe mehr auf ihre „Gestaltwirkung" hin zu überprüfen, die Wirkung von Farben wären eine zusätzliche Komponente der Wahrnehmung. Generelle Prinzipien von Gestaltung wie der Goldene Schnitt oder die typischen Proportionen von Platzgestaltungen in Hinblick auf die angenehme Wahrnehmung wären auch neu überprüfbar bzw. könnten so auch gemsessen werden mithilfe humansensorischer Messungen.

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Semantic Medical Care in Smart Cities

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1 ABSTRACT

Medical care is a vitally important part of successful smart cities further development. High quality medical treatment has always been a challenging task for administrative departments of cities government. The key reason is that the treatment of patients significantly depends on the skills of medical stuff that can hardly be controlled and estimated. Semantic technologies by now have showed capabilities to solve highly complicated badly formalized problems in conditions of uncertainty. It makes reasonable to apply them in medical domain. In the paper a real example of information system for semantic medical care is presented. The system is being developed for Federal Almazov North-West Medical Research Centre in St-Petersburg, Russia (http://www.almazovcentre.ru/?lang=en). The main attention is paid to the proposed solution for the problem of medical treatment estimation in administrative and managerial departments. We focus on medical treatment examinations matching, trend analysis and administrative analytical and prediction task solving making use of semantic technologies, statistical analysis and deep learning applied to huge amounts of diverse data. Semantic medical data analysis project is an attempt to proceed to semantic medicine - an interoperable approach to medical domain area.

Keywords: Smart City, Urban Planning, Deep Learning, Medical Data, semantic technologies

2 INTRODUCTION

Medical data is growing dramatically every year, the volume of this knowledge doubles every two years. With large-scale digitization, several medical engines went on display, such as public searching systems of biomedical literature, specialized catalogues and indices for health workers and quality management systems. The latter of which is most significant, because it allows setting the feedback during treatment and influences the results in real time. However, while quality management systems have a significant contribution to making large medical databases accessible, their users often have to deal with the burden of browsing and filtering the numerous results of their queries in order to find and analyze the precise information they were looking for. This point is more crucial for practitioners who may need an immediate response to their queries during their work and for administrative workers who need to control and improve the process of treatment.

When we talk about the purposes of health care, the main ones are to increase the level of public health and satisfy needs for qualified medical aid. At first glance, these tasks are easily solved, but they encapsulate a set of problems. Nowadays quality of medical care is considered from different perspectives - effectiveness, sufficiency, economy and moral standards. There are also many different definitions of qualitative medical help, such as interaction between doctor and patient, physician's ability to reduce the risk of disease progression and the emergence of a new pathological process, optimal use of medical resources. So many aspects of the one process cause complexity not only for analysis, but for comprehending as well.

Formalization of medical processes meets a number of problems:

(1) Each patient is a unique living organism. Results of treatment depend on its own peculiar features, current state and whole case history. Existence of these factors makes the majority of pattern-based approaches insolvent.

(2) The state of the organisms rapidly changes in time. The changes take place in conditions of occurring planned and unexpected events. The consequences of events usually come only in some time after the event. Besides each event is supposed to be considered in relation to other events. Dealing with events requires application of fuzzy temporal logic that is highly complicated.

(3) Joint usage of medicines for patient treatment can take different effect depending on the combination of medicines, earlier prescribed medicines and conditions of their taking. It means that doctors prescribe medicines is conditions of uncertainty.

(4) Gathered data about a patient requires efforts for its understanding and consumption. The data is scrappy as the parameters that describe the patients' state are measured from time to time. Moreover, the timelines of the results of the measurements and occurred events are not coherent. Data must be preprocessed using mathematical and statistical procedures.

Unfortunately these technologies cannot be directly used for raw objective and subjective medical data processing and analyses. It is proposed to use deep learning models, methods and algorithms to extract information and knowledge from initial data and represent it in standard formats that are supported by semantic stack.

In this context, we need system able to respond to administrative worker queries fast and accurate. Responses should allow manager to track health care dynamics, identify the causes and react on them.

3 BACKGROUND AND PROBLEM STATEMENT

Nowadays many quality management and medical information systems provide basic services. Information systems have penetrated and became an indispensible part of city medicine from online register offices for medical appointments to diagnostic systems based on symptoms and high-load distributed among the medical establishments medical error reporting information systems aimed at patient safety intervention (Riga M.). However, automated diagnostics and treatment systems (Edvin C.) appear to be a double-edged sword if law background is taken into account: a doctor is a legally responsible person, thus, he is punished by law in case of wrong diagnosis and treatment, or, in worst case, in case of patient's death. If obligations are imposed on the information system, there is nobody to blame, which is unacceptable in most of the establishments. Therefore, we have no intentions to overview or develop any system claiming to replace the doctor.

Most of the existing researches are focused on telecare medical information systems (TMIS), i.e. a set of various medical services for patients and practitioners (Zeeshan S. et al, Qi J. et al, Dheerenda M.), however, most of such systems are no more than a way of communication between patients and doctors and a way to store medical records and identify the patient, which is still far away from intelligent medicine managerial information system. Some of investigations are dedicated to Internet of Things among medical measuring devices to obtain telemetric indicators of patient's state (Boyi X. et al). Other researchers spot on automatization of medical processes in dedicated sections or examinations like automated optics calculation in ophthalmology (Nilanjan D., et al), which is undoubtfully a magnificent and convenient way to simplify doctors' routine tasks, but does not provide a way of comprehensive analysis and automation of all time-consuming routine processes of doctors' and administration workflow as a result of lack of structured knowledge instead of data and algorithms to process it. In accordance with the identified problems, the great solution may be adding the semantic aspect to the technology stack of the system which allows processing meaning and knowledge, but not the raw data.

Recently there has been an explosion of new data sources about diseases, drugs and treatments. Integration of these data sources and the identification of patterns that go across them are of critical interest. Through integrated and intelligent data mining, this information could provide important insights into the complex functions of the process. However, this can only be achieved when data is semantically integrated (i.e. using multiple data sources that are connected in meaningful ways) and in particular when all resources are brought together in such a framework.

There are critical problems in medicine that can only be solved through computational analysis of this kind of integrated information about every patient and its case history. For example, it is considered increasingly important to profile existing and potential new drugs for their effects across many targets, not just a single target of interest. Only by exploring the relationships of the drugs to a wide body of target information can we determine this profile.

Further, we can determine the ability of physician actions and drugs to influence at multiple points of treatment process, this will provide more robust efficacy in subsequent ones. Relationships between these pathways and potential side effects of drugs can only be determined by large-scale analysis.

Implementing such an integrated system involves creation of large networks of linked entities from multiple, heterogeneous and unstructed sources. It must give a possibility to query these data in ways that go beyond querying from a single source and allow inferencing among cross-domain information (medicine domain and complementary domains). Currently, there are significant barriers to carry out this kind of analysis. Many of the needed data sources overlap and cover similar data (we refer to them as homogenous or semi-homogenous data sources) but with slightly different foci. All data sources also tend to be published in very diverse formats (text files, journals, XML, relational databases) and may be structured or unstructured. The semantic relationship of these datasets to each other is often unclear.

Recent Semantic Web technologies provide efficient ways to integrate heterogeneous data. Various semantic languages have been established to represent and query semantic meaning of data and relationship. Our main goal and intention is to survey and design a system to support doctors and other medical establishment workers in routine task solving: matching of objective analysis data and medical notes, verification of treatment regimes including lack or excess of treatment, a set of predictive or analytical tasks for research purposes and other problems which are not contrary to law, in other words, managerial tasks and a set of doctors routine tasks.

4 SMDA PROJECT

SMDA (Semantic Medical Data Analysis) project for Federal Almazov North-West Medical Research Center (Saint-Petersburg) is an attempt to extract data in medical domain area and build an aggregated knowledge base and system following ontological approach, enabling complicated analytics, diagnosis comparison and control based on both objective numerical indicators and subjective certificates and prescriptions. Main challenges within the domain we deal with are:

(1) a multi-stage service-driven natural language processing to analyse and process medical certificates and prescriptions including concept matching to collate synonymous concepts within domain lexicon and terminology;

(2) high-performance unstructured data extraction, big data processing to gather, aggregate and analyse flows of madical data in s scalable way to provide universality;

(3) building and providing formal models for medical data, information and knowledge representation in a vivid and easy-to manage way;

(4) ontology learning, design and population and deep learning to produce a powerful knowledge base in order to meet system consistency requirements;

(5) building a linked semantic data space based on knowledge graphs and a set of ontologies related with medicine and complementary domains for continuous knowledge usage, refinement and enrichment;

(6) methods and algorithms for adaptive medical data real-time processing and analysis;

(7) semantic business logic implementation as a dynamic medical business process design, configuration and execution;

(8) design and implementation of a framework for semantical medical systems in such a way that the target establishment or a complete domain area may be changed and the system may be adopted to it using a flexible agile approach;

(9) rule-driven productive logical inference to process, analyze and verify data and make predictions;

(10) providing a functional stack of smart services for each specific task and workplace and combine them into semantic service network including coherent set of services selected from global net of services as well as internal services designed for particular specific tasks.

A combination of solutions for mentioned challenges provides a technological stack and framework to build up the distrubuted service-based system with the following resulting functionality:

(1) use of multimodal data sources including both structured and unstructured;

(2) linked data, information and knowledge space providing both human-readable and machine-comprehensible data;

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Editors: Manfred SCHRENK, Vasily V. POPOVICH, Peter ZEILE, Pietro ELISEI, Clemens BEYER

(3) complicated analytics for doctors, econimists and administration as a step to next level of solution application;

(4) adaptive model-driven business processes, solutions for complicated issues within the context;

(5) agile ontology-based architecture of SMDA systems to meet the needs of all-level end users within the domain of medicine.

4.1 Prototype overview

The platform is constituted of a number of layers including a number of components grouped by tasks: storage, internal processing and external processing. The central part of the platform is internal domain-oriented semantic processing of data including domain area (input and output of domain-oriented information), processing (based on stream of incoming data, information and knowledge, DIK) and semantic blocks (storage of knowledge and tools to process and display knowledge and produce new knowledge). The central part of the system appearing to be the server is a combination of components (Fig. 1) interacting with each other in some way and having a common source input and client output interfaces to provide the system with unstructered or semi-structured data, exucute processing stages on the server side and present the results of processing to managerial personell. The input dataflow requires data transformation from raw unstructured representation into a well-defined semantic form which includes preprocessing, processing and postprocessing followed by storing into a knowledge base formed of an integration of semantic components and services such as triple store (BlazeGraph), knowledge management (MetaPhacts) and visualization (OntoDia) sybsystems as well as a separate model of semantic service graph not discussed within the paper as a separate work is required. Note that preprocessed semi-structured data is stored as well in InterSystems DB Cache and provided with interaction interfaces to deal with numerical objective data and textual data (concepts and concept relation in described case).

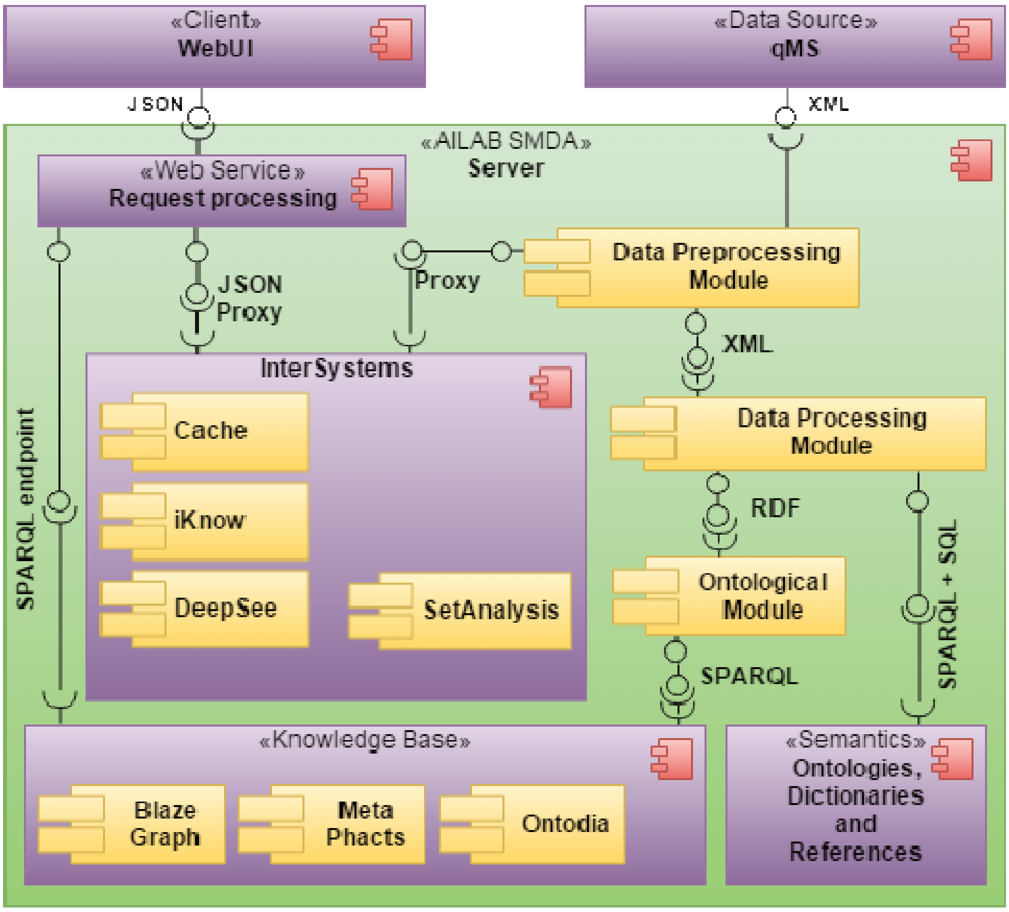

Fig. 1. SMDA simplified component diagram

All interactions between the components depending on the level of data structure are implemented via standard interfaces: XML and JSON for semi-strutured and structured data exchange, RDF upload API to import datasets into a triple store of knowledge base and SPARQL-endpoint for inference and interaction with the knowledge base while request processing.

A separate but tightly integrated component is a layer of external services and a set of complementary ontologies, dictionaries, standards and references for the task of knowledge enrichment and inference. External services are a set of single-task APIs described in the knowledge base together with internal services supported by input data format and structure requirements, output data format and structure, descriptions and deployment URLs to form a semantic service graph providing an interface for building-up a processing chain depending on input data format and desired output (requested administrative task). For better reliability and robustness all of the internal components may be either deployed at one physical server or distributed among separate machines on conditions of proper backup (Fig. 2).

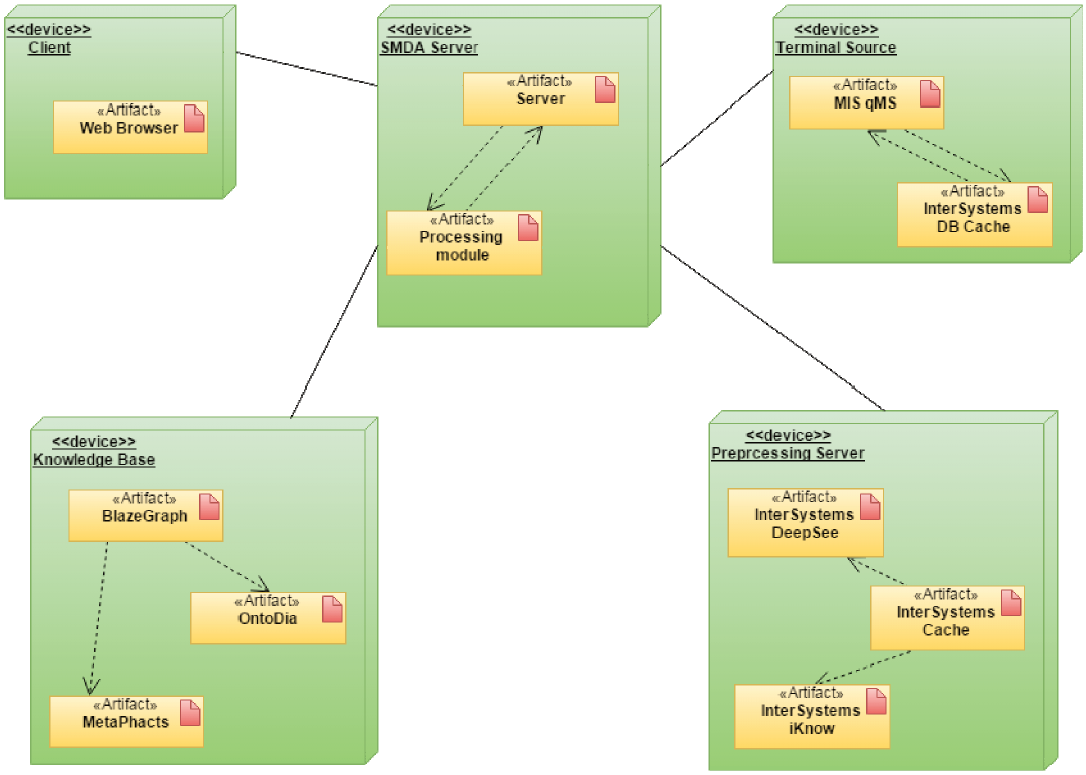

Fig. 2. Component deployment diagram

4.2 Workflow and data processing pipelines

All medical data of Almazov medical center is presented by objective numerical data (analysis and examination indicators provided with measurement units), organoleptic test indicators and textual subjective notes and image data which assumes at least three parallel data processing pipelines. We omit image data processing for the prototype as in requires special expert knowledge to develop a set of methods and focus on numerical and textual data processing pipelines (Fig. 3).

Numerical data is a subset of objective data obtained from results of analyses, examinations and measurements of patient's state (blood test, blood pressure, body temperature and others) as well as demographics (current age, date of birth, sex and others). This kind of data, in general, is presented by numbers, number pairs or number intervals accompanied by measuring unit and timestamp in various formats which are to be unified for further processing and analyses. Objective data is the main source for managerial statistical and research tasks which requires a powerful math unit provided by semantic service graph. Numeric data processing includes measuring unit refinement as far as units are textual data pieces and lack in standardization within the domain; formatting of floating-point numbers as they are initially provided as text strings; storing preprocessed data into a database with respect to domain object model. In the course of further postprocessing tasks on administration request all required numerical data undergoes specific calculations and comparison with norms depending on patients' age and sex to present statistical overview and trends of needed data section. However, not only is objective data required for most of the administrative tasks, information distributed over medical certificates and notes matters as well.

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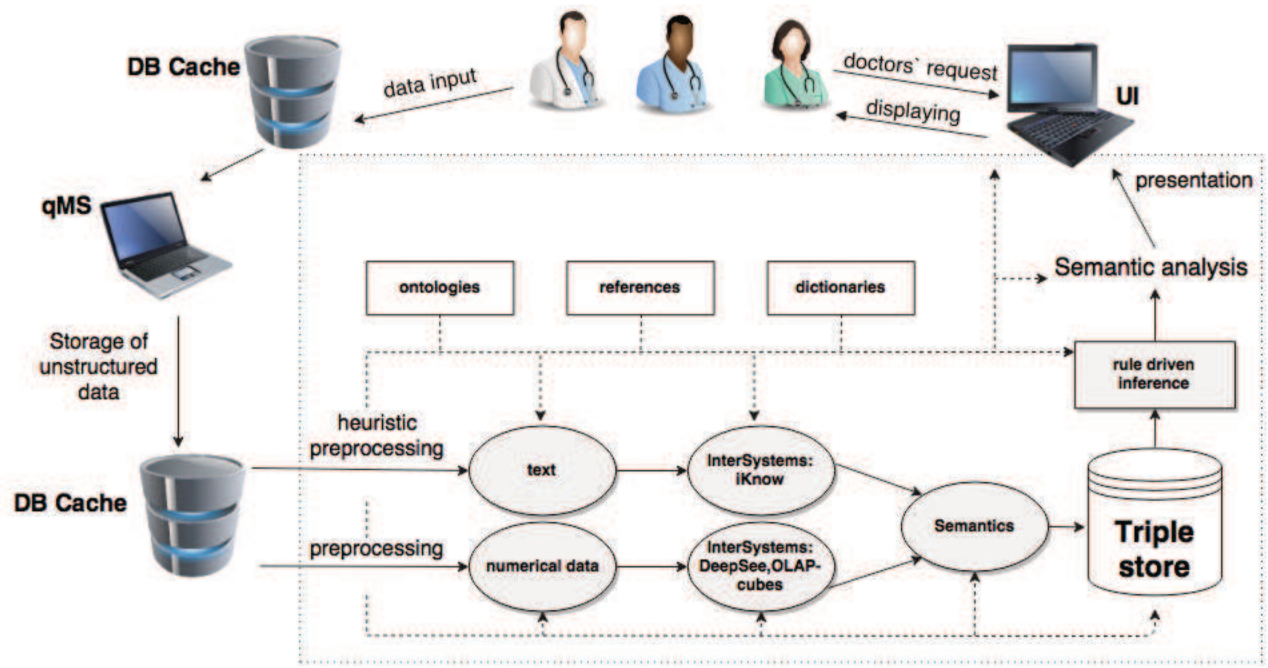

Fig. 3. Workflow and data processing pipelines

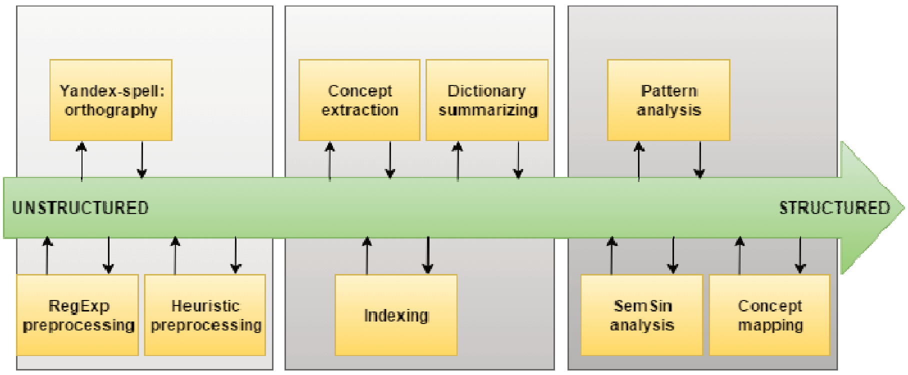

Fig. 4. Textual data processing pipeline

Manual thorough textual data analysis has shown that medical texts are specific domain-area related text pieces possessing a number of traits which leads to lack of possibility to treat them as usual textual data by widely used classification tools. Our tool needs deep analysis of medical documents in order to extract relevant information. At the first level of this information come the medical entities (e.g. diseases, drugs, symptoms). At the second, more complicated level, comes the extraction of semantic relationships between these entities. Information extraction is a complex task which is necessary to develop high-precision information retrieval tools. Our approach is based on the use of linguistic patterns. For every couple of medical entities, we collect the possible relations between their semantic types (e.g. between the semantic types Therapeutic or Preventive Procedure and Disease or Syndrome there are a few relations: treats, prevents, complicates, etc.). We construct patterns for each relation type and match them with the sentences in order to identify the correct relation. The relation extraction process relies on two criteria: (i) a degree of specialization associated to each pattern and (ii) an empirically-fixed order associated to each relation type which allows ordering the patterns to be matched. We target six relation types: treats, prevents, causes, complicates, diagnoses and sign or symptom.

Every textual note undergoes a number of preprocessing and processing stages before being stored into a knowledge base which are out of the scope of this work and are to be proposed in a dedicated paper. Nevertheless, we mention the chain in brief (Fig. 4):

(1) text refinement and purification by means of regular expressions heuristics to eliminate domain-specific noise as a result of human factor and restricted time reception at the doctor causing contractions and abbreviations;

(2) further text preprocessing making use of internal and external services mostly aimed at spell-checking and mistake correction;

(3) text conceptualization (concept and relation extraction) by means of InterSystems iKnow;

(4) semi-automated thesauri organization with a help of involved experts within the domain area or from the establishment, mainly to match establishment-specific synonymous lexemes and collations;

(5) structural analysis of the text by means of SemSin tool to extract sentence structure in a machine-processible xml form;

(6) pattern analysis based on predefined templates (experts are involved) and mentioned above thesauri to form the triples to be stored into a knowledge graph.

Now, when all raw data, both numerical and textual, is transformed into semantics (a data-set of triples "subject" - "predicate" - "object") and stored into the triple store, it becomes available for semantic analyses on requested user tasks involving external linked data sources, ontological and productive inference.

5 SEMANTIC IN SMDA PROJECT

Semantic layer of semantic medical data analysis project is represented by a number of third-party platforms, specific tools and services, triple store, medicine ontology and complementary ontology, inference engine and s set of thesauri, references and dictionaries to form a semantic knowledge and service graph for flexible task solving. The third-party tools we use for particular storage and analysis tasks include:

(1) BlazeGraph used as a triple store and SPARQL-endpoint for graph search and knowledge inference and a high-performance knowledge base graph platform, supporting RDF in a scalable and flexible way;

(2) MetaPhacts as a platform providing solutions and a number of services to describe, query and interchang graph-based data, as well as a way for visual analysis and interaction with knowledge graphs;

(3) OntoDia as free and user-friendly online OWL and RDF diagramming tool to present a knowledge base;

(4) Apache Jena as an open source fre of charge Java framework for Semantic Web and Linked Data applications based on onologies and elements of enference.

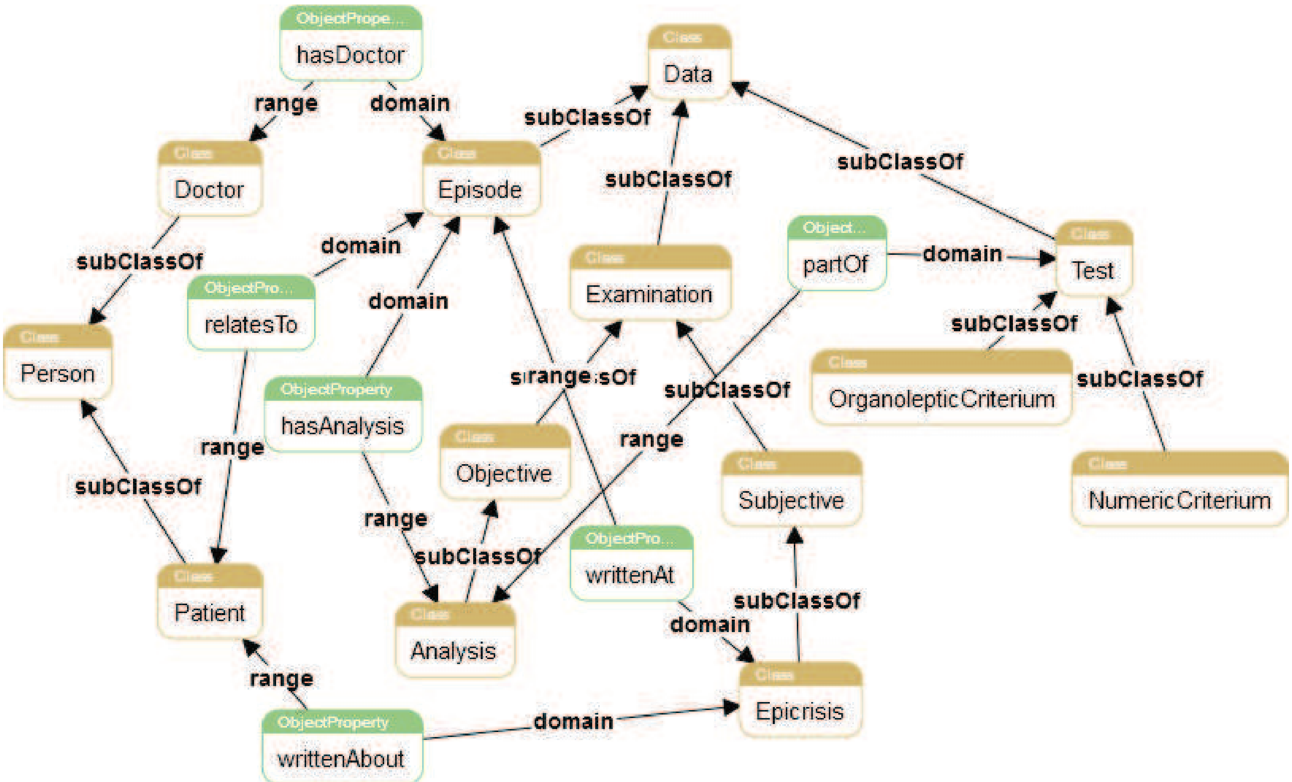

Fig. 5. A prototype subontology of SMDA-ontology

The central part of ouur system semantic core is a knowledge base, which includes semantic service knowledge graph, medical ontologies, references and thesauri as well as context-aware well-structured

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semantic establishment-specific medical data covered by SMDA-ontology (Fig. 5). The processes, technologies and tools for performing preprocessing tasks to populate the knowledge base are outside the scope of this paper and describes in dedeicated works, the brief process is presented in previous sections.

6 CASE STUDY

6.1 Objective and subjective data matching

One of the best ways to evaluate the effectiveness of physician is to match objective and subjective data of the treatment process. It means that we compare current situation with a standard sequence. Objective data includes precise results of analysis and examinations. It is presented by objective numerical data (indicators provided with measurement units). Subjective data are physician notes and records, which are usually textual, unstructed and hard to distinguish and process automatically. This data is often based on objective parameters. Comparison of these data types allows administrative officer to determine physicians' mistakes. The most common of them are misdiagnosis, prescribing unnecessary test and procedures, wrong medication reception, choosing wrong treatment regimen and incompetence in the matter of a particular field.

At first glance, this method of comparison allows us to consider the error only after the fact, when the patient's health is already irretrievably damaged. But firstly, it will prevent such incidents in the future, by excluding negative influencing factors. Secondly, it will provide us with basic knowledge for further identification of such patterns of behavior or qualification and solve the problems in the early stages.

Example: Percentage of diagnosis "hypertension" increased in the abstract cardiology department. After a couple of complaints on the treatment the comparison according to the above scenario was done. That revealed the incompetence of the doctor which having objective indicators of low pressure of the patient made the opposite diagnosis. The reasons for this behavior have been clarified on the spot, measures have been taken, and most importantly - primary knowledge about the incident (exact numeric statistics) have been received. Soon it will identify similar chain of events.

The above method will work even if the problem will not come from the doctor, and lies, for example, under the faulty equipment, which initially gave the wrong allegedly objective data. Any deviation from the standard will be noticed.

6.2 Statistical data analysis for managerial and research tasks

In addition to improving efficiency in specific areas, it is important to observe the general dynamics of the processes that are directly related to medicine. Basically it is simple and well-structured global data. The most common statistic - a mortality distribution by diagnosis and detected diseases, trends in the market of medicines and medical equipment. Even these raw data bring benefits, suffice to visualize them in the right way and to provide a convenient interface for manipulating them.

6.3 Productive and analytical functionality for trend analysis

Having a knowledge base with sufficient precision, but different data, you can make the process of interlinking these data with other data pieces. On the basis of these relationships we can make inferences. This will reveal previously unnoticed dependencies and trends which significantly optimizes the processes taken separately.

As in the previous method, the information we get will be used as the initial data for further machine learning, in order to avoid repetition of implicit errors .

7 CONCLUSION

In this study we showed that introduced techniques and technological stack are applicable for the issue of medical routine tasks automatization and managerial analysis efficiency and trends. Along with the techniques we introduced a tool-chain that potentially dramatically improves the quality medical service and treatment as a result of continuous effectiveness control an preventive measures after early identification of mistakes or poor qualification. However, the system we propose is not a way to undermine the authority of physicians. We propose a way to make city medicine more smart on the way to semantic medicine as a new paradigm of healthcare. We just assume that human factor is possible in any domain.

Despite the prospects we spot, the prototype is to be improved dramatically to provide a powerful, stable and reliable solution. Investigation and analyses of further cases are desired as well as smart context-sensitive user interface so that managerial tasks are implemented in a completely semantic way.

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Semantic Platform for Building Coherent Net of Smart Services

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1 ABSTRACT

Information infrastrucrure of modern cities has been developing very intensivly and nowadays a lot of new services appear and a problem of their integration has become evident. Existing integration solutions used both in frames of enterprise information system and Internet-oriented solutions are not efficient enough when scaled to city infrastructure. In this paper an integration platform based on semantic technologies is proposed. The services and their peculiar features are described in ontology. Now semantic platforms are effectively used in a number of applied domains for solving a wide range of problems, for example, support of medical and administrative processes in medical centers. Semantic smart services networkes are shown to be an efficient intelligent way of building a data processing chain for diverse input state of structure and varied desired output format or stage in a flexible way. We present one of the examples of using smart services for doctor routine tasks to present the temporal data in a convenient inlelligent way.

Keywords: Building Network, BIM, integration technologies, semantic platform, smart services

2 INTRODUCTION

Information infrastrucrure of modern cities has been developping incredibly fast over last decades. Improvement of all kinds of services has been impatiently demanded by end users in all domains who where forced to keep up-to-date not to lose ground in their spheres of interest. As a result, the majority of services used now are high-quality services that meet the extended requirements of end users. They can be definitely called smart services. The proplem is that there are a lot of services, but they are not compatible with each other. They can hardly be considered as elements of complicated business processes. It leads to creation of new services with duplicating functionality. Observed dynamics of service market development and its short term prediction clearly shows that in near future it will be impossible to satisfy all requests for new services and service infrastructure will become overheated. At the level of enterprises the problem is commonly solved by means of enterprise service bus, at the level of WWW – due to building and overall application of semantic web services. For the level of cities still there are no solutions that allow building complex logical structures based on existing services. The most obvious way for services integration is their unification. Even this simple solution is unimplementable for two reasons. First, it requires huge resources that depend on the total number of services. Second, it can affect the functionality of the services that is inadmissible for end users. So, one can say that at the level of the city integration solutions based on enterprise service bus are too light but Internet oriented solutions such as semantic web servises are too heavy.

In this paper we propose a platform for agile service integration that allows linking services using semantic technologies. The platform does not generate additional requirements to services or imposes any restrictions. It supports linking services and, thus, building a net of services. Furthermore, it can reveal possible links between services that can enrich the service infrastructure. Sematic technologies form the base for integration platform. The services and their peculiar features are described in the platform ontology using OWL language. The OWL description of the services clarifies reasonable cases and ways for services usage. Similar approach is used for describing logic of complex services application. The processes of services interaction are defined in ontologies as well. For logic description BPEL is used.

3 BUISNESS PROCESSES, ONTOLOGIES AND KNOWLEDGE GRAPHS

Semantic service integration, state of the art: R&D in the domain of automatic generation of business processes is being realized for at least 15 years. By the most part web services that are used in the process have semantic description. Such approach is called semantic web services (SWS) approach. Essential results

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have been achieved in this sphere [1, 2]. OWL-S standard was proposed [3]. Certain results have been received in the domain of semantic grid services [4]. Detailed analysis of the problem of semantic integration of web services one can find in [1]. Described approaches can be classified as Internet-oriented or heavy-wheight solutions. Nowadays it becomes more and more evident that in the nearest future general solution of the problem of 'on the fly' generation of business processes on the base of semantic solutions will be strongly claimed.

For solving the problem of autumatic generation of BP on the base of existing services for city information systems more simple solutions can be used. They can be classified as light weight SWS (LW SWS).

Idea of suggested approach: The main idea of suggested approach is usage of ontology based knowledge graph (RG) which describes all possible business processes. Needed business processes are tailored from the KG. So we have semidistributed system. To KB of buisness servises an agile integration platform is required. The platform must meet the following requirements:

i) the platform must be able to generate business processes on the fly or manually,

ii) a user can see generateg BP and can correct it,

iii) the platform must have agile features, i.e. if context is changed the selected path in KG must be corrected,

iv) the corrections will define changes in the corresponding BP,

iv) the platform must provide possibility to change BP structure inaccordance with results of executed operations,

v) the platform must be easy to use, a user can form BP by defining its goal.

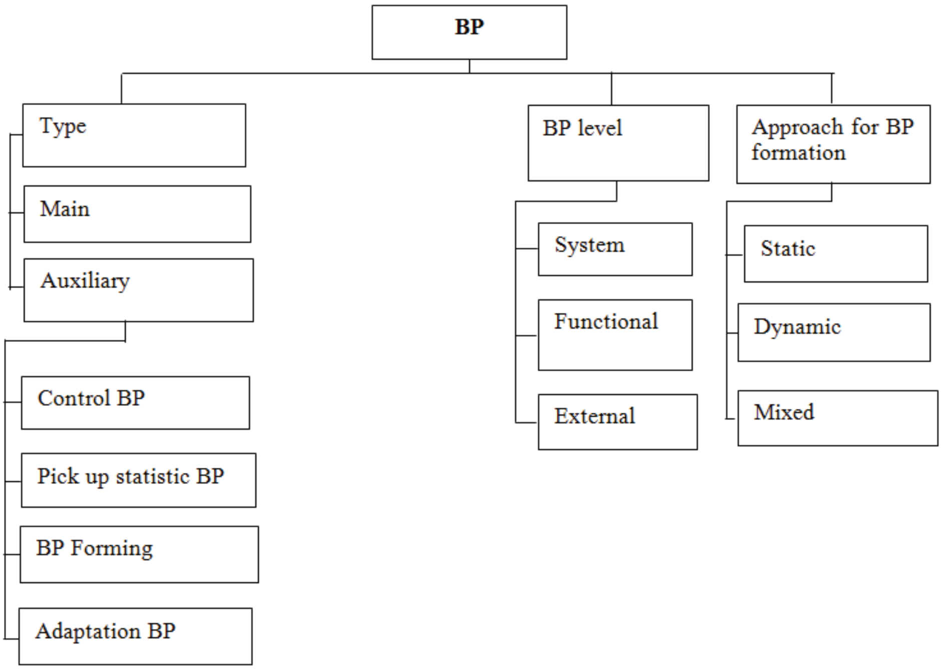

Fig. 1. Approaches to BP implementation

4 AGILE BUSINESS PROCESSES AND SEMANTIC SERVICES

In order to describe suggested approach to building BP on the base of knowledge graphs the following main terms are used: technology, pattern, service and business process (BP).

Technology defines a sequence of steps to be done to solve the problem. Steps are described in general, they may be described even in business terms. Technology can also be defined as not ordered or partially ordered set of method, algorithms, patterns, libraries, services or scripts and a set of business rules and restrictions concerned to business rules. Technology is built on the base of ontological models.

Pattern (business process pattern or abstract business process) is a description of steps to be done to solve the problem described in terms of concrete technology. One can build a pattern in statics in run time mode. It is described by the oriented graph. Pattern is associated with the target. A target-oriented pattern can be conceded as a part of a technology. Pattern is to be used for creation of an executable model of buisness process, i. e. UML model. Then using proper tool it is possible to receive executable code in any form (application, library, service, script, bpel, set of business rules etc).

Business processes: BP (Fig. 1) is a process of invokation of BP of lower level in defined order. BP can be invoked in sequence, parallel or mixed mode. BP can be planned in static or in dynamic mode. Static BP as a rule is realized with the help of bpel or other script language. Dynamic BP can be realized by means of business rulus or sematic web services. Agile BP can be defined as BP which can be adapted to context. Different mechanisms can be used for adaptivity realization. The main one is formation of BP in run time.

Service view point on buisness processes (SVP). SVP can be concided as one of key archtectural view points on buisness processes. In SVP BP are described as triples: **SVP ={S, BP, M},** where S is a set of services, **BP** is a set of **BP** and **M** is a set of BP control stratagies. BP can ivoke services. It also can be ivoked as a service. A service can be realized as BP.

As a rule servises are correlated with levels such as infrastructure servises, system services, busines services and external services.

Infrastructure servises are a low level services, for example, naming service, life cycle services. They are used as elements for building higher level services. System services are composite service realized as business procecces. Their opration is described in terms of subject domain.

Business servises are high level services, their opration is described in business terms. Business services are formed as a composition of system services.

External services are high level services which are to be used for realization of B2B interaction. As a rule they are also business services.

Types of services. From the point of view of tasks to be solved by a service, services can be classified in the following way: functional services, data, information, knowledge (DIK) services, interpreters (engines) and auxiliary services.

Functional services realize procedures of DIK processing. The main types of functional service are transformation services, harmonization services and integration and fusion services.

DIK servises can be divided into 3 groups: services that realize get-set functions for DIK, services for DIK search and mining (data mining, process mining).

Interpreters (engines) are used as scripts interpreters. It may be bpel-engine, business rules engine, sws-engine, etc.

Auxiliary services are used for realization such infrastructure functions as life cycle support, security, etc.

BP management strategies. One can use following strategy: directive strategy, data flow driven strategy, demand driven strategy and resource driven strategy.

Directive strategy – the order of services invocation is defined on the stage of BP forming. This strategy can be realized with the help of i.e. bpel.

Data flow driven strategy – the single precondition of the strategy is that input data for service invoke is available. Implementation of this approach needs special script languages.

Demand driven strategy - the precondition for service invocation is request for results of service operation. For the strategy implementation as a rule 2 passes are used. First step is creation of the graph of requests (BP graph); on the second pass the BP is realized. This approach is used for BP formation in dynamic mode. This 2 passes (stages) can be overlapped.

Resource driven strategy: as a rule is used as an auxiliary one when there is not enough resources to realize all required tasks in parallel.

5 AGILE INTEGRATION PLATFORM

Agile software development approach supposes a series of interactive methods and techniques based on dynamically changing technical requirements to provide their implementation as a result of intercommunication and contribution of diversely qualified engineers and specialists. We propose agile approach for the platform (Fig. 2) for the reason that all kinds of personell is desirable provided that the

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Editors: Manfred SCHRENK, Vasily V. POPOVICH, Peter ZEILE, Pietro ELISEI, Clemens BEYER

framework is a multi-layer system at the intersection point of a number of domains causing an unability to obtain developers of same qualification within all of the fields.

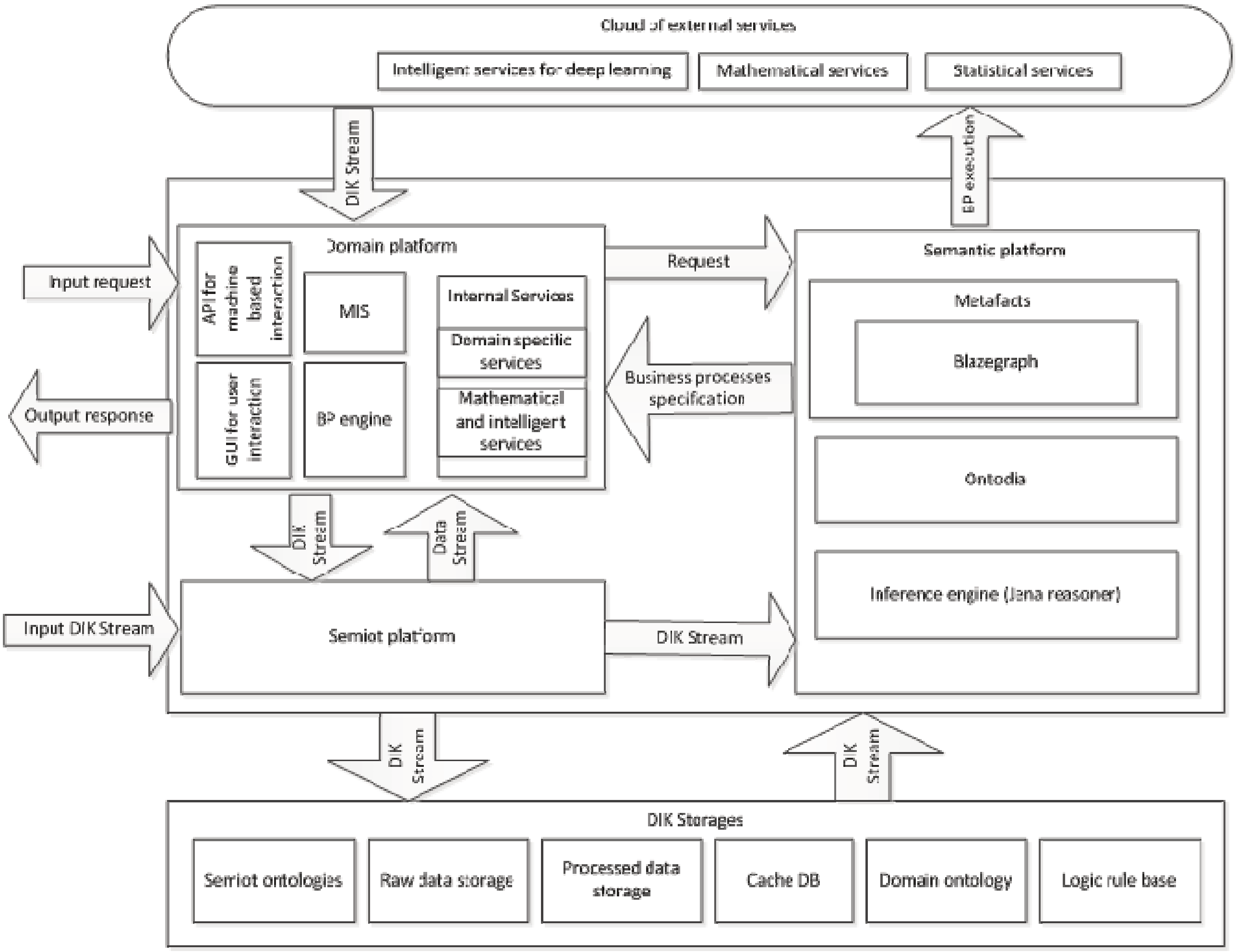

Fig. 2. Structure, breif description of the components and logic of their interaction

The platform is constituted of a number of layers including a number of components grouped by tasks: storage, internal processing and external processing. The central part of the platform is internal domain-oriented semantic processing of data including domain area (input and output of domain-oriented information), processing (based on stream of incoming data, information and knowledge, DIK) and semantic blocks (storage of knowledge and tools to process and display knowledge and produce new knowledge). We give more information on each block below:

Semantic platform as a component of knowledge storage base and queries, production-rule-based inference and knowledge base display and analysis:

(1) BlazeGraph as a scalable and flexible triple store and SPARQL-endpoint for search and inference and a high-performance graph database platform with support of RDF for knowledge data-set upload with a support of up to 50 billion edges;

(2) MetaPhacts as a product providing powerful solutions and numerous services for describing, querying and interchanging graph-based data, as well as a user-oriented open platform to visualize and interact with knowledge graphs;

(3) OntoDia as a simple and free of charge online OWL and RDF diagramming tool to represent a knowledge base with no programming involved;

(4) Apache Jena as a free and open source framework for Java to build Semantic Web and Linked Data applications based on onologies and elements of enference (needs to be supported with powerful inference engines based on pruduction logic such as Drools).

Semiot platform is a platform for gathering data from sensors and web services and providing data for semantic processing and analyses.

Domain platform including a wide range of tools from initial data display tools (information systems, IS) to data processing (domain-specific and internal intelligent services) to provide a processing pipeline from input as an API request to user interface as a result of all processing stages requested by user.

All of the raw, preprocessed and semantically processed data are stored in a lower layer in a data storage of four data state levels: unstructured data, preprocessed semi-structured data, data covered by ontologies and a rule base. These are unstructured raw data storages, semi-structured DB Cache and processed data storages and ontology storages of SemIoT and domain area.

The other part of the platform is constited of a combination of externall services including intelligent data processing services (mathematics and statistics), deep learning services and other auxiliary services and tools distributed all over the wide web to provide a powerful way for data processing.

Main data flow assumes the following processing chain:

(1) input of raw data into SemIoT platform;

(2) processing by services providing us with data for convertion to semantic data;

(3) request to BlazeGraph accompanied with visual representation of the process;

6 SEMIOT PLATFORM

The architecture of the platform was developed to meet two main high-level requirements:

- support of different communication protocols and data models for collecting data from connected devices, and ease extension for a new protocol and model;
- access to the data of the devices through a unified interface, so the data could be accessed and queried regardless of the data model supported by a particular devices.

The architecture of the Platform is presented on Fig. 3. It consists of 5 modules, 2 database and device drivers.

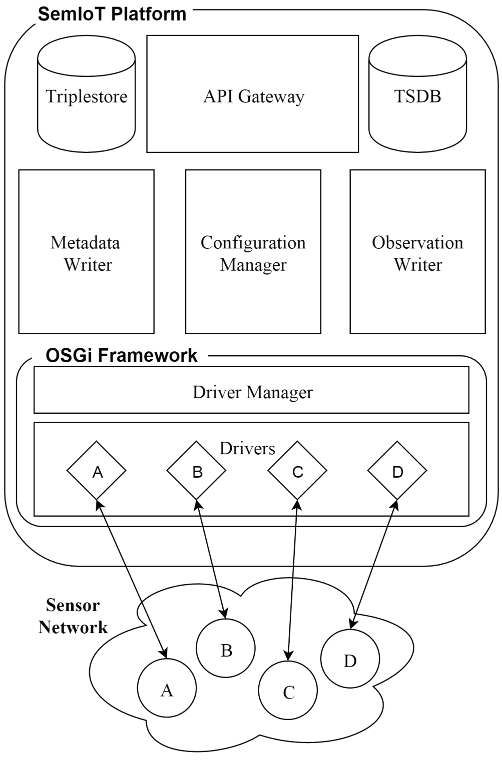

Fig. 3. An architecture of the SemIoT Platform

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- Device drivers are OSGi services implementing an algorithm of data collection from connected devices over some communication protocol and data model. E.g. HTTP API and JSON-based model. The drivers are installed, uninstalled and configured by Configuration Manager.
- Driver Manager is an OSGi service responsible for collecting the data from device drivers and passing into Metadata Writer and Observation Writer.
- Metadata Writer is a module that manages metadata of the devices, such as structure, measuring capabilities, location and etc. The metadata is stored in Triplestore.
- Triplestore is an RDF database which provides a SPARQL endpoint and implements the GeoSPARQL extension for querying devices by their location. In the current implementation we use Apache Fuseki.
- Observation Writer is a module responsible for managing observations of the devices. They are stored in TSBD.
- TSBD is a time series database optimised for storing time-based data such as sensor observations. In the current implementation we use OpenTSDB (http://opentsdb.net).
- API Gateway is a REST-like programming interface for accessing data of the devices and accessing Configuration Manager.

7 CASE STUDY

Coherent net of smart services is now build and used in medical domain. One of the significant examples is Botkinsky sheet - a temporal matrix of patient's state indicators and manipulations over patient during the curation process: medicine prescriptions, operations and other influencing events. The matrix is named after Russian physician contributed a lot to medicine. Botkinsky sheet is considered to show the advantages of the semantic platform in multi-service intelligent data processing tasks.

Temporal matrix entity is a way to represent various temporal patient's characteristics (body temperature, blood pressure, great number of analysis results) measured within a time interval in a set of coordinate planes consisting of x axis as a unified temporal axis and a number of y axis as indicators' value axis. Thus, all patient's parameters are represented simultaneously to form a convenient and efficient analytical space for the doctor.

In order to display of the desired characteristics statistical analysis and intelligent algorithmical processing of significant amount of data is required. The best way to organise the process pipeline is to present single-processing-task srvices as a semantic graph to be able to pass through the analysis and processing depending on data initial state to form a final-state report. Patients' temporal data is a matrix of analysis indicators' resultes in columns distributed along a time axis in rows. The fact that analysis and measurements are not taken or obtained immediately on a regular basis (for example, body tempurature and blood pressure are measured everyday, however blood analysis is done once or twice a week), the matrix is not uniform and contains gaps. To build a proper temporal regular matrix prior calculations are desired (Fig. 3).

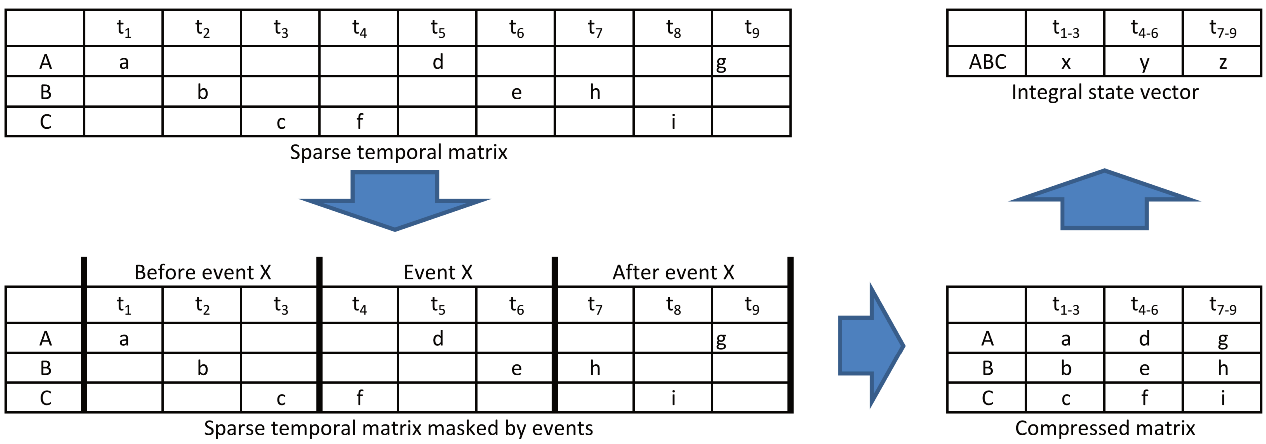

Fig. 3. Matrix transformation: from sparce matrix to integral state vector

Thus, to organize a temporal matrix, the following chain of processing stages is required:

(1) requesting a list of episodes by patient's identifier;

(2) requesting analysis and temporal event data by episode identifiers;

(3) segmentation of sparse temporal matrix based on temporal events and value changes;

(4) matrix compression based on event intervals;

(5) calculation of integral patient's state vector.

Note that the entrance point may vary (a complete chain of processing methods 1-5 is not obligatory and may vary depending on initial state of data and desired state). Service semantic graph is an intelligent way to define the processing path provided that each service requires definite state and type of data and outputs processed data in a described well-defined state and type which is described ontologically.

Each service of semantic service graph should provide information on input data it requires (taking into consideration that multiple input may be needed), provided output data, which may be multiple as well, service API end-point and service metadata such as service name and description. Both input and output data objects are individuals of one superclass (same range of objects) so that output of one service easily becomes an input of the following service.

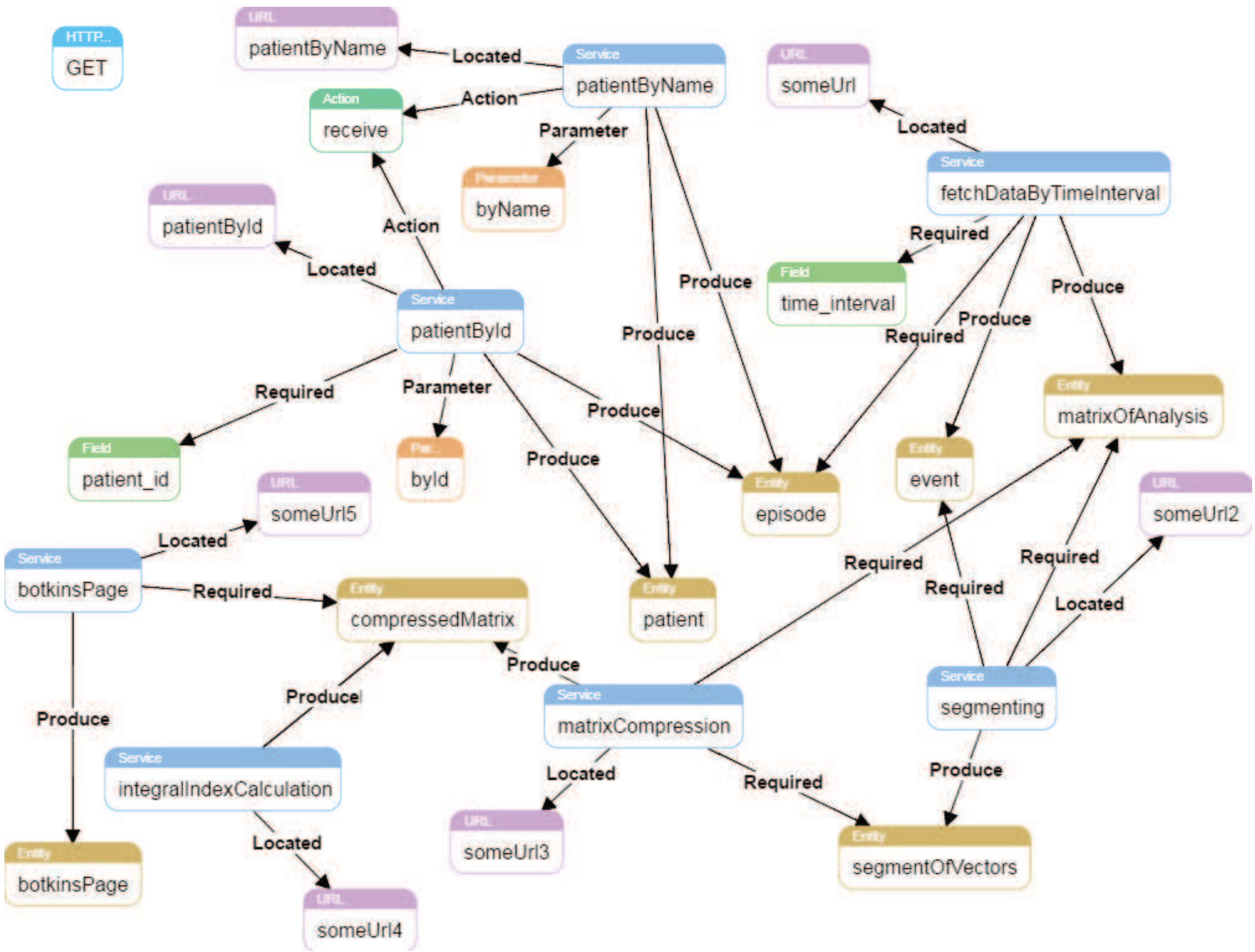

Fig. 4. Semantic service knowledge graph

As soon as all processing services are organaized as a semantic knowledge graph and SPARQL-endpoint is deployed, a basic combination of queries is able to trace a service path to process initial data so that it is converted to desired data formats. Three types of queries are of high importance for and data transformation and temporal matrix display:

(1) define services based on initial data state and relations between the services;

(2) define which service is required to proccess existing state of data;

(3) trace tha path from initial data state to temporal matrix final data.

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Execution of a processing chain leads to a final data state required for Botkinsky sheet which includes patients's identifier, analysis matrix provided with event meta-information (segments) and a vector of patient's integral state indicator. Note that segments are desired to be manually shifter in cases doctor considers it to be necessary which means that not a full transformation chain is to be executed, but only the integral indicator calculation stage which is resolved by means of a new query which defines a contracted processing stage based on another current state of data.

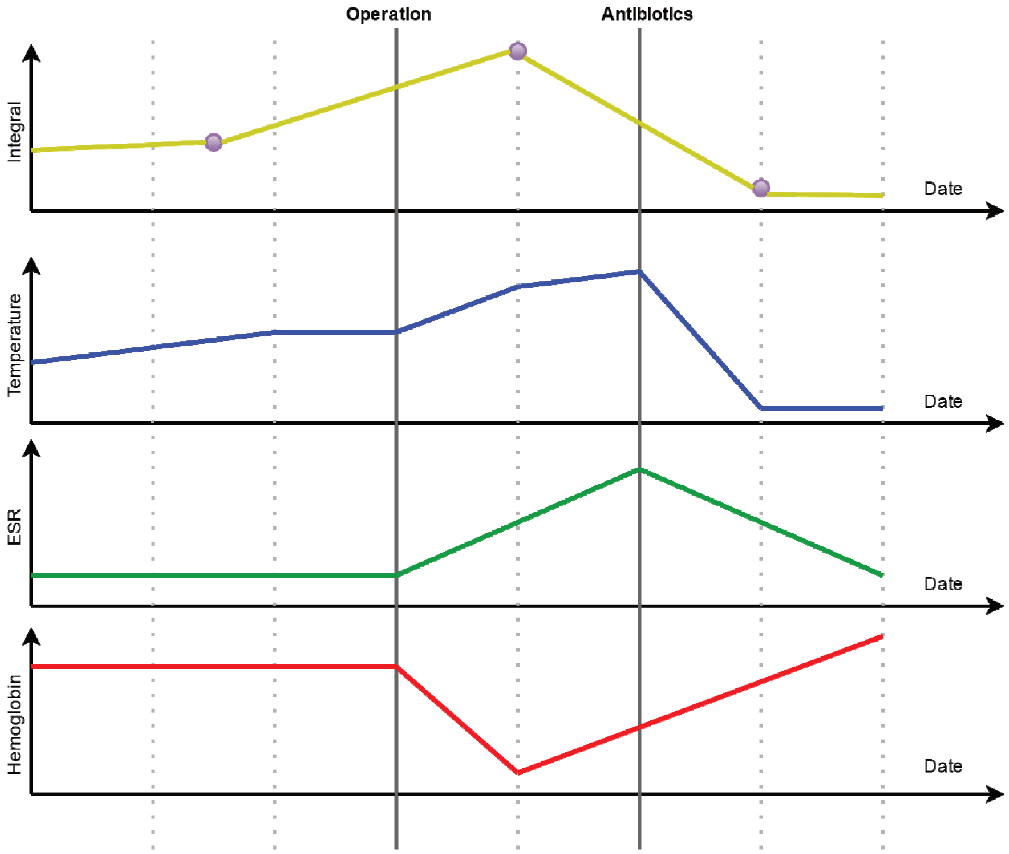

Fig. 5. Botkinsky sheet for three parameters (hemoglobin, ESR and body temperature) and patient's integral state indicator based on two events

8 CONCLUSION

Information systems of modern cities grow very intensively, mumber of available services permanently grows that makes very difficult to realize effective business processes in the frames of information systems used in city infactructure. In the paper a platform for services agile integration that allows link services is proposed. The agile platform can be positioned as a platform that implements a light weight semantic web services approach. The platform was tested while solving problems in medcine domain. Results of tesing proved efficiency of the proposed solution and showed that it can be applied to solve complex problems in any applied subject domain up to the domain of cities infrastructure. The platform is capable to form the base for morden urban systems.

Future directions of the platform development are oriented on adding new features and tools, which should allow to solve more complex problems such as coordinated development of several cities.

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reviewed paper

"Sidewalk" as a Realm of Users' Interactions: Simulating Pedestrians' Densities at a Commercial Street in Cairo City

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1 ABSTRACT

During the last four decades, researchers have developed many tools in order to investigate pedestrians' behavior at sidewalks. Those tools tried to study sidewalks by investigating two main components: built environment and pedestrians' movement. This paper presents a simulation for the pedestrians' movement at a commercial street in Cairo, using an agent-based model. The model was designed in a way by which we could examine: pedestrians' densities, the influence of types of uses on densities, the influence of flow-generators and destinations. In addition, we categorized the uses along the selected case of study by type of service and time spent by customer.

The method which we utilized for this work could be divided into two main phases: The first phase, included site video-based survey at different times and days, by which we could calculate flow rates at each generator point, and test the influence of uses on the density along the sidewalk. The second phase was to develop the model. In parallel, we focused on the uses' types and how it affects controls pedestrians' densities. Our results referred to a strong relation between use's type and densities' distribution along the street.

Keywords: Agent Based Modelling, Cairo City, Density, Pedestrians Movement, Sidewalks

2 INTRODUCTION, PROBLEM AND OBJECTIVES

Cairo is one of the biggest metropolitan areas in the world, it locates in the 9th rank among the most growing mega cities with a population over 18 million residents (UN, 2015). In addition, it receives more than 2.5 million visitors daily. Transportation problems are considered the worst which Egyptians face daily. So, during the last three decades, the Egyptian government established and developed many projects to renovate this system, such as Cairo Metro, which daily transports more than 4 million passengers (NAT, 2015). However, these projects are considered as pain-killers for some temporary problems, because of lack of financial supports and absence of wider vision. For example, these trials haven't included yet a project for revising the legislations related to urban problems, renovating pedestrians' realms nor enhancing walkability.

This work is a part of a wider research project that aims to investigate pedestrian s' movement characteristics at sidewalks, in Cairo, especially in the absence of clear and strict urban legislations. That research tries, to simulate the pedestrian movement at one/some sidewalks in Cairo.

Basically, the vague control of the urban environment in Cairo allows a lot of violations which we found. These violations could be seen not only in buildings or sidewalk's occupancies, but also in pedestrians' walking behavior such as, walking outside sidewalks and crossing areas. By observing many sites and investigating local urban regulations, we could easily understand that these behavioral violations are caused by: (1) Absence of pedestrians' spaces identifying, (2) A lack of pedestrians' services allowed such as: furniture, signage, lighting, and public transit stations, and (3) Some other violations caused by buildings' residents/owners which force pedestrians to walk out of their own path. On the other hand, we observed some similar problems on the level of vehicle traffic too, which make the situation more chaotic.

So, in this paper we basically aim to simulate the pedestrians' movement in the case of study as much realistic as we can. Also, we aim to develop a method for measuring pedestrians' densities testing their relation with the distribution of uses. Accordingly, we can investigate and develop a list of pedestrians' characteristics that would help us, then, to simulate the movement more realistically.

3 LITERATURE REVIEW

In recent years, many researches have been conducted to understand pedestrians' movement and some related topics, such as: pedestrians' flow, densities, and speed. Basically, most of those studies concluded

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that there are major factors affect the pedestrians' movement behavior: (a) Pedestrians' characteristics (Schelhorn, 1999), such as: gender, age, trip purpose (Willis, 2004), and physical fitness (Polus, 1983), (b) Spatial and Urban Factors, such as: design, materials, regulations and property rights (Whyte, 2014), and (c) Environmental Factors (Whyte, 2014).

However, all of those studies have been studied the western European and American cities. Some more recent studies started to investigate pedestrians' movement in some Eastern and Arabic cities as a part of cities' outdoor spaces (Gehl, 2013) or as a part of physical built environment that affects outdoor spaces' life (Mortada, 2011 and Hakim, 2013). Originally, plazas and wide open areas were and still are the most attractive destinations and the base of public space life in the European and American cities (Moudon, 1987 and Whyte, 2014). Conversely, streets in Arabic cities, and Egyptian cities as well, are considered the basic public space where both pedestrians' generators and destinations mostly locate at (Akbar, 1989). We define this as a "Linear public spaces-based city", especially with the lack of outdoor spaces in Cairo which indicates that residents' proportion of outdoor space less than 1.0 m2 (Khorazaty, 2004 and Tadamun, 2014).

Generators of pedestrians' movement in both cases may be a building, a shop, a vehicle's drop-off area or other similar points. But destinations are the critical points here, which make the difference. To explore differences, we should first investigate the pedestrians' trip purposes which definitely determine destinations in cities' outdoor spaces. We will follow the assumption of Jan Gehl that says there are three types of outdoor activities: necessary activities, optional activities, and social activities (Gehl, 1987). For the last type, social activities, they indirectly supported whenever necessary and optional activities are given better condition in public space (Gehl, 1987). So, the presence of the necessary and optional activities are the two major types that happen in outdoor spaces. The presence of necessary activity may not need specific condition to happen as they are "necessary". It usually refers to the daily duties, such as going to school, work, supermarket, and to mosque, in the case of Arabic cities, and Egyptians as well. But for the optional activities, and as per assumed by Gehl, they need some condition by which they will happen, such as: good weather, sitting areas, and community activities. They take place only when exterior conditions are optimal and inviting them (Gehl, 1987).

In our case, Cairo, we found that pedestrians' densities should be the major effective factor that affects the pedestrians' movement behavior, where pedestrians' generators and destinations locate at the same linear space. Also, uses distribution will be one of the focus points of our study.

So, and to understand and test our assumption above, we need to simulate the actual movement behavior of pedestrians at one dense and chaotic case at Cairo. Accordingly, we expect that we can a clearer vision about the influence factors on pedestrians' movement and densities' distribution too.

4 PROCEDURES

The method of this work is basically based on observing pedestrians' movement behavior using a video-based survey. Our procedure flow is formed by five phases followed by results and outputs:

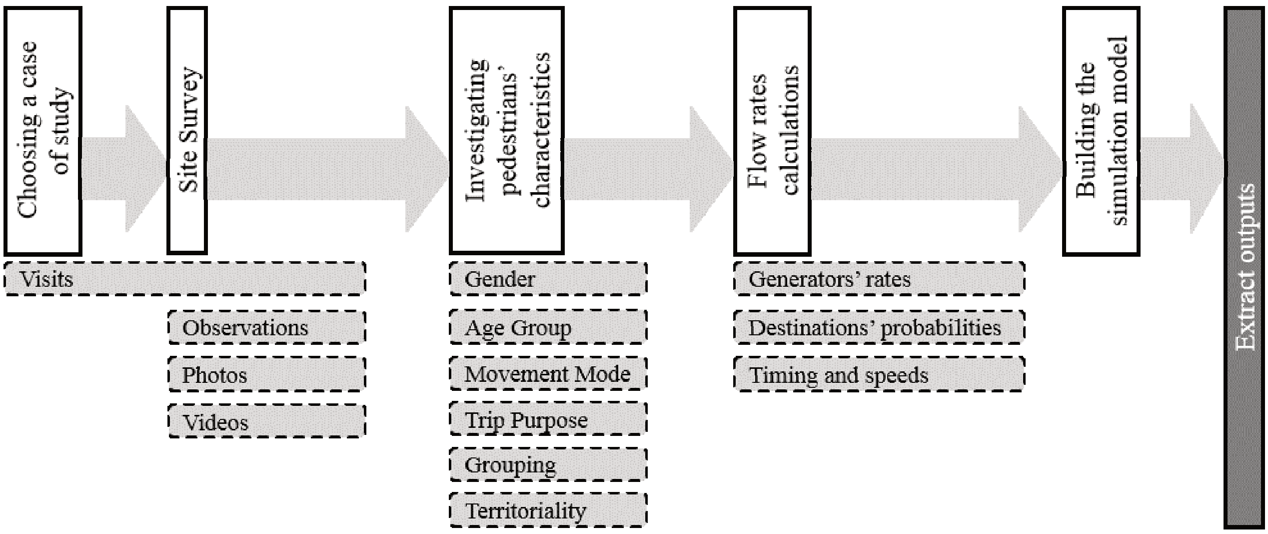

Fig 1: The procedures' flow of study.

4.1 Choosing a case of study

Primarily, during the last 18 months, 27 visits have been made to eight formal commercial streets at Cairo. These streets are located at 5 different districts sporadically. Among them, we chosen the case of El-Nasr Street at El-Basateen District south of Cairo. It borders two big districts, El-Maadi and El-Basateen, these two districts are populated with more than 540,000 residents (Governorate, 2016). We specified a 360 m length of the street to be our area of study. Four criteria have been applied to choose the case which were to: (1) Be formal and well regulated street, (2) Has a variety of uses connected directly to the sidewalk, and (3) Be safer from crime and crashes.

Fig 2: left, El-Basateen District boundary[1] and right, Elnasr Street map[2] with area of study.

4.2 Site Survey: observations, photos and videos

Almost three weeks have been spent at site by daily visits which basically focused on observing pedestrians' movement. We noted and classified observations which were supported by photos. In addition, we have made a video based survey using video cameras watching sidewalks from different locations and at different days and times. In the following part we will represent these observations and the technical procedures of photography and filming:

4.2.1 Observations:

The most important observations noted were as follows:

- Most of pedestrians walk outside the planned sidewalk where many obstacles, stairs and occupancies locate. They, the pedestrians, walk at a virtual lane with 2.50 m width at least from the asphalt road.
- A 2.0 m wide lane of cars permanently park attached to sidewalks, and no specified parking areas for retail shops exist. As a result, this lane of parking cars separates walking pedestrians into two groups, inside and outside the sidewalk, which enhances the dis-connectivity of sidewalks.

4.2.2 Filming technique:

The data which we use in this study have been collected by watching and recording pedestrian traffic using a digital camera and external multi-configured lenses. The camera's shutter speed ranges from 30 seconds to 1/4,000 second with high ISO sensitivity up to 3200 and high focal more than 200 mm. Our survey has been executed in three weeks, during November and December 2014. We have been recorded separate video-clips each of which was 5 to 8 minutes in average. Totally, we have recorded more than 5 hours in different times of the day from 8:30 to 23:30. The study time which we chosen is on Saturday, from 19:00 to 23:00. In average, the weather was moderate and the temperature ranged from 14 °C to 23 °C, the humidity was 65%, the wind speed was less than 15 km/h, and the visibility ranged from 3 to 9 km.

We specified seven locations for fixing the camera as shown in Fig 3, in order to watch most of the pedestrians' routes and to avoid the high dense trees which are located in the mid island. The videos recorded respectively and we have calculated average number of each measurement in the same time weekly.

[1] Cairo Governorate's Official Website, 2016.

[2] from The Egyptian Survey Authority's CAD maps, Cairo City, 1998, and Google Earth Pro.

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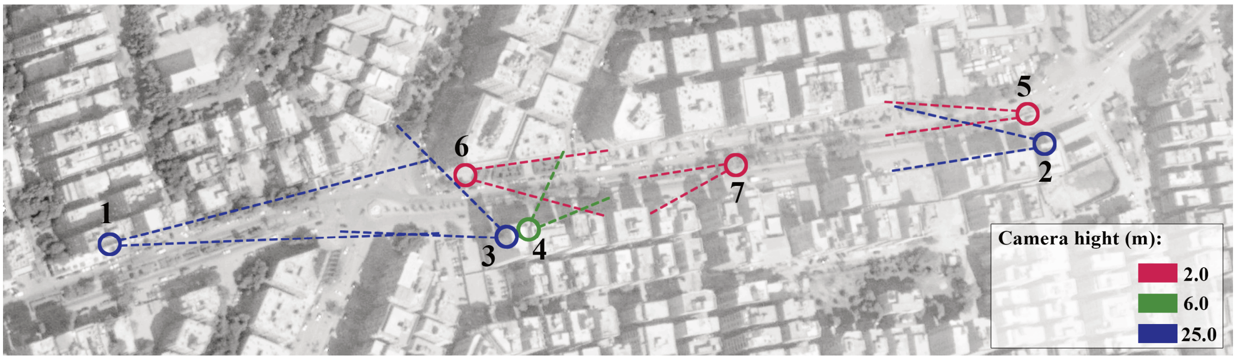

Fig 3: Video cameras’ locations at the field of study.

4.3 Investigating pedestrians’ characteristics

This step is the most important one by which we could later determine types, numbers and behavioral characteristics of each agent in the simulation model. We classified the pedestrians’ characteristics into six basic categories, which describe most of the pedestrians’ personal and physical conditions. These basic categories were: 1. Age Group, 2. Movement Mode, 3. Trip Purpose, 4. Gender, 5. Grouping, and 6. Location. We have surveyed a sample of 635 pedestrians whose trips were completed in the video-clip records. So, we could determine all characteristics shown in (Table 1, left). Then, we filtered this sample by eliminating all values which were under 10 percent. We, could, then, determine three fixed characteristics: Walking, Individuals, and Adult pedestrians, and set up both genders, and three different types of trip purposes as per shown in (Table 1, right). These extracted the characteristics that formed the agents’ types in the model which we will explain in details in a latter part.

		number	%		number	%
Age Group	0~12	33	5			
	13~22	207	33	13~22	207	38
	23~50	335	53	23~50	335	62
	51+	60	9			
Total		**635**	**100**		**542**	**100**
Movement Mode	Walk	620	97	Walk	620	100
	Run	0	0			
	Bike	5	1			
	Wheelchair	0	0			
	Assistance	10	2			
Total		**635**	**100**		**620**	**100**
Trip Purpose	Transients	209	33	Transients	209	40
	Partial user	218	34	Partial user	218	41
	Full user	102	16	Full user	102	19
	Waiter/Sitters	106	17			
Total		**635**	**100**		**529**	**100**
Gender	Male	459	72	Male	459	72
	Female	176	28	Female	176	28
Total		**635**	**100**		**635**	**100**
Grouping	Individuals	297	70	Individuals	297	100
	2 per group	35	9			
	3 per group	28	6			
	more than 3	13	2			
Total		**373**	**100**		**297**	**100**
Location	Semi -public	174	28	Semi -public	174	28
	Public	192	30	Public	192	30
	Out of Sidewalk	269	42	Out of Sidewalk	269	42
Total		**635**	**100**		**635**	**100**

Table 1: Left, Pedestrians survey sample and right, setting up the simulation sample.

4.4 Investigating obstacles

In addition, we investigated obstacles' types found in the case of study. The obstacles could be classified into three classifications according to their effects. The first group is obstacle that appears when pedestrians face a different mode of movement, such as bikes, cars, or wheelchairs, as they differ in speed, volume, and other movements' characteristics, we call this group as Dynamic-Physical obstacles. The second group includes the obstacles which are perceived by human sensory, such as daylight/dark and weather, we call this group as Dynamic-Nonphysical obstacles. The third group we call it Static-Physical obstacles, which include all built environment's elements, parked cars and other physical permanent elements. In our model we considered both of static and physical obstacles.

4.5 Investigating retails' uses

In our case, we had 49 uses that were currently open and working at that time (Saturdays' evenings and nights). We surveyed how long does each pedestrian spends at each of them. Then, these uses have been categorized into four major groups (A, B, C, and D), by the type of service provided and the average waiting time that each pedestrian spends. These four groups are:

(A) Emergency and quick needs (less than 130 seconds), such as: pharmacies, ATM, and newspapers.

(B) Daily needs (1200 seconds), such as: groceries and take-away restaurants.

(C) Food Facilities (2000 seconds), such as: coffee-shops and sitting-based restaurants.

(D) Usual needs (more than 2000 seconds), such as: wearing, furniture and cars showrooms.

4.6 Calculations

4.6.1 Generators and Destinations:

In this phase, we specified 25 points that could be considered as "Generators" of pedestrians' flows. We counted the average number of pedestrians generated per second during the period of study specified. Additionally, we specified 74 destinations to which pedestrians intend usually. These destinations were divided into two main types: (a) In-between destinations (39 points) which some pedestrians intend once or several times during his trip, and (b) Final destinations (35 points) after which pedestrians go out of the area of study. The calculations were made using a O/D Matrix (Origin/Destination Matrix) filled with 635 pedestrians' trips. The calculations extracted the probabilities of flow from and to each point.

4.6.2 Walking-Flow Rates:

Also, we counted the "Walking-Flow Rate", it means the rate of coming pedestrians at a specific point in a specific time. This rate has been measured by counting the number of pedestrians who come from each generator point in either one a second or a minute.

4.6.3 Speeds and waiting times:

Using the same survey's data, we measured the average regular speed of pedestrians, and it was found that the adult male who is under 50 years old walks with an average speed of 1.4 m/second (5.04 km/h), and for females, it was 1.25 m/s (4.5 km/h). We, also, observed some other changes happen in speed if some other variables are considered in walking, such as existence of: (a) a physical barriers or level change, (b) densities, (c) a dangerous zone, and (d) trip purpose's change. Table 2 shows the change that happens in the constant speed when any variable changes. The zero speed, which refers to the waiting time of each pedestrians, was counted according to the category of use mentioned above.

	Age Group				Movement Mode			Gender		Grouping			Trip Purpose			Obstacles				
	50+	23~50	13~22	0~12	Walk	Run	Bike	Male	Female	3 Ped	2 Ped	Individual	Transient	Partial User	Fully User	Stairs/level	Vehicles	Neighbor pedestrian	Narrow width	walls/fences
Pedestrian typical speed is counted as 5.04 km/hour	0.6	1	1		1	2	3	1	0.9	0.7	0.8	1	1	0.85	0.75	0.5	Varies			

Table 2: Changes in agents' speed value according to change in type (1 = 100%).

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4.7 Building the simulation model

For our model, we used ArtiSoc-V3.5. It is a multi-agent simulator software which was originally released by Kozo Keikaku Engineering, Inc. Japan, in the spring of 2006 (Yamakage, 2009). The measuring area unit of ArtiSoc equals (40*40 cm) in real, and the time measuring unit is a (time slice) which could be coded to equal more or less than the time units in real. This one (time slice) is the time length which is enough to make only one step of the simulation, and usually it is measured as one second. Our assumption is based on the actual pedestrians speed in our survey sample which equal 1.4 m/s. So, we coded the agents' behavior to walk 3.5 ArtiSoc's units (40 cm* 3.5) per second (one time slice). According to our pedestrians' classification mentioned above, we have developed six agents which behave differently, Fig 4. We have counted the probabilities of generating each type from one generator point. Also, we coded the simulation to count the destinations probabilities which each agent seeks, whether they are in-between or last destinations.

0- Individual-Walking-13:50 yrs	Female	Passerby
1- Individual-Walking-13:50 yrs	Female	One destination
2- Individual-Walking-13:50 yrs	Female	Two destinations
3- Individual-Walking-13:50 yrs	Male	Passerby
4- Individual-Walking-13:50 yrs	Male	One destination
5- Individual-Walking-13:50 yrs	Male	Two destinations

Fig 4: Agent types and characteristics in the model.

For the movement method, we developed a "Waypoint Map" by determining the most frequent nodes and links for walking in real situation. Then, we have coded a waypoint matrix to count each link's connection, location and length. Then we added this matrix data in the model. We assume that all pedestrians got to their destinations seeking the shortest path. Accordingly, we have calculated "Shortest Path" using the Dijekstra's Algorism to be the agents' method for reaching a destination.

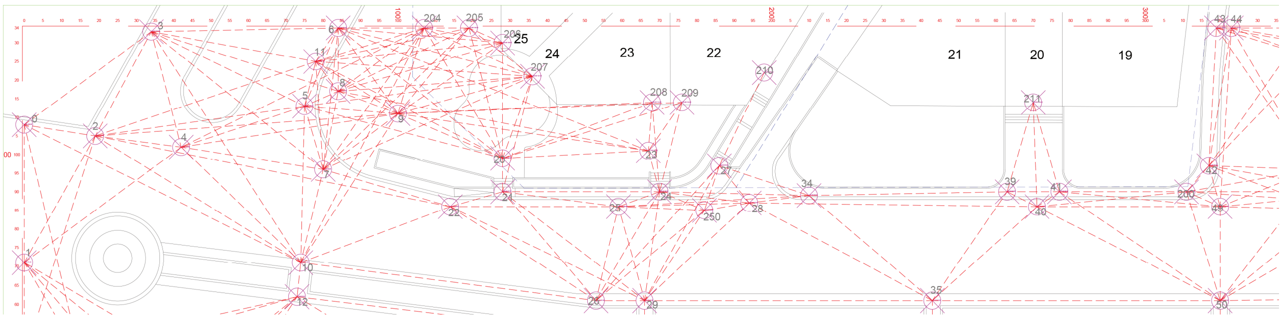

Fig 5: A part of the Waypoint Map, micro-scale (1:2000).

The next step was to code the agents walking behavior. Using the Flow-Chart in Fig 6, we coded the walking behavior of each agent considering many variables, such as: starting point, walking speed, barriers which agent faces, avoiding other pedestrians, and trip purpose which determines destinations.

Accordingly, we can explain each agent's route structure in few steps, as per shown in Fig 7:

- The generator locates itself and generates six types of agents considering given probabilities.
- Each agent intends to reach a destination by counting the shortest route.
- In case of multi-destinations trips, each agent waits for a specific time according to the uses changes as per mentioned above.

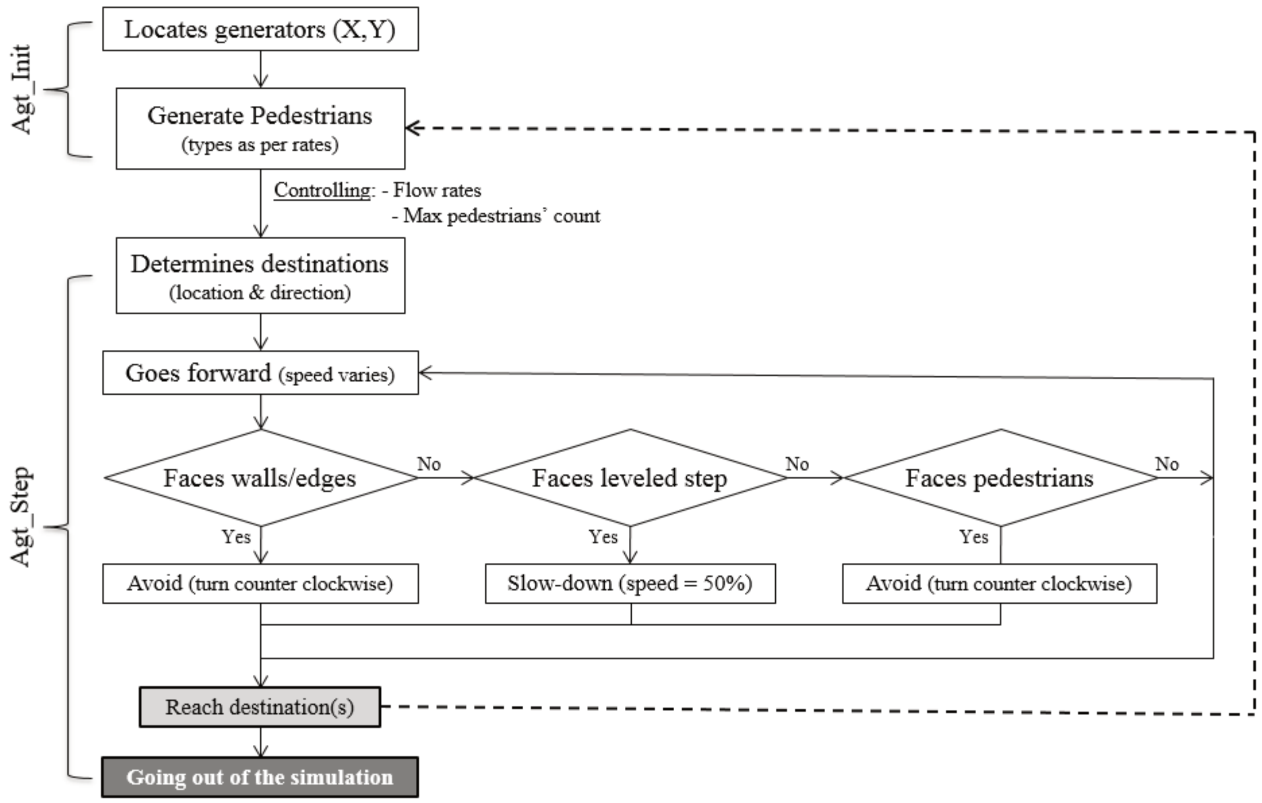

Fig 6: Flow chart of one type of agent's behavior.

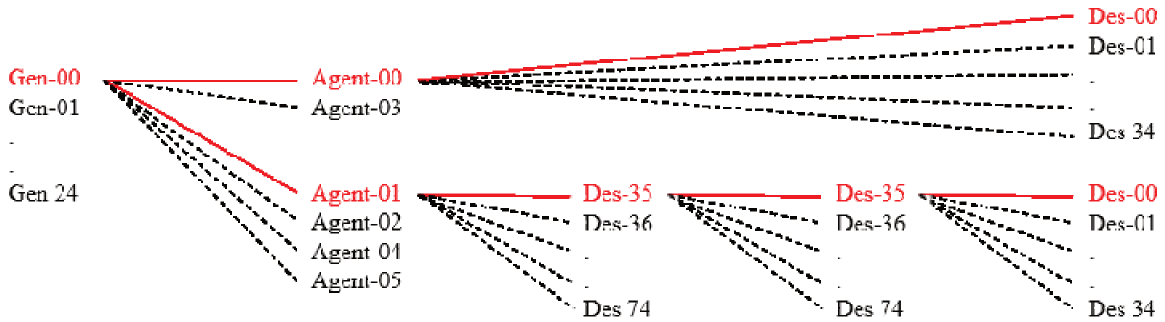

Fig 7: A diagram of agents' routes structure.

In parallel, we have created the field (space) where the simulation would run. Our space has been expressed by a GIF format image that presented a plan of the area of study showing: the sidewalk, the asphalt road the mid-island, and the retails colored as per categories.

Now, the simulation is ready to run, and each agent has been coded with needed behavior at the area of our case of study. But, we have coded other controlling panels to make the simulation more flexible for any change in further surveys, and also to be computable with other similar case(s). These additional controlling panels were basically for calculating pedestrians flow rates and pedestrians total count who come from each generator point. By running the simulation, agents appeared walking in different colors (to identify the user type) following the pre-coded behavior at the field of study, Fig 8.

As per mentioned above, we have created a control panel to control the pedestrians' flow rates and number of pedestrians. Besides that, we have developed a measurement method to calculate the densities along the sidewalk while the simulation runs. We can explain these two analytical steps in the following:

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Editors: Manfred SCHRENK, Vasily V. POPOVICH, Peter ZEILE, Pietro ELISEI, Clemens BEYER

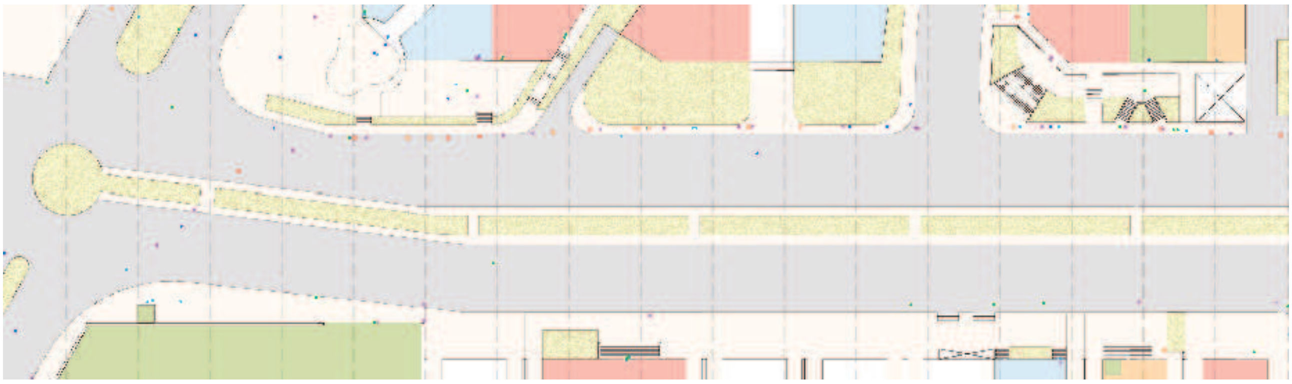

Fig 8: Simulation preview with: street, uses, and walking pedestrians (dots).

4.8 Control panels

Two control panels has been created to control the flow rate and the maximum number of pedestrians' count for each generator point. This means that our model can control the whole simulation with 25 flow rates controllers and additional 25 pedestrians' count controllers. These control panels can control the simulation before or while running. They make the model more flexible if we want to expand or shrink the field of study. Also if we get new data from another survey(s).

4.9 Densities calculations

Measuring densities and their relation with the type of use is our main goal of study. So, we have developed a way to measure the density at many points considering the change of uses. First, we divided the street length (360 m) into 36 zones equally (every 10 m). Secondly, we have counted the area where pedestrians walk at each zone using AutoCAD. Then, we have recoded the model to count the number of pedestrians found at each time length (120 steps, two minutes) and to calculate the density at each zone, then, to extract all data in a CSV format sheet, read by MS. Excel. Finally, we run the simulation again, with the new measurement method, for 14400 steps (equals two hours in real). Accordingly, we could got the results of the simulation by two ways, in parallel. The first way was by checking a dynamic bar-graph preview which was counting densities while the simulation running, and the second one was after finishing the simulation by getting data from a CSV format sheet.

4.10 Simulation results

The results we got were the values of pedestrians' densities each two minutes at 36 zones along the street on both sides. We extracted the down shown graphs from the data sheet, Fig 9 to Fig 12. Then, we calculated the average value of density at each zone in order to specify the standard deviation of values, Fig 13. Then, we put preferred not to count the first and the last zone which were mostly high because they contain many generator and destination points.

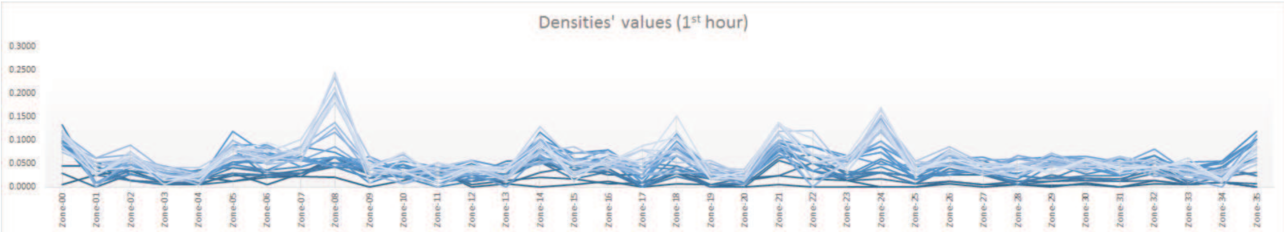

Fig 9: The densities' values during the first hour.

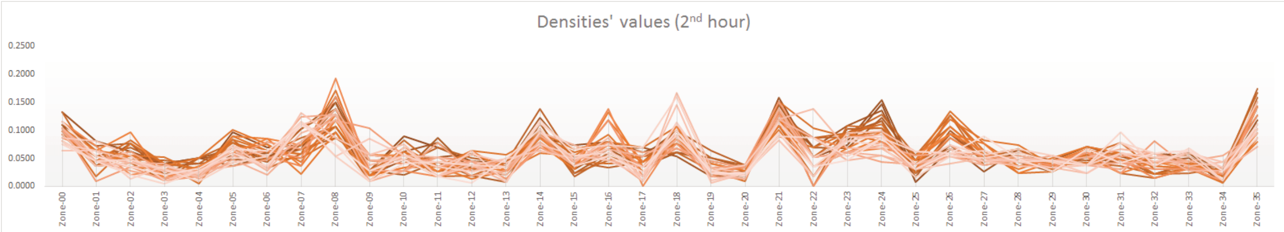

Fig 10: The densities' values during the second hour.

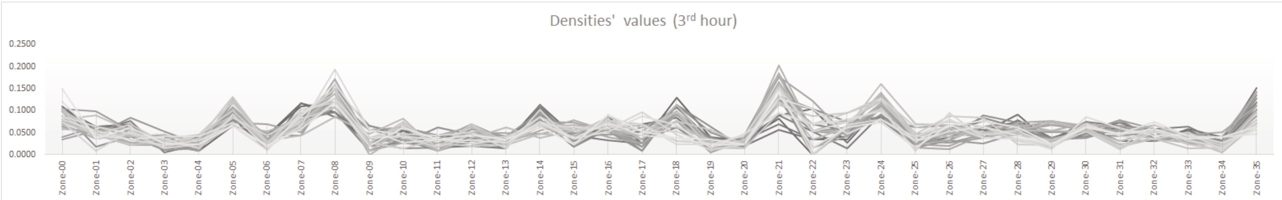

Fig 11: The densities' values during the third hour.

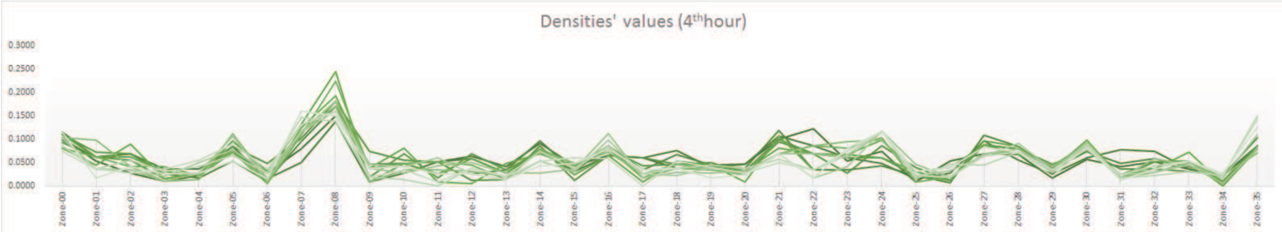

Fig 12: The densities' values during the fourth hour.

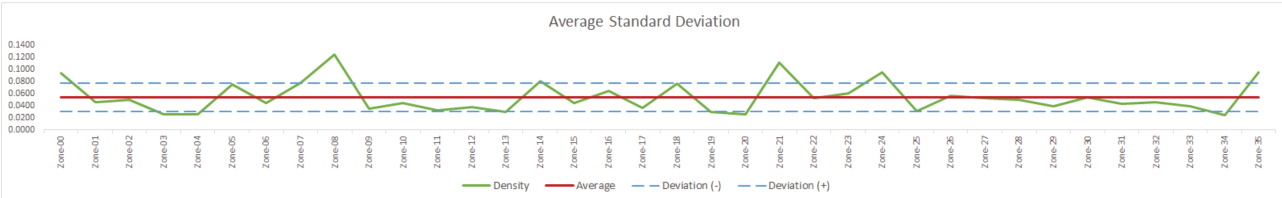

Fig 13: The densities' values average and the standard deviation ranges.

The average density value recorded was 0.054 pedestrian/m2. Also, the results indicated that 9 zones were recorded higher than the average and 7 of them were attached to food facilities. The highest average density recorded was 0.123 pedestrian/m2, at "zone 08", it is a zone of food facility retail too. The lowest average density recorded was 0.026 pedestrian/m2 at "zone 34", it is a zone of side street crossing.

The excessively high dense zones, which passed the higher limit of standard deviation, were: 07, 08, 14, 21, and 24 which mostly belongs to the use group "C"(Food Facilities). And, the excessively low dense zones were: 03, 04, 13, 19, 20, and 34 which are mostly areas of either street crossings and parking areas at both sides. The other densities values were closed to the average and roughly equal at 22 zones, these zones are attached to various uses' types including food facilities, parking areas, and crossings too.

5 CONCLUSION

The case we have studied faces basically two main problems: (1) a lack of clear and strict urban regulations and (2) chaotic movement behavior which, basically, emerges in walking outside the sidewalk and non-respecting of the traffic rules, if found. So, in our experiment, we could simulate the pedestrians' movement at the case of study. This simulation could be conducted by identifying, mainly, five items: (1) A video-based site survey, (2) Identifying the pedestrians' actual characteristics that found in the case, (3) Developing a waypoint map by which we could determine the actual movement routes as much realistic as we could, (4) Calculating pedestrians' generating rates at generators and vanishing rates at destinations, and (5) Primarily, categorizing the retail uses using the time which each costumer stays at each of them.

We used these mentioned variables to control the walking speed during the simulation by investigating the influence of each variable on the pedestrian's speed. Also, they enabled us to easily to count pedestrians' densities along the street and to identify their relation with the category of uses. We could find that the food facilities might be an indication of high pedestrians' densities, and that may lead us to taking in consideration a unique and different sidewalk's spatial characteristics at these zones.

6 FURTHER WORK

The case of the study is very complicated, especially that pedestrians cannot walk at sidewalks. In addition, our model was built in a simple way to simulate the actual movement behavior of pedestrians. The results were basically logic, however, we believe that this model has some lacks, such as eliminating 10% of the pedestrians' types in average. Also, it ignored the obstacles influence on walking speed and movement behavior in general. In addition, it was built based on a short-time survey. The model should become more

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sophisticated by modifying and expanding some features. These features could be considered as our further work as the following:

(1) Conducting a wider survey to get almost 30 hours of video-clips records during eight weeks' survey, at least, therefore, getting more accurate O/D Matrix, and more accurate probabilities calculations.

(2) Expanding the field of study to add 75m length, at least, from both east and west sides to test the influence of the closest two crossings.

(3) Considering more types of obstacles and update the pedestrians' behavior accordingly.

(4) Updating the method of generating pedestrians by developing a potential of dynamic generators, and destinations' frequencies.

(5) Adding a new control panel to control the time of counting the densities, thus, we can control the calculation timing while the simulation runs or make it dynamic second by second.

(6) Adding the ignored pedestrians' characteristics, such as: children, aged people, pedestrians' groups, running pedestrians, and bike riders.

7 ACKNOWLEDGEMENT

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All video-clips and photos used in this paper have been taken using a permission given by The General Administration for Relations and Media Office which is followed The Ministry Of Interior (MOI) and with the acceptance of El-Basateen Police Station at south of Cairo. Most of video-clips' and photos' records used in this paper have been taken in collaboration with a professional architect photographer: Mr. Obada Nussair.

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Smart Cities or Smart About Cities

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1 ABSTRACT

This paper builds on the one towards CORP 2014 'Plan it Smart' which attempted to define 'smart cities' for the purpose of planning and against other city typologies. It concentrates on how ICT or 'smart technology' is applied in cities and discusses its critiques. It explores who benefits from 'smart' interventions: the ICT industry, governments or the users and whether there are inherent contradictions between top down and bottom up urban interventions. It explores the preconditions of improving living conditions for all by 'smart' technologies, including the role of discourse analysis, and raises issues of equity and social justice. Lastly, the paper discusses Hajer's alternative of 'smart urbanism' expressed in his agenda for planning and design in 'Smart about cities' and concludes that the growth ideology still prevails despite promising excursions into decoupling it from urban resources.

Keywords: contradictions between societal factors, smart about cities, smart cities, smart urbanism, spatial social justice

2 WHY 'SMART CITIES'?

It is only fair that the conferences on "Urban Planning and Regional Development in the Information Society" (CORP) initiated by ICT-savvy academics who have an interest in physical development should focus on the role of ICT in planning. It follows that 'smart cities', or more generally 'smart urban technologies' were discussed at CORP in 2014 and pursued further in 2016.

'Smart' as a concept related to urban development gained widespread adaptation. Wikipedia defined 'smart cities' as: "a smart city is an urban development vision to integrate multiple information and communication technology (ICT) solutions in a secure fashion to manage a city's assets[1] A techno definition of 'smart cities' is proposed by ARUP[2]: "…smart cities is where the seams and structures of the various urban systems are made clear, simple, responsive and even malleable through technology and design…"

Akin to the definition of 'smart cities' the purpose of 'smart cities' is in the eyes of the beholders, the main protagonists being global ICT industry and government. Both parties claim that the main beneficiaries are the users of ICT driven 'smart' solutions for the delivery of urban services, ranging from e-governance and citizen services to waste, water and energy management, as well as urban mobility. More recently other services have got 'smart' treatment, such as tele-medicine, tele-education, tele-skill development and ICT driven trade facilitation. All these 'sustainable service provisions' are deemed to improve people's quality of life and wellbeing, besides freeing the environment from man-made problems. Many other international ICT industry associations coined their own definitions and staked out their own objectives of 'smart cities' to advance their common interests[3] further served by commercial conferences.[4] 'Smart cities' remain a regular subject of public debate among industries and increasingly in dialogue with government,[5] and they became even the subject matter of academic degrees thereby qualifying for establishment status.

The next step of advancing 'smart cities' consisted of operationalising them. Among the many protagonists who are contributing to this is the European Union by creating a Digital Single European Market.[6] For Sam Musa, the success of 'smart cities' rests on people, processes and technology. His linear road map proposes an operational progression starting with the study of the community to determine the expected benefits of a 'smart city' initiative. This is followed by a 'smart city' policy driving the initiative which determines the

[1] http//en.wikipedia.org/wiki/Smart_city
[2] http://www.arup.com/services/smart_cities
[3] Some of these are discussed in Judith Ryser's paper on 'Planning Smart Cities… Sustainable, Healthy, Liveable, Creative Cities… Or Just Planning Cities? towards CORP 2014.
[4] https://www.re-work.co/. e.g. Future Cities Summit, Docklands London 2014. Smart to Future Cities & Urban IoT, London 2016
[5] ARUP. 2010. Smart Cities, transforming the 21st century city via the creative use of technology. p4
[6] https://ec.europa.eu/digital-single-market/en/smart-cities

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roles, responsibilities and objectives of plans and strategies to realise the overall goals. Lastly this process engages the citizens through the use of e-government initiatives, open data and events.

International consultancies specialising in urban development are key players in operationalising and promoting 'smart cities'. ARUP's[7] techno-operational conception is that "…a 'smart city' happens when three specific networks interact: the communications grid, the energy system and the logistics internet which can track people and things through transport and supply systems".

3 MAKING 'SMART CITIES' OPERATIONAL AT ALL LEVELS

What had started with anodyne remote controls of home utilities, such as space heating or lighting, has evolved into city-wide centralised digital control mechanisms. Even individual home controls are linked to centralised 'big data' beyond the control of those from whom it is extracted without their consent. Such big data is used by commercial utility suppliers and whoever these databases of behavioural information are sold to, usually without the knowledge or permission of the 'subjects' of such data.

It is argued that traffic lights and their control were the first large scale, sectoral ICT use in city management.[8] Since then ICT uses, or 'smart' urban service management have proliferated to other urban sectors, such as public transport, utilities, waste disposal, energy, water, health, education, communication, and have significantly permeated cities with random CCTV without specific purpose. ICT systems were also applied citywide. An example is the IBM built quasi 'Nasa mission control system' for Rio de Janeiro which amounts to a high tech control centre for the entire city, or what some consider a massive 24/7 '1984 style' surveillance system.[9] Many attempts at introducing 'big data' collection and management systems into the public sector, such as the health service have failed though at great tax payers' expense. This led Leo Hollis to the view that 'smart cities' are perpetual beta cities[10] where accidents will happen due to over-reliance on technology and interconnections between sub-systems, and are prone to bugs which will continue to take down whole operating systems.

Regardless of the spatial level of 'smart' technology application, be it the city as a whole, operational sectors such as public transport and energy supply, or sustainable use of individual homes, Simuldyne[11] suggests that those who devise and control these systems should try them out first in virtual reality using simulations and visualisations before rolling them out at large. It is not clear though whether this would create greater trust between the providers of such systems and users involved in these experiments, as all such data is exclusively held by the company which produces the simulation models. Tyler Lyon[12] who claims to be able to predict group behaviour from his digital games imagines that people may prefer to live in city simulations rather than in the real world, albeit with the proviso that they may become unaware of material changes affecting them directly. The way the younger generation is using smart phones may serve as a preview of such 'virtual' urban living disconnected from physical reality. At all these levels, ICT driven 'smart cities' are conceived to be managed top-down, from centralised positions with hold over command and control.

4 'SMART CITIES' CRITICS

Predictably critics of 'smart cities' raised their voices.[13] Peele found that smart cities, predicated on ubiquitous wireless broadband and the embedding of computerised sensors into the urban fabric may destroy democracy as we know it.[14] According to Steven Poole a battle between techno-utopians and postmodern flaneurs is fought over whether the city should be an optimised panopticon with citizens reduced to unpaid data clerks, a smooth moving pixel and 3D graphic display, or a melting pot of cultures and ideas.[15]

[7] ARUP. 2010. Smart Cities, transforming the 21st century city via the creative use of technology
[8] Tom Saunders & Peter Baeck. Rethinking Smart Cities From The Ground Up. 2015. NESTA.
[9] http://www.theguardian.com/cities/2014/dec/17/truth-smart-city-destroy-democracy-urban-thinkers-buzzphrase
[10] http://formtek.com/blog/smart-cities-living-in-a-world-of-perpetual-beta/
[11] http://www.simudyne.com/
[12] of Watch Dogs Play station/ SimCity - https://tylerjlyon.wordpress.com/tag/watch-dogs/
[13] e.g. Adam Greenfield. 2014. Against the Smart City. ISBN: 9780982438312 e-book. See also critique of 'smart city' in Judith Ryser's paper towards CORP 2014
[14] e.g. http://www.theguardian.com/cities/2014/dec/17/truth-smart-city-destroy-democracy-urban-thinkers-buzzphrase. Steven Poole, The Guardian, 12/12/2014..
[15]http://www.theguardian.com/cities/2014/dec/17/truth-smart-city-destroy-democracy-urban-thinkers-buzzphrase op.cit.

'Smart city models' based on the 'internet of things', such as Dongtan in China, Masdar in Dubai, or Songdo in South Korea were promoted mainly in the developing world by Western consultants (respectively ARUP, Foster + Partners, and KPF, all with headquarters in London) and developers in cooperation with global ICT companies, and were interchangeably advocated as eco-cities.[16] Here 'smart city rhetoric' is all about efficiency, optimisation, predictability, convenience and security. Usman Haque[17] claims that the smart city industry aims at city managers who can claim 'big data' for their decision making. For Dan Hill of Future Cities Catapult[18] 'smart city' is the wrong idea, pitched in the wrong way to the wrong people. He extends the notion of 'smart city' to a 'low carbon city' with jobs and housing conceived so as to facilitate sustainable movement. Bottom-up critics are concerned that the 'smart city', relying on sensors amounting to millions of electronic ears, eyes and noses can become a vast arena of perfect and permanent surveillance for whomever has access to the data feeds. An illustration of this is an article entitled "Privacy alert after expert hacks into 'smart' hotel room" which shows how easy it is to get access to such data feeds.[19] Conversely, another article shows how a "Burglary victim's smart way to keep out thieves" relies on a bag lock which digitally recognises him, containing a motion sensor to alert him of thieves.[20] All these devices are vulnerable though as they rely on charged batteries, and many critics claim that these remote control instruments divert attention from everyday living.

Nesta undertook to rethink 'smart cities' from the bottom up[21] and made the case to move on from a purely technology driven 'smart city' to a people centred 'smart city'. For Nesta the best use of digital technology is by applying collaborative technologies and above all by citizens powering them. They propose to set up a civic innovation lab for this purpose and use open data and open platforms to mobilise collective knowledge. They state that human behaviour and necessary change are as important as technology in achieving 'smart city' goals. Ultimately it is 'smart people' who mobilise innovation and if they feel that they have ownership they will support it. What needs changing is to put urban challenges before technology, generate evidence, open up to alternative initiatives to improve cities and cooperate more closely with citizens. Data collection has to evolve using new technologies such as 'thing sensing' instruments, but needs to be complemented by more integration, analytics and visualisation. Besides better data city resources generally have to be harnessed better to work towards a collaborative economy by using and sharing time, skills and everyday belongings. Already established tools are civic crowdsourcing for data collection, mapping, and building up collective intelligence through participatory planning, budgeting and policy making. Nesta believe that collaborative technologies and actions can help raise awareness by using environmental sensing, or through interactive facilities such as the London Datastore of the Greater London Authority. Nevertheless, Yet Nesta has still a strong technological bias, despite proposing to take human behaviour as seriously as technology and investing in smart people, not just smart technology.

5 'SMARTNESS': BOTTOM-UP, DEMOCRATIC, ACCOUNTABLE, COLLABORATIVE?

It may be revealing that community-centred ways of devising and/or managing 'smart cities' are difficult to find on the internet, and examples from the developing world are even rarer, although bottom-up 'smart' initiatives and experiments are undertaken there in urban as well as rural environments.[22] UNEP touches upon such alternatives in its work on sustainable alternative lifestyles.[23] In its study on creative communities for sustainable lifestyles (CCSL) UNEP explores 9 scenarios: mobility (car sharing, bicycle centre, car pooling on demand); food (urban gardens, vegetable bag subscription, family take-away); and housekeeping

[16] Judith Ryser. 2013. Asian Eco-Cities, a Critique, In: FuturArch 26/1. Judith Ryser, 2014, Eco-cities in Action, sustainable development in Europe: lessons for and from China? “EU-Asia Dialogue, Konrad Adenauer Stiftung, et.al.
[17] http://www.haque.co.uk/info.php
[18] https://www.google.co.uk/search?q=future+cities+catapult&ie=utf-8&oe=utf-8&gws_rd=cr&ei=1o71VsXiJISz-wHZ2qOIBw
[19] London Evening Standard, 24/03/16.
[20] London Evening Standard, 05/02/16.
[21] http://www.nesta.org.uk/sites/default/files/rethinking_smart_cities_from_the_ground_up_2015.pdf.
Rethinking smart cities from the ground up. Tom Saunders & Peter Baeck . Nesta (Geoff Mulgan), and Intel China, UNDP, 2015.
[22] Marteen Hajer gave examples of community managed and owned ATM systems, mobile phone networks and charging facilities, as well as credit unions to give local communities access to ICT use in his keynote address at the ISOCARP congress 2015, Rotterdam, 2015.
[23] http://www.unep.org/pdf/DTIx1321xPA-VisionsForChange%20report.pdf

(urban composting, energy management, collective laundry). Some of these scenarios have the potential to use ICT for sharing and disseminating experiences. The Journal of Community Informatics also publishes articles on bottom up approaches of ICT use in the development process.[24]

In "Smart cities vs smart communities", Mike Gurstein[25] argues that it is necessary to empower citizens instead of propping up market economics. He is critical of the way governments, the ICT industries and, to some extent, academics are incorporating digital technology into traditional practices of urban development and management. This is done sector by sector, by focusing separately on smart energy, smart buildings, smart mobility, smart technology, smart healthcare, smart infrastructure, smart governance and smart citizens. In his opinion, citizens are unlikely to get involved unless they have an interest in embracing smart and green solutions in their day-to-day work schedule. Refuting the techno-industry driven approach he proposes alternative criteria focusing on 'smartness' at community level.

They include seven smart community aspects. For him, 'smart community planning' is to support citizen involvement in the delivery of “smart services". 'Smart community governance' is to provide a means for public scrutiny of municipal budgets, including funding for training and support for those with little education to review budgets and ensure that they are being spent appropriately and equitably among citizens. 'Smart community health' is to assist decentralised health support workers and facilities. 'Smart community citizenship' is to ensure support for location-based electronic interaction among citizens around issues of local interest, with information (government data) being structured (geo-tagged) in such a way that information could be directly accessed and locally aggregated to foster participation and intervention in municipal planning and programme design processes. 'Smart community infrastructure' is to deliver incident reporting facilities to enable citizens to report on issues concerning public infrastructure in an aggregated way based on location and where these electronic facilities are transparent to the user. 'Smart community resources' are to provide digital support for administrative decentralisation to structure governance as to being responsive to local circumstances and requirements, including established processes for citizen participation in localised decision making. Lastly, 'smart community dwellings' are contributing to digitally enabled public land use and dwelling records, including rentals, renter complaints, work orders, etc. and make them accessible to, and usable by local communities. He sees these 'smart community alternatives' as opportunities for politicians and government officials, albeit without developing his ideas into the realm of practicalities. His overall purpose is to apply ICTs to empower citizens in transforming their cities from the bottom up.

Paul Mason[26] considers that "…we cannot allow the tech giants to rule 'smart cities'…". Although people wear tracking devices voluntarily so far, it is important to establish democratically who is controlling and minimising the risks of the 'smart city project and its big data' and with what legitimacy. Unlike in the commercial world which hides itself behind commercial secrecy, the 'smart city' needs data to flow freely across sectors. Only open source city data will be conducive to foster innovation, prevent stultifying monopoly formation and long term lock-in, and guarantee democratic participation and public ownership of data generated from public services. Mason evokes the current Madrid government which encourages an ecosystem of competing uncontrolled human networks believed to lead to creativity and diversity and provide the basis for publicly agreed priorities of dealing with social problems. For that reason the city of Madrid is supporting open source collaborative technologies instead of funding proprietary systems with public money.

[24] http://digitalcommons.calpoly.edu/cgi/viewcontent.cgi?article=1015&context=poli_fac
The use of mobile phones for development in Africa, top down meets bottom up partnering. Laura Hosman, Elizabeth Fife. In: Journal of Community Informatics, Vol 8, no 3 (2012).
http://ci-journal.net/index.php/ciej/article/view/1090/1114
Neighbourhood planning of technology, physical meets digital city from the bottom up with aging payphones. Benjamin Stokes, Francois Bar, Karl Baumann, Ben Caldwell. In: Journal of Community Informatics, Vol 10, no 3 2014.

[25] https://gurstein.wordpress.com/2014/11/06/smart-cities-vs-smart-communities-enabling-markets-or-empowering-citizens/
Smart Cities vs Smart Communities: empowering citizens not market economics. 14/11/06.

[26] The Guardian 25 October 2015.

Katie Allen[27] also addresses the issue of big data, its legitimate ownership and access. She claims that the UK big data project is 'playing money ball' to build smarter cities. From the arguments she heard at the Big Bang Data exhibition it becomes clear that human accountable decision making has to be decoupled from ICT tools and their holders. Big data carries a lot of unresolved problems, which include survey techniques, quantity and quality of raw data, accessibility and transparency. Processed data is seen to be under pressure of being subjected to future proofing economics, as economic sectors and techno specialists are promoting public streamlining of big data. It could be argued that any data set is being collected with a specific purpose in mind, but much data, whether in the public domain or purchased, is used by third parties for different agendas. This leads to discrepancies between' facts and figures' and their alternative end use, and sometimes to the distortion of objectives to fit the data set. Nevertheless, many cities have already garnered comprehensive databases for their own purpose and are sharing them with the public which has shown to benefit overall quality of life.[28] Helsinki was one of the first city to experiment with such open source city data.[29]

6 BEYOND TOP DOWN AND BOTTOM UP DICHOTOMY

Time may have come to disown the assumed myth that only large scale, centralised interventions resort to high-tech while small scale diffused actions are confined to low- or no tech. Both rely on change in human behaviour. Thus it can be argued that the role of ICT is a mere tool and certainly not an aim in itself, when improving quality of life in cities. However objectives differ between the key players and it has to be recognised that there is asymmetry between the top-down and bottom-up approaches to better urban living, with or without access to technology.

The big players are the ICT companies and governments, and only in a minor role people, and even then not as individuals but as a collective, organised labour, voters, consumers. In the top down scenario of 'smart cities' ICT companies are in the business of selling their ex-ante mass produced ware globally and governments associate with them with the aim to increase efficiency, reduce expenditure and maintain control of their cities through feedback from big data, while citizens are seen as passive consumers having to adapt their behaviour even in their own homes. What are the impacts, for example, of metering utilities? For industry it provides valuable free big data to optimise supply chains and target marketing. Governments may have to adjust regulation in favour of business to benefit from big data. Greater awareness of their consumption may lead passive citizens to reduce consumption, albeit with likely loss of comfort, or to shift utility usage to the detriment of their time budgets.

Conversely, active citizens can decide for themselves to change their behaviour to their advantage by engaging in projects of their own making, in collectives of their own choosing, sometimes out of necessity, but not without having the possibility to resort to ICT. Such actions may bring about important changes in governance from the bottom up. For example guerrilla food growing in Los Angeles led the city to change the law regarding the use of public and semi-public space, and the 'food to spare' project in Denmark assisting food growers to sell produce rejected by their market outlets led to changes of commercial rules regarding types of food they sell. Both initiatives used social media to disseminate their effects which are taken up in many other places.

Bottom-up use of ICT is not confined to the developed world. In Africa and Asia ICT is used even in remote dispersed places.[30] Groups of people resort to solar powered ATM machines and solar powered dispensers of drinking water, electricity or other utilities. They create their own networks of communication with second hand mobile phones and sim cards. However, none of these life improving initiatives among the poorest people in the world would be possible without the top-down technology and networks.

[27] The Guardian 3 January 2016.

[28] Eleanor Ross, The Guardian 15 October 2014 referring to a comparative city study by Dietman Offenhuber, Boston Mass.

[29] Early "I-Hubs" providing open city data formed part of the Study of Ecosystems of Innovation, led by Judith Ryser at Fundacion Metropoli 2007.

[30] for unbanked mobile money in Africa, see https://www.weforum.org/agenda/2015/01/how-mobile-money-is-transforming-africa For people centred Internet, see http://peoplecenteredinternet.org/2015/12/ For solar powered ATM see http://www.greenprophet.com/2011/02/solar-atm-abu-dhabi/ for solar powered decentralised water supply see http://www.scidev.net/global/water/opinion/solar-powered-water-atms-deliver-at-the-last-mile.html

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It could be argued that international institutions such as ITU which are tri-partite in nature[31] were instrumental in disseminating technology globally and deeply also to developing countries, guided by the principle of equal, equitable or universal access/ service negotiated between the three main interest parties which constitute ITU. This was a precondition for availability of ICT in bottom up development initiatives, such as solar powered ATMs to assist community credit provision, or kiosks to charge mobile phones for interaction in dispersed, remote places with sparse services such as health or education. Thus bottom-up actions are taken up to cope with availability, accessibility and affordability of services. While they depend on ICT providers and their networks even for informal operations,[32] the top down operators do not depend on bottom up action. Free market principles and competition dominate also 'socially useful' ICT use, despite a fund for 'smart' subsidies to launch new universal access projects.[33] Even ITU continues to advocate the economic growth model for 'the south', leapfrogging the north exponentially by resorting to advanced technologies but according to the discipline and profit motivated objectives of the free market. However, the World Telecommunications and Information Day[34] is promoting ICT entrepreneurship for social impact. This is based on the conviction that ICT entrepreneurs, start ups and SMEs have a role to play in ensuring economic growth in a sustainable and inclusive manner. From this evidence it seems appropriate to look for alternatives to contrarian top-down and bottom-up 'smart' development and find new ways of combining those approaches into viable projects and actions.

7 URBAN ECOLOGY: ALTERNATIVE VANGUARD TO 'SMART'?

Taking the side of the planet and its survival instead of unlimited economic growth when conceiving 'smart cities' may be a third way. This is where approaches to 'smart cities' and eco-cities converge. 'Smart' management of urban resources could reduce the ecological footprint and bring cities closer to a balance between the planet's capacity and human consumption. ICT could contribute positively to that goal, helping people to reduce consumption of non renewable energy, contribute to full cycle water management, shift from car journeys to cycling, walking and public transport and optimise their travel generally. By its nature the ecological standpoint is holistic and encourages a more integrated approach to 'smart' solutions, especially at the level of the city as a whole. Eco-city planning attempts to network the various strands of resource management by merging sectoral measures into more comprehensive planning strategies. Not only is land use and transportation dealt with together, but many other sectors are incorporated in urban development strategies to respect the longer term ecological capacity of a city. The ecological standpoint's critique of modernism is its functional segregation, unrestrained urban sprawl onto agricultural land, together with stress on efficient use of service networks. The idea of the compact city with mixed uses and higher densities at public transportation nodes is but one example of this shift in planning thinking.

Emanating from the USA, new urbanism[35] is a variation of this evolution of mainstream planning and urban design towards a more eco-friendly approach. It adopted ten principles which would deliver places with higher quality of life. They are: walkability, connectivity, mixed use and diversity, mixed housing, quality architecture and urban design, traditional neighbourhood structure, increased density, smart transportation, sustainability and quality of life. Its followers have adopted a 'smart code' based on environmental analysis.[36] The philosophy behind new urbanism reminds the garden city movement and relies on small scale neighbourhood initiatives although it claims that its principles apply to all scales. Its critics call it 'neo-traditionalism',[37] trying to create communities where there were none. Even its 'smart' code is focusing on communities and ecological principles, rather than technology. In this sense it can be associated with the

[31] ITU, International Telecommunication Union, an intergovernmental agency of the United Nations which brings together governments (as regulators), industry (as suppliers of innovative technology) and organised labour (as factor of production). All these intergovernmental institutions are paying lip service to people, the users, the consumers, but they do not have a collective seat at the table equivalent to the other interest groups.
[32] e.g. 'umbrella people' in Nigeria which sell second hand mobile phones and prepaid sim cards but which depend on licensed networks to function.
[33] ITU_universal_access.ppt
[34] http://www.itu.int/en/wtisd/2016/Pages/default.aspx
[35] http://www.newurbanism.org/
[36] http://smartcodecentral.com/
[37] U.S. News. 2012

'cittaslow' movement[38] and other bottom up autonomous community initiatives promoted by Etzioni or Putnam[39] aiming at a better living environment with less reliance on non renewable resources.

Maarten Hajer[40] for one, argues that the ecological constraints of 'increasing acceleration' worldwide is presenting daunting conditions which require fundamental change, similar to those of industrialisation in the 19th century and the modern movement and its reliance on the motorcar in the 20th century. The sanitary reform movement intervened in the former and became the foundation of spatial and urban planning as we know it. Neither post-modernism nor the green movement were able to tame the latter though, nor its blind belief in technological fix and infinite exploitation of nature, nor its inevitable inequality gap between rich and poor as argued in 'The Spirit Level'.[41] What is needed is a decoupling of the economic growth ideology from resource consumption. According to Hajer, technology is unlikely to be able to disentangle the fossil fuel based 'lock-in' which is characterising existing urban infrastructures, as their institutional embeddedness hampers any transition toward a more ecologically appropriate urban metabolism. The diffusion of this hegemonic growth model to the developing world is compounding the adverse ecological impact of the on-going and accelerating urbanisation process. UNEP is also making the case against the false trade-off between economic development and environmental and social sustainability. It supports decoupling natural resource use and environmental impact from economic growth[42] and is critical of measuring 'progress' by adding environmental and social considerations to GDP measures.[43]

8 'SMART CITY' AS DISCOURSE

One way of preparing the path to necessary transition from current ecologically 'out-of-sinc' urbanisation and what Hajer calls 'the next economy'[44] is to resort to discourse analysis which he considers a powerful base of changing current influential language into new concepts more appropriate for an ecologically sound urban future. According to him, the 'smart city' discourse includes five key concepts: a managerial take of the city, expressed in notions such as 'smart' grids, or efficiency and dominated by ICT technology which Swilling calls 'algorithmic urbanism';[45] discourse coalition in fora between business, government and knowledge institutes who then adopt the same language; public-private partnerships as the default organisational structure of 'smart' opportunities; innovation as an essentially technological matter, discarding the importance of debate leading from problems to solutions without transplantation of solutions may be inappropriate in other contexts; and lastly a weak discourse on historical awareness. Maintaining the predominant discourse would mean continuing with the current 'default model' of cities. He proposes 'collaborative smart urbanism' instead, still to be invented, as the means to transform the cities of the 21st century into ecologically sound, liveable cities. This presupposes new ways of planning, as well as cities of the south leapfrogging to reconfigure the urban metabolism worldwide.

Discourse analysis has become popular among urban researchers as an alternative to statistical and numeric comparative urban analysis. Akin to the top-down bottom-up dichotomy, it may be useful to consider discourse analysis as simply another tool towards the toolkit of generating knowledge and understanding of urban processes, including the role of 'smart cities' and related technologies as a basis of future urban development policies. In this regard, UN and its specialised agencies such as UNEP may well have been influential in changing the current discourse by introducing the concept of 'decoupling' with focus on

[38] http://www.cittaslow.org/

[39] see Amitai Etzioni's communitarianism –The Essential Communitarian Reader, 1998. Rowman & Littlefield; or Robert Putnam's trust in the community, - Bowling alone: the collapse and revival of American community, 2000. IN: Journal of Democracy 6 (1): 65-78.

[40] Marteen Hajer's concepts discussed here in connection with 'smart cities' are elaborated in his essay in Maarten Hajer & Ton Dassen, Smart About Cities, visualizing the challenge for the 21st century urbanism, 2014, nai010 publishers/ PBI publishers.

[41] see for example the gini index debate. Richard Wilkinson & Kate Pickett, 2009, The Spirit Level: why equality is better for everyone. Equality Trust.

[42] UNEP, Decoupling Natural Resource Use and Environmental Impacts from Economic Growth, 201

[43] UNEP, 2012, Sustainable, Resource Efficient Cities – Making It Happen!

[44] 'The next economy' at the intersection of public policy, urban development and environmental design is the theme of the 2016 IARB (International Architecture Biennale Rotterdam) which Hajer is curating.

[45] Swilling, 2014, Towards Sustainable Urban Infrastructures for the Urban Anthropocene, In" Allan A, Lampis A., Swilling M (eds) Untamed Urbanism, Routledge, quoted in Hajer 2014.

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sustainability of consumption and production when translating millennium development goals into the urbanisation process. Nevertheless, the power of globalising free markets, including ICT applications to 'smart cities' may well overwhelm the findings of scientists[46] and government policies. This may be reflected in the fact that even alternative strategies advocated by UNEP are built on growth, albeit with the proviso that it would have to be sustainable and resource efficient, as well as equitable.[47] The UNEP International Resource Panel's study on sustainable cities stated success factors as innovation, public participation and 'socio-economics' of urban divide, but it maintains the 'smart' discourse in terms of 'smart' urban logistics and spatial planning, as well as 'smart' design, finance, technology, skills transfer and development.

9 'FROM 'SMART CITY' TO 'SMART URBANISM'

Hajer's tentative solution to evolve from the techno-driven 'smart city' concept towards a broader, more encompassing approach to urban development proposes to move to the idea of 'smart urbanism'. He expresses his understanding of 'smart urbanism' in an 'agenda for planning and design'[48] which includes seven considerations and he gives concrete examples to illustrate their role in reaching a more ecologically sound urban metabolism. The considerations are: decoupling as strategic orientation; coming up with a persuasive story line about the (urban) future; the use of urban metabolisms as framework for strategic decision making; focusing on the default in infrastructure; designing the 'smart city' outside the box; engaging in new open collaborative politics, and creating a globally networked urbanism. They are briefly discussed below.

Decoupling prosperity of a city from the use of resources, or more generally wealth from resource use, may be the most effective means to shift to a new sustainable urban development paradigm. Hajer thinks that this could be best achieved through a separate Urban Sustainable Development Goal. It has to be kept in mind though that such laudable global goals tend to slide and remain without implementation, due to lack of commitment from the private sector and lack of both powers and means of cities which are de facto in charge of transforming such goals into reality.

Hajer's persuasive story telling about the future is along the lines of Throgmorton's[49] idea that "planning is persuasive story telling about the future", away from science and the experts. Perhaps the custom of architectural project presentation to clients may be a precursor of this practice. It could be argued that self declared 'smart cities' have already adopted such story telling to convince citizens to change their behaviour. However, it may be unwise to substitute sole speculation about the future for a knowledge base rooted in long range history when aiming to realise cities resilient to future shocks.

Using 'urban metabolism' as a framework for strategic decision making sounds promising. However, without foundation in scientific knowledge and empirical evidence it is hard to see how an abstract notion of urban metabolism could persuade citizens as 'good to have'. Metabolic flows, such as water, electricity, traffic, information may be more relevant to cities as places of human improvement, creativity and exchange. The second part of 'Smart About Cities' contains an impressive compendium of easy to read representations of such flows which could attract popular agreement needed to curb the adverse effects of waste and emissions of metabolic flows.

As infrastructure is shaping the way of life of citizens Hajer believes that connecting 'smart city' discourse to urban metabolism may stand a better chance of changing the 'default in infrastructure'. This would apply to infrastructure hardware as well as rules regulating the use of infrastructure to achieve decoupling resource efficiency from wellbeing and access to services. Both hard and soft infrastructure are under political control which could shift from favouring business to user benefits. This could be done by providing access to a broader range of independent suppliers which, in Hajer's view, would stimulate innovation. However weak government may have difficulties in intervening in the rapid pace of urban change and bring about the necessary shift from blueprint ex ante planning to pragmatic intervention based on experience, including

[46] e.g. the reports of the expert panel of UNEP disseminated in UNEP's Our Planet, "Rio+20, from outcome to implementation", 2013, with significant disclaimers regarding the path to a green economy.
[47] UNEP, 2012. Sustainable, Resource Efficient Cities (pdf). Incorporating findings of the International Resource Panel, including the Cities Working Group in Cities and Decoupling.
[48] Maarten Hajer, 2014. Smart About Cities. Smart urbanism: an agenda for planning and design, pp29-42.
[49] James Throgmorton, 1996. Planning as persuasive story telling: the rhetorical construction of Chicago's Electric Future, University of Chicago Press. http://press.uchicago.edu/ucp/books/book/chicago/P/bo3616995.html

spontaneous bottom up initiatives. Nevertheless, in an increasingly interdependent world most local actions are dependent on networked supra-structures which supply and dominate provision, such as connectivity for mobile phones or non piped water.

Thinking outside the box is not new but difficult to penetrate the mainstream. Hajer postulates that social innovation is as necessary as technological one and considers it a disruptive force capable of uprooting existing vested interests, for example by shifting from aspiration of car ownership to car sharing. However, his proposed shift from the car as a life structuring status to the mobile phone is not liberating but perpetuating the same generic dependence on global corporations.

Alternative actors have pleaded for open and collaborative politics for a long time. History shows that usually their groundswell actions have ended in a return to the status quo of power relations. How would Hajer's approach differ? He criticised the model of an elected council with monopoly of knowledge, but it is hard to see how technological and social innovations will provide a more democratic and equitable alternative relation between the most powerful vested interest groups and citizens. While the classic model of decide – announce - defend has lost credibility, no viable model using 'intelligence of energetic citizens' as Hajer proposes has replaced it yet. The defection of the young generation from voting may signal the redundancy of the old model. Yet no positive alternative will arise while they are excluding themselves from participating in creating a new discourse, thinking out of the box and imposing their own ideas on the mainstream. Accumulation of decentralised autonomous alternative interventions – what Hajer calls 'radical incrementalism' - into a critical mass capable of changing 'soft' infrastructure, rules and regulations has not happened to date. Even Hajer acknowledges that at present the organisations promoting 'smart cities' are too powerful to be forced to include the wants and needs of citizens. His Amsterdam example which lets all flowers bloom alongside large scale high tech urban interventions may not stand the test of time, as signs are already apparent that the 'smart city' industry and even the traditional protagonists of urban (re)development are taking over the small scale operations, thus what he calls 'creative combination and implementation' is not happening just yet.

Finally, Hajer's proposal to create a globally networked urbanism remains realistically still out of reach. It would be worthwhile to remember the many attempts of local groups to network their experiences and build collective memory, well before the age of the computer and try to find out the reasons for their disappearance, if not outright failure. The phenomenon of 'exhaustion' comes to mind, besides other internal structural limitations of shifting from direct democracy to a more remote model of decision making while keeping control over the future. All these phenomena have attracted far less attention and research than techno-based developments to bring about the 'smart city'. If the recognition that social as well as technological dimensions matter for the sustainable future of cities, perhaps more attention to understanding the soft aspects is needed in both research and practice.

10 CONCLUSION

'Smart about city' instead of 'smart cities', 'smart urbanism' instead of urbanisation driven by 'smart' tech industry may still be a long way off, considering the evidence and the arguments of current 'smart city' discourse. 'Smart' technology may well be able to make a useful contribution to shifting the soft and moving boundary from 'need to have' to 'nice to have'. However, 'smart' technology alone is unlikely to deliver the story line of a liveable urban future embedded in ecological sustainability and regional bio-economics, and may well exacerbate the socio-economic divide.

This does not mean that such a goal is not desirable, or not doable comprehensively in the longer term. It would presuppose though work on operationalising the alternative principles assisted by progressive politicians, enlightened scientists, strongly driven environmentalists, and would need to encompass the large amount of disenfranchised people left out of the benefits of 'smart' technology. Decoupling wealth from resource use is a promising and scientifically endorsed premise for staying in a 'safe operating space' within planetary boundaries. However such a scenario beyond the 'smart' discourse could only become sustainable of it was also socially just.

Smart Cities: a Policy Tool for City Efficiency?

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1 ABSTRACT

The level of interest in smart cities has been growing during these last years. The academic literature (Hollands, 2008; Caragliu et al., 2009, Nijkamp et al., 2011 and Lombardi et al., 2012) has identified a number of factors that characterise a city as smart, such as economic development, business-friendly, environmental sustainability, social innovation, information and knowledge process, and human and social capital. Thus, the smartness concept is strictly linked to urban efficiency in a multifaceted way as well as to citizens' wellbeing through the use of appropriate technologies. Instead, from a "political perspective" smartness is mainly related to the ability of using ICT as instrument to strengthen economic growth. A research by Giffinger et al. (2007) to support European policy has defined the concept of smart city on the basis of several intangible indicators (such as a smart economy, smart mobility, smart environment, smart people, smart living, and smart governance) and has become a benchmark for European policy makers (European Parliament's Committee on Industry, Research and Energy, 2014). Following this influential research, the aim of our paper is to verify how much that smartness definition can influence the efficiency and indirectly the growth of the cities. Using the concept of output maximising, we built a stochastic frontier function in terms of urban productivity and/or urban efficiency by assessing the economic distance that separates cities from that frontier. Our conclusions highlight that not all the six indicators defined in the Giffinger et al. (2007)' analysis contribute to strength the city efficiency.

Keywords: policy, smart city, city efficiency, smartness, stochastic frontier

2 INTRODUCTION

With half of the world's current population living in cities, the urbanisation process is still present in all countries. At the beginning of the 20th century, cities with 8 or 10 million inhabitants were unimaginable, as well as unmanageable. Sociologists and urban planners believed that the growth of cities should be limited and alternative solutions should be offered. These hypotheses, however, have been overridden by reality as city populations continue to increase. More recently, some scholars, such as Sassen (2004), emphasise the phenomena of the irreversibility of a city's growth and of the centrality of cities as the engine of development. Nonetheless, there are negative aspects regarding cities. First, they consume approximately 80% of the energy produced in a country. Second, they represent the place where the majority of communication occurs. Third, they are the primary source of pollution. For all of these reasons, making cities more liveable and more efficient is rapidly becoming the most important, and no-longer postponable, objective of policy makers.

In recent years transforming cities into "smart cities" has emerged as the main way to achieve this target. From the academic point of view, the smart city notion is not so recent and can be subdivided into two main streams. The first one is based on the debate of Smart Growth and new Urbanism Movements. Even if these two movements are characterized by some differences, they present a common aim: the opposition to urban sprawl. These movements in fact consider that cities should be more compact, walkable, mixed-uses, transit-friendly and finally should create a range of housing opportunities and choices (Knaap and Talen, 2005; Bohl, 2000; Burchell et al., 2000; Gibbs et al., 2013). The second is based on innovation as the engine for development with economic, social and environmental sustainability as targets to aim for. These targets are strongly intertwined with human capital and education – or, following Florida (2002), with the creative class – in the urban context, as pointed out by Berry and Glaeser (2005, 2006) who show that innovation is driven by industries and products that require an increasingly more skilled labour force. Following this line Caragliu et al. (2009) and Nijkamp et al. (2011) include human and social relations, intellectual capital, health and governance concepts within a triple helix model (Etzkowitz and Lydesdorff, 2000). In their perpective, the city is called "smart" when:

"Investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance" (Caragliu et al., 2009, p.6). "Furthermore, cities can become "smart" if universities and industry support government's investment in the development of such infrastructures" (Nijkamp et al., 2011, p.3).

In line with this literature, Kanter and Litow (2009) define smart cities only the cities that create the necessary conditions of governance, infrastructure, and technology to produce social innovation. In other words, smart cities can solve social problems related to growth, inclusion and quality of life by involving various local actors including citizens, businesses, and associations. Moreover, Dirks and Keeling (2009) focus the attention on the way information and knowledge are produced, collected, and shared to raise the process of innovation. Regardless of the type of communication (financial, economic, social or cultural), cities are increasingly active nodes of these intangible flows in addition to the physical flows.

Finally, more recently, Neirotti et al. (2014) provides a taxonomy of application domains of the smart city concept, namely: natural resources and energy, transport and mobility, buildings, living, government, and economy and people.

From the political point of view, instead, the smart city concept was introduced within the SET (Strategic Energy Technology) Plan by the European Union in 2009 to foster economic growth. The SET Plan indicates that a smart city is a city or a large conglomerate that aims to improve energy efficiency by undertaking as target the double level, i.e., 20/20/20, as determined by the EU. Moreover, the EU 2020 strategy (see the Horizon 2014-2020 programme) has emphasized this concept focusing especially on the use of ICT within cities and assuming the definition developed by the University of Vienna and Ljubliana with the work of Giffinger et al. (2007) (European Parliament, 2014).

"A smart city is a city well performing in six characteristics, built on the 'smart' combination of endowments and activities of self-decisive, independent and aware citizens"

This definition identifies six dimensions or characteristics: economics, people, governance, mobility, environment, and quality of life. They, in turn, are broken down into 31 major factors and 74 indicators. This definition has allowed, for the first time, a classification of cities according to their level of smartness.

As shown, the smart city concept, first related to energy saving and efficiency use issues, has been developed to include different aspects such as the quality of life, the environment and so on. As a consequence, smart city has become more close to and, for some authors (Audirac, 2005; Herrschel, 2013), has joined with the smart growth concept. In the urban planning debate, smart growth is mainly related to urban sprawl and its negative impacts on physical form and on urban life. Besides, the concept of smart city means even the possibility of creating an urban context identity of protecting natural contexts, reducing the car use, and supporting the urban "mixity".

The smart city concept, however, is not generally accepted as a new urban economic paradigm because some authors (Hollands, 2008; Greenfield, 2013; Söderström et al., 2014; Vanolo, 2014) consider this concept as empty and ambiguous based more on an imaginary and discursive level. In other words, the underlying thought is the risk within the smart city vision of reducing the democratic process the specific conflicts in favour of a well-organized and ordered city.

Despite the variety of specifications, features and pros and cons defining a smart city, the Giffinger et al. (2007) definition has become the main benchmark at the political level. Given that the European Union has considered the "smart city" as one of its main policies for the 2014-2020 programming period, the central issue is to understand whether this definition is coherent with the EU's goal, which consists in improving growth (namely GDP) of the European cities.

In order to answer that question, the aim of our paper is to verify the robustness of the Giffinger et al. (2007) smartness indicators in explaining city efficiency and city growth using the same sample of European cities from Eurostat Urban Audit dataset. Applying the stochastic frontier approach (SFA), we can estimate a production function distinguishing between production inputs and inefficiency factors and hence we can rank the European cities using technical inefficiency values.

3 THE METHODOLOGY

As we have already emphasised, cities as well as countries must face the challenge of improving their performance. In other words, cities must become more efficient. According to the neoclassical economic theory, two agents having the same information on the production function could maximise their profits and thus be efficient in an identical way. We apply the same hypothesis to those cities chosen by Giffinger et al. (2007).

In reality, however, two cities – even if identical in terms of "inputs" used – can produce only a similar output. In other words, two cities can be different because of unforeseen exogenous shocks and the analysis of efficiency through the SFA can allow explaining these dissimilarities (Desli et al., 2002).

Traditionally, the empirical analysis of production functions has focused on the standard econometric approach based on the OLS model that incorporates a random error term that can take both positive and negative values. However, a simple OLS regression is not sufficient for estimating the relationship between output and inputs, as described in Feld et al. (2004) because of the impossibility to measure the distance of each unit of analysis from the efficient frontier for a given production function. Consequently, in recent years, several new econometric techniques have been developed to estimate the frontier of a production function that better corresponds to the economist's theoretical definition (Kalirajan and Shand, 1999 and Kumbhakar and Knox-Lovell, 2000).

To estimate a production function frontier, either parametric or nonparametric techniques, can be applied (Coelli et al., 1998). The parametric model SFA chosen,[1] firstly developed by Aigner et al. (1977) and Meeusen and van den Broeck (1977), allows to distinguish between production inputs and inefficiency factors and to disentangle distances from the efficient frontier between those due to systematic components and those due to noise. Through the systematic component, that is an additional error term, exogenous shocks beyond the control of cities are captured and technical inefficiency[2] is estimated.

This estimation is based on a single stage maximum likelihood approach in which exogenous variables were incorporated directly into the inefficiency error component as developed first by Kumbhakar et al. (1991). The subsequent development is the Battese and Coelli (1995) model where the allocative efficiency is imposed, the first-order profit maximising conditions removed, and panel data are permitted.

Following this last model, the production function can be expressed as:

$$Y_{it} = x_{it}\beta + (v_{it} - u_{it}) \qquad i=1,...,N,\ t=1,...,T \quad (1)$$

where Y_{it} is (the logarithm of) the production of the *i-th* city in the *t-th* time period; x_{it} is a $k\times 1$ vector of (transformations of the) input quantities of the *i-th* city in the *t-th* time period; β is a vector of unknown parameters. The unobserved random noise is composed of a first component v_{it}, which are random variables following the assumption of normally distributed error terms [iid N(0, σ_V^2)], and a second independent component to capture the effects of technical inefficiency defined as u_{it}, which are non-negative random variables assumed to be independently distributed as truncated normal N(m_{it}, σ_U^2) distribution.

The mean of this truncated normal distribution is a function of systematic variables that can influence the efficiency of a city:

$$m_{it} = z_{it}\delta + \varepsilon_{it}, \quad (2)$$

where z_{it} is a $p\times 1$ vector of variables that may have an effect on the production function of a city and δ is a $1\times p$ vector of parameters to be estimated.

Following Battese and Corra (1977), the simultaneous maximum likelihood estimation of the two equation system is expressed in terms of the variance parameters $\sigma^2=\sigma^2_v+\sigma^2_u$ and $\gamma=\sigma^2_u/(\sigma^2_v+\sigma^2_u)$ to provide asymptotically efficient estimates. Hence, the acceptance of the null hypothesis that the true value of the parameter γ equals zero implies that σ^2_u, the non-random component of the production function residual, is zero.

The technical efficiency of the *i-th* city in the *t-th* time period is given by:

[1] A number of comprehensive reviews of this literature are now available see, for example Coelli et al. (1998) and Kumbhakar and Knox-Lovell (2000).

[2] We follow the Farrel (1957) measure of a firm's efficiency consisting of two components: technical and allocative. The former reflects the ability of a firm to obtain maximal output from a given set of inputs, while the latter reflects the ability of a firm to use the inputs in optimal proportions given their respective prices. These considerations are obviously true also at the country level considering that the aggregate output comes from the sum of national producers.

$$TE_i = e^{(-u_i)} = e^{(-z_{it}\delta - \varepsilon_{it})} \quad (3)$$

The technical inefficiency values oscillate between 0 and 1, being the latter the most favourable case. If $TE_{it}<1$ then the observable output is less than the maximum feasible output, meaning that the statistical unit is not efficient.

4 THE EMPIRICAL MODEL

Using the 1995 Battese and Coelli' specification and an unbalanced panel dataset, we perform the SFA to analyse the efficiency of several European cities. Data have been drawn from the Urban Audit dataset of Eurostat. This dataset, however, presents several limitations. Data are collected every three years and many variables have missing values. Even if there are several waves of the survey,[3] due to comparability we use only three out of the six waves: 1999-2002, 2003-2006 and 2007-2009. As regards the choice of cities, we select the same 70 European cities considered in the ranking developed by Giffinger et al. (2007) (see Table in Appendix).

The production of each city is measured by the proxy GDP in PPS of NUTS 3 region (in euro) (Y_{it}) and, as usual, is assumed to be a function of three inputs: physical capital (K_{it}), labour (L_{it}) and human capital (H_{it}). Typically, the value of the physical capital should comprise buildings (dwellings, warehouses and other buildings), transport equipment and other machinery and equipment. Because a city is not a firm, assessing city's physical capital is a challenge especially when data are lacking[4]. The only thing to do is to use as proxy two available variables: i) houses, measured by the number of dwellings, and ii) transport, measured by the length of the public transport network (km)[5]. The second input, labour variable, is represented by the number of employees. As regards the third input, human capital is measured by the number of students (aged 15-64) with ISCED level 3 or 4.

By assuming that the production function takes the log - linear homogeneous Cobb-Douglas form, our stochastic frontier production model is specified as follows:

$$ln(Y/L)_{it} = \beta_0 + \beta_1 ln(Kdwelling/L)_{it} + \beta_1 ln(Ktransport_{net}/L)_{it} + \beta_2 ln(H/L)_{it} + v_{it} - u_{it} \quad (4)$$

where the dependent variable is the value of the economic performance of the *i-th* city at time *t* (*i=1,...,N; t=1,...,T*) divided by a scale variable (labour force) to remove potential problems of heteroskedasticity, multicollinearity and output measurement (Hay and Liu, 1997). As independent variables, we put *Kdwelling/L* and *Ktransport_net/L* as per-worker physical capital of the *i-th* city at time *t*, and *H/L* as human capital measured by per-worker education level of residential people of the *i-th* city at time *t*.

According to the SFA, the systematic component of error includes exogenous factors that can influence city's efficiency. These factors are captured by city smartness measured by Giffinger *et al.* (2007) indictors, as shown in the following equation:

$$u_{it} = \gamma_0 + \gamma_1 Smart_{Economy_{it}} + \gamma_2 Smart_{People_{it}} + \gamma_3 Smart_{Governance_{it}} + \gamma_4 Smart_{Mobility_{it}} + \gamma_5 Smart_{Environment_{it}} + \gamma_6 Smart_{Living_{it}} + \sum_{k=7}^{26} \gamma_k Countrydummy + \varepsilon_{it} \quad (5)$$

where $Smart\_Economy_{it}$, $Smart\_People_{it}$, $Smart\_Governance_{it}$, $Smart\_Mobility_{it}$, $Smart\_Environment_{it}$ and $Smart\_Living_{it}$ are the Giffinger *et al*. (2007)' indicators that jointly describe a city as a smart city. On this basis researchers have ranked the 70 European medium-sized cities. The main criticism to the Giffinger et al. (2007)' analysis is based on the combined use of data at both national and local level and on the mix of timing of the different components of the six indicators. Moreover, the methodology to aggregate all factors

[3] The first three waves of the survey (1989-1993, 1994-1998, 1999-2002) can be considered as a "pilot", as the first full-scale European Urban Audit took place in 2003 for the then 15 countries of the European Union.

[4] Because the very recent literature on smart cities is not well developed, there is not an accepted measure of city physical capital. A first attempt to measure this input was conducted by the Economist Intelligence Unit (2012). Even if we are aware that this report is not academic, the authors follow a very similar method to our assumption. Another method to estimate capital stock of city production function is based on investments as in Segal (1976), but unfortunately urban audit dataset does not include this type of data.

[5] We have been obliged to use this proxy because of a lack of "length of road" variable in the Urban Audit dataset.

into six indicators is too simple[6], and it does not consider heterogeneity among cities. However, the European Union considers this approach the most relevant benchmark for defining a smart city.

Finally, to analyse a recent issue that emerged in the new economic geography literature that asserts that a city belonging to a well-developed area can perform better than a city belonging to a less developed area, we have introduced *m*-1 country dummies to capture the effect of city's geographical localisation and the heterogeneity among cities. A country in northern Europe should influence positively city's economic performance, and thus, technical inefficiency should be less with respect to other cities in other countries. In other words, the gap from the optimal stochastic frontier of this kind of city should not be very wide.

5 DESCRIPTIVE EVIDENCE AND RESULTS

Results of the stochastic frontier estimations are reported in Table 1. In the first and second model, the estimated results exclude the variable "length of the transport net" but include country dummies (as in column 2). In the third and fourth model, instead, the length of the transport net is included, and thus, the missing value problem drastically reduces the observations. Cities considered are reduced to only 54 cities in model 1 and 2 and to only 39 cities for model 3 and 4. In the Appendix, we report the differences, in terms of cities considered, among our estimation datasets, the Urban Audit dataset and the Giffinger et al. (2007) dataset.

Subdividing cities according to the country to which the city belongs, only Germany presents 6 cities in the sample, while other countries show a lesser number of cities and some others are considered because of the presence of only one city. The missing data problem is a quite serious one when the Urban Audit dataset is used and can create some comparability problems among European cities. On the basis of the Giffinger et al. (2007) smart indicators, the Scandinavian cities are highly ranked, while Germany and the United Kingdom are, more or less, in the middle of the classification.

Considering that, in all the specifications, we reject the null hypothesis of the insignificance of the non-negative error component (γ), we conclude that the SFA is a good model to analyse the effect of smart city's indicators on cities' economic performances. The parameter (γ), meaning that a proportion of the total variance is due to inefficiency effects, is significant at the 1% level in all estimations, and varies between 0.48 and 0.80. This indicates that from 48% to 80% of the total variance of the model is explained by inefficiency effects.

As to the estimated results, they are mixed. The production functions in all models show that physical capital measured by dwellings has always a positive and significant sign, while physical capital measured by the length of the transport net has a negative, albeit insignificant, sign. Human capital has again a negative but insignificant (on three of the four models) coefficient sign. These results should be taken carefully due to the relevance of the missing data problem within the dataset as underlined by the number of observations.

When we observe the signs of the smart city's indicators in the first model, we note that only Smart People and Smart Environment show negative signs, thus indicating that both variables have a positive effect on efficiency and, hence, a negative impact on inefficiency. The other smart indicators show a vice versa effect in that they increase inefficiency and decrease efficiency. However, we must emphasise that the signs are not robust to the inclusion of other variables and that the significance of the coefficients is drastically reduced in the other model considered in Table 1.

To deepen our analysis, we have estimated technical inefficiencies for each city, using the models described in column (2) and in column (4). In both tables, we report the technical inefficiency values of European cities for three separate years - 2000, 2004 and 2008 -which represent the three different waves of the survey. We then rank the European cities according to the level of inefficiency reached in 2004.

The results confirm that the inefficient cities are those belonging to the eastern European countries, but they do not confirm that the Scandinavian cities are the most efficient. Enhancing the Giffinger et al. (2007)' analysis, a city belonging to a well-developed and best performing country such as Germany or UK can perform better than a city that belongs the other countries.

To understand and emphasise the differences better, we compare our European city rankings with that of Giffinger et al. (2007) (see Table 4). In particular, our comparison is based on the rankings resulting from

[6] They aggregate additively the factors divided by the number of values added.

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model 4 for the year 2004 where only 36 cities are considered. The comparison highlights the gap, in the last column, between the resulting relative positions of the 36 cities. For 13 out of 36 cities, the gap is not relevant (less than 3 positions), thus suggesting that the two rankings provide similar results, while for the rest of the cities, the gap increases quickly, reaching a spread of 22 positions in the worst case (i.e. the city of Aalborg in Denmark).

dependent variable: gdp/L	1	2	3	4
Const β0	10.66***	10.82***	10.16***	10.58***
t	83.00	81.34	20.80	9.85
K dwelling/L β1	0.57***	0.51***	0.62***	0.51***
t	4.41	4.13	4.15	3.45
K_transport net/L β2			-0.11*	-0.13
t			-1.73	-1.31
H/L β3	-0.14**	-0.06	-0.08	0.16
t	-2.44	-1.06	-0.60	0.79
const γ0	-3.86***	-0.91	-3.98***	-2.22***
t	-11.13	-0.92	-5.85	-2.76
Smart Economy γ1	0.33***	0.44***	0.03	0.14
t	3.30	2.63	0.14	0.48
Smart People γ2	-0.21**	-0.17	-0.11	-0.07
t	-2.43	-0.71	-0.83	-0.16
Smart Governance γ3	0.36***	0.41	-0.07	0.21
t	2.64	1.37	-0.40	0.55
Smart Mobility γ4	0.47***	0.15	0.66***	0.58
t	3.89	0.45	3.67	1.52
Smart Environment γ5	-0.01	0.08	-0.01	-0.14
t	-0.24	0.58	-0.09	-0.57
Smart Living γ6	0.22	-0.33	0.70**	0.19
t	1.08	-1.02	1.96	0.30
Number of cities	54	54	39	39
Observations	101	101	69	69
Sigma squared	0.09***	0.04***	0.09***	0.06
t	4.76	3.09	3.75	1.57
Gamma	0.59***	0.48***	0.65***	0.80**
t	5.96	3.33	5.98	2.37
Log likelihood	-1.79	32.65	-1.35	9.28

Table 1: SFA models with GDP per-capita as the dependent variable. Note: * significant at 10%; ** significant at 5%; *** significant at 1%

6 CONCLUSION

In this paper, we analyse how a number of European cities face the challenge to be smart according to the political point of view. Using the definition of smartness developed by Giffinger et al. (2007), the European Union policy considers cities as the main engine of growth in the next future. Thus improving the efficiency of a city represents the best target to be aimed as emphasized in the EU 2020 strategy.

In the study of Giffinger et al. (2007), a city could be considered as smart on the basis of several intangible indicators. Drawing on this influential work, our aim is to verify if the Giffinger et al. (2007)' six smartness indicators are essential in explaining the efficiency and indirectly the growth of the same sample of European cities. In particular, using data of the Urban Audit Eurostat dataset and the six indicators that jointly describe a smart city, we analyse the relationship between economic performance, measured in terms of GDP, and the efficiency of these European cities through the inefficiency term. Applying the SFA approach, results show that only Smart-People and Smart-Environment have positive effects on efficiency, while the other smart indicators increase the city's inefficiency.

CITY	COUNTRY	VIENNA RANKING	2004 MODEL 4 RANKING	GAP
Liepaja	LV	33	33	0
Nijmegen	NL	8	8	0
Enschede	NL	12	12	0
Joenkoeping	SE	11	11	0
Ruse	BG	36	35	1
Pleven	BG	35	36	1
Pecs	HU	32	31	1
Kaunas	LT	31	30	1
Groningen	NL	9	10	1
Nitra	SK	27	28	1
Banska Bystrica	SK	30	29	1
Miskolc	HU	34	32	2
Kosice	SK	29	27	2
Eindhoven	NL	7	4	3
Magdeburg	DE	19	15	4
Kiel	DE	20	14	6
Ljubljana	SI	10	17	7
Goettingen	DE	13	5	8
Oviedo	ES	28	20	8
Umeaa	SE	14	22	8
Maribor	SI	17	26	9
Tartu	EE	24	34	10
Valladolid	ES	26	16	10
Erfurt	DE	18	7	11
Pamplona	ES	25	13	12
Trier	DE	16	3	13
Regensburg	DE	15	1	14
Aberdeen	UK	23	9	14
Tampere	FI	5	21	16
Portsmouth	UK	22	6	16
Aarhus	DK	1	18	17
Turku	FI	2	19	17
Oulu	FI	6	23	17
Leicester	UK	21	2	19
Odense	DK	4	24	20
Aalborg	DK	3	25	22

Table 4: Comparison between the two European city rankings

Ranking the European cities according to the level of inefficiency reached in 2004, we highlight several differences with the study of Giffinger et al. (2007). This allows us to compare different characteristics and to identify strengths and weaknesses of medium-sized cities. Among the most efficient European cities, we find some German and United Kingdom cities, while the inefficient cities are mainly located in the eastern European countries. A city belonging to a well-developed and best performing country can perform better than a city that belongs to the others European country. Comparing our European city ranking positions with that of Giffinger et al. (2007), we find that more or less one third of the sample seems to confirm the previous ranking while for the rest of the cities the position gap is quite relevant, suggesting that dominates dissimilarities between the two rankings.

In conclusion, we may underline that Giffinger et al. (2007)' smart city definition is not able to explain cities' efficiency and thus economic growth paths. Therefore, European policy makers should either use a different structure of indicators to foster urban efficiency and indirectly city's growth or draw on a different final target as output, i.e. European Commission should change its objectives from GDP or value added to well-being, happiness or quality of life. These different outputs are more completed and are more strictly related to the idea of urban performance. This means a more complex target where a city is smart if and only if it is able to be a focus for skilled labour force, ICT firms, honour students, tourists and to implement policies for ameliorating the business environment, reducing pollution, facilitating the development of social capital, and so on.

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reviewed paper

Smart City – Smart Design? Die Auswirkung digitaler Medien auf die Stadtgestalt

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1 ABSTRACT

Die Smart City dient oftmals als Katalysator für Hoffnungen auf eine neue, zukunftsorientierte und intelligentere Art der Stadtplanung. Der Diskurs um neue Informations- und Kommunikationstechnologien in der Stadtplanung geht mit der Einschätzung einher, dass sich durch diese Technologien unser Verhalten im Stadtraum und damit auch die Gestaltung unserer Städte verändern wird.[1]

Zu Beginn der Digitalisierung war die Prognose für den "realen" Stadtraum häufig eine düstere. Genährt von vorangegangenen Warnungen zur Verödung, Segregation und Privatisierung[2] unserer Städte, war die Befürchtung einiger Stadtforscher und Beobachter, dass sich in der digitalen Gesellschaft, die Frage nach realen Treffpunkten oder öffentlichen Räumen letztlich vollständig erübrigen würde.[3] Allen Befürchtungen zum Trotz, stellen wir heute und dies besonders unter dem Einfluss digitaler Medien[4], eine Renaissance der Stadt[5] und ihrer öffentlichen Räume fest.

Gerade im Zuge der Smart City werden so unterschiedliche Themen, wie etwa die intelligentere Organisation von Infrastrukturen und Stadttechniken, aber auch die gängigen Standards der Partizipation und der Stadtgestalt neu verhandelt. Die Akteure reichen hierbei von lokal agierenden, gut vernetzen, engagierten Initiativen und Bürgern, über Verwaltungen und Forschungscluster, bis hin zu global agierenden Technologieunternehmen. Auffällig erscheint in diesem Kontext, dass alle bislang erdachten Konzepte und Experimente von einem neuen, intelligenteren und besseren Stadttypus ausgehen. Während sich bezogen auf die Nutzung und Einbindung von Big-Data Analysen, einer ökonomischeren und ökologischeren Nutzung vorhandener Ressourcen, die (Online-basierte) Einbindung der Bürger oder der Reorganisation der Verkehrsströme bereits erste Ansätze in der Praxis formulieren lassen, ist der Bezug der Smart City zu Ihrer Stadtgestalt und die Ausprägung Ihrer öffentlichen Räume noch weitestgehend ungeklärt.

Was ist also dran an der neuen Form der Stadtgestaltung? Welche Auswirkungen hat die Smart City auf die Gestaltung unserer Städte? Gibt es einen neuen Stadttypus oder andere öffentliche Räume? Wie sind die Auswirkungen der Smart City in Bezug zu technologischen Innovationen aus den vergangenen Jahrhunderten einzuschätzen? Folgt der Smart City tatsächlich konsequenterweise ein Smart Design?

Anhand eines historischen Rückblicks auf einschneidende, technologische Neuerungen und deren Auswirkungen auf die Gestalt der europäischen Stadt, sowie einer Analyse der derzeit diskutierten gestalterischen Ansätze in der Smart City, will der Beitrag "Smart City - Smart Design?" das im Diskurs bislang unterrepräsentierte Verhältnis von digitalen Medien und analogen, städtischen (öffentlichen) Räumen reflektieren. Denn zwischen der Reproduktion bewährter Typologien (Vgl. Songdo) und DIY-Urbanismus scheint die Stadtgestalt in der Smart City bislang vor allem eine formlose zu sein.


Fig. 1 (links): Songdo International City, Fig.2 (rechts): Luchtsingel Bridge, Rotterdam

Keywords: Digitale Medien, Stadtplanung, Design, Smart City, Stadtgestalt

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2 HISTORISCHE, TECHNOLOGISCHE INNOVATIONEN UND DIE STADTGESTALT

Die europäische Stadt ist als iterativer Prozess zu verstehen, weshalb die Auseinandersetzung mit historischen Entwicklungen für die zukünftige Stadtplanung unabdingbar ist.[6]

Die europäische Smart City wird also zwangsläufig auf Ihren bestehenden Strukturen aufbauen müssen. Zu diesem Zweck wird im Folgenden auf zwei einschneidende Perioden der europäischen Stadtentwicklung und deren Auswirkung auf die Stadtgestalt verwiesen. An Hand einer Reflektion zur Integration der historischen, technologischen Innovationen in diesen Entwicklungsperioden, werden Rückschlüsse für die zukünftige Integration neuer Technologien erwartet.

2.1 Industrielle Revolution

Im Zuge der Industrialisierung wurden die europäischen Städte durch neue Technologien gepaart mit einem enormen Bevölkerungswachstum maßgeblich transformiert und erweitert. So stellt für viele Städte der Anschluss an das aufkommende Eisenbahnnetz bis heute einen der prägendsten Einschnitte in Ihren Stadtgrundriss dar. Die Lage des Bahnhofs und die Einbringung des Gleisverlaufs im Stadtkörper beeinflusst nicht nur das damalige Wachstum der Städte, sondern ist auch heute noch für viele Städte Taktgeber in Ihrer aktuellen und zukünftigen Entwicklung. Am Beispiel von Stuttgart kann die direkte Abhängigkeit von Schienenverlauf, Bahnhof und Stadtkörper von 1846 bis zum heutigen Stuttgart 21 idealtypisch nachgezeichnet werden. Auch in Nürnberg lässt sich an Hand des Schienenverlaufs noch deutlich erklären, warum die Südstadt bis heute mehr strukturelle Probleme aufweist als die nördlich der Bahn gelegenen Stadtquartiere.

Neben der Eisenbahn stellte aber vor allem das einsetzende Bevölkerungswachstum und neue Möglichkeiten in der Stadttechnik die Städte vor große Herausforderungen. Der historisch "gewachsene" Bestand der teils noch mittelalterlich anmutenden Städte musste an die neuen Herausforderungen hervorgerufen durch die Übervölkerung der Zentren, miserable hygienische Bedingungen und zunehmende Dichte in den engen Quartieren angepasst werden. So erfolgte etwa in Paris die Umgestaltung des historischen Zentrums durch Georges-Eugène Haussmann, welche noch heute einen deutlichen Abdruck im Stadtgrundriss zeichnet und gleichzeitig gestaltprägend für die aktuelle Rezeption von Paris ist. Neben den planerischen und baulichen Eingriffen in die Stadtstruktur und der berechtigten Kritik an der Rücksichtslosigkeit in der Umsetzung der Hausmann´schen Planungen lässt sich am Beispiel von Paris vor allem folgendes Erkennen: Die Integration neuer Technologien (Kanalisation, Verkehr) in bestehende Strukturen kann langfristige Veränderungen der Stadtgestalt hervorbringen und die Technik vermag, insofern sie mit einer Gestaltabsicht (Boulevard, Verbindung von Sonderbauten, Typologische Festlegungen auf Architekturebene) einhergeht, langfristig positiven Einfluss auf die Stadtgestalt entwickeln.

Fig. 3: Haussmann-Plan für Paris, 1851

[6] NAGLER, Heinz Nagler, Internetauftritt, 2015. Online: http://www.tu-cottbus.de/fakultaet2/de/staedtebau-und-entwerfen/lehre/lehrkonzept/grundsaetze.html (letzter Zugriff: 23.03.2016)

Was Haussmann für Paris war, war James Hobrecht für Berlin. Der für den Hobrechtplan von 1862 bekannt gewordene Stadtplaner zeichnet sich maßgeblich für die gründerzeitliche Erweiterung, die Einführung eines neuen Verkehrsnetzes und die Integration eines modernen Kanalisationssystems in Berlin verantwortlich. Mit deutlichen Einflüssen aus Paris und London entstand unter Hobrecht der erste Fluchtlinienplan Berlins, in welchem zukünftige Straßenverläufe und damit einhergehend neu zu entwickelnde Baufelder definiert wurden. Hobrecht hatte zwar neben den technischen Lösungen eine klare Vorstellung davon wie eine neue Bebauung aussehen sollte,[7] konnte diese aber rechtlich nicht in den Fluchtlinienplan aufnehmen. Die Folgen sind bekannt: Auf Grund mangelnder Aussagen etwa zur Art und Dichte der Bebauung entstanden im Zuge der Hobrecht-Planungen die später stark kritisierten Mietskasernen, mit teils schwierigsten Lebensbedingungen. Hobrecht gelang es nicht seine Gestaltabsicht über den Stadtgrundriss und die Integration der Stadttechnik hinaus zu fixieren und so zeichnet sich, neben der Bodenspekulation, welche mit dem einhergehenden Entwicklungsdruck der damaligen Zeit fast unausweichlich erscheint, vor allem ein technisches Detail für das Entstehen der Mietskaserne mitverantwortlich: Die Reduktion der Vorschriften auf brandschutztechnische Belange. Die beinahe einzige Vorschrift, welche die damalige Baupolizeiordnung für die Bebauung der Hobrecht´schen Baufelder regelte, war die Freihaltung eines Innenhofes von 5,34m im Quadrat zur Einbringung der Feuerspritze im Brandfall. Anders gesagt: Die Feuerspritze bestimmt damals (und in Teilen der Bebauung bis heute) die besondere Stadtgestalt der Berliner Gründerzeitquartiere.

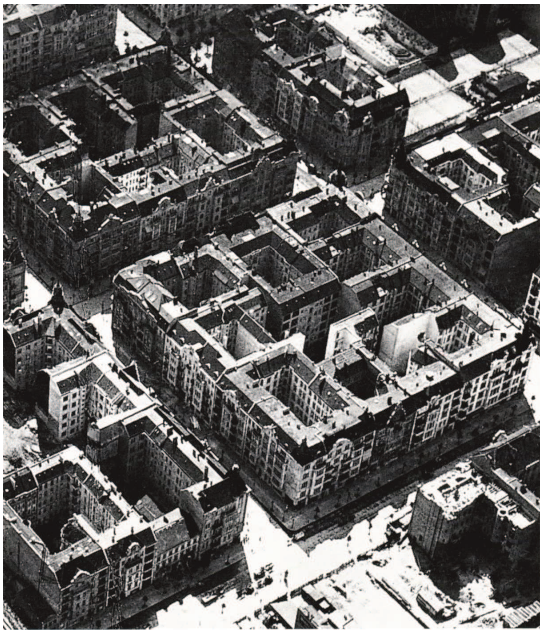

Fig. 4: Mietskaserne in Berlin um 1900

Zur Ehrenrettung Hobrechts sei gesagt, dass sich die Erweiterungsquartiere von 1862 als äußerst resistent, adaptionsfähig und nachhaltig erwiesen haben und heute diejenigen Stadtteile in Berlin sind, welche auf Grund Ihrer Stadtstruktur, Ihrer einheitlichen Gestalt, ihrer sozialen Mischung und ihres Charmes, die begehrtesten Wohngegenden in Berlin sind. Nicht unwesentlich sei in diesem Zuge noch auf Peter Joseph Lenné verwiesen, dessen "Projektierte Schmuck- und Grenzzüge von Berlin mit nächster Umgebung" von hoher stadtgestalterischer Qualität waren und die Hobrechts Pläne wesentlich mitbestimmt haben. Der Einklang zwischen gestalterischer Absicht (Lenné) und der Integration moderner Stadttechnik (Hobrecht) prägt das innerstädtische, international geschätzte und in vielen Teilen mittlerweile denkmalgeschützte Berliner Stadtbild bis heute maßgeblich.

2.2 Die autogerechte Stadt

Nach der Zerstörung der Städte im zweiten Weltkrieg erfolgte der Wiederaufbau in Deutschland unter höchst unterschiedlichen Prinzipien. Ganz grob gesehen lassen sich zwei Richtungen erkennen: Zum einen der konventionelle, am historischen orientierte Wiederaufbau (z.B. Nürnberg), zum anderen der moderne Wiederaufbau (z.B. Hannover).

[7] STROHMEYER, Klaus Strohmeyer: James Hobrecht und die Modernisierung der Stadt. Potsdam, 2000

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Der moderne Wiederaufbau griff hierbei auf die "ideologische Unversehrtheit" der Charta von Athen (u.a. funktionsgetrennte Stadt) zurück und versuchte oftmals das aufkommende Automobil als technologischen Fortschritt in die Stadtstruktur zu integrieren. In diesem Zuge entstand auch die Idee der autogerechten Stadt, in der sich alle Planungsmaßnahmen dem ungehinderten Verkehrsfluss des Automobils unterordnen sollten. Eine besonders prägnantes Beispiel für den Wiederaufbau zu einer autogerechten Stadt findet sich in Hannover.

Der 1948 berufene Stadtbaurat Rudolf Hillebrecht beabsichtigte das zu 80% zerstörte Hannover als eine autogerechte, gegliederte und aufgelockerte Stadt wiederaufzubauen. Die Innenstadt wurde hierzu als ein Zentrum aus Büro-, Dienstleitungs- und Verwaltungsgebäude definiert, das Wohnen überwiegend aus ihr verdrängt. Der Verkehr um dieses Zentrum wurde über einen Ring ("Tangenten-Fünfeck") organisiert und über Radialen nach außen vernetzt. Der City-Ring war vor allem auf die Geschwindigkeit des Autos ausgelegt und erhielt große Knotenpunkte, die als Kreisel organisiert wurden. Hillebrecht setzte ferner auf die Trennung der Verkehrsströme, so dass Hochstraßen und Fußgängertunnel in die Planungen integriert wurden. Das Ziel des ungehinderten Verkehrsflusses konnte so in Hannover beinahe idealtypisch erreicht werden, der Fußgänger, die Aufenthaltsqualität und die Stadtgestalt blieben aber zugunsten einer monofunktionalen, rein technischen Ausrichtung auf der Strecke.

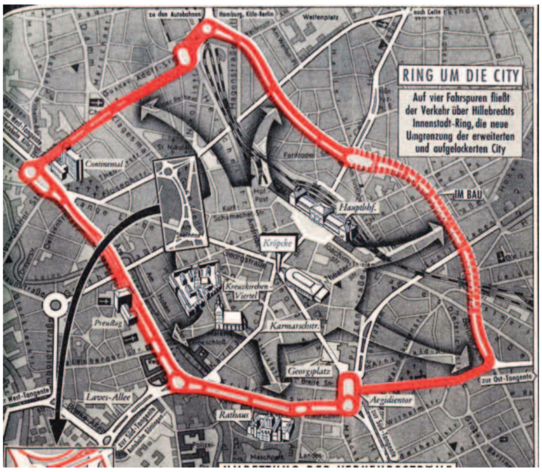

Fig. 5 (links): Der City-Ring in Hannover, Planung, Fig. 6 (rechts): Hochstraße am Aegidientorplatz

Bereits in den Siebziger-Jahren setzte in Hannover zunehmend die Kritik an den Planungen Hillebrechts bzw. an der Verödung der umgebenden Stadträume ein, weshalb sich die Stadtverwaltung 2008 entschloss den städtebaulichen und landschaftsplanerischen Ideenwettbewerb Hannover City 2020+ auszuloben. Eingebettet in ein umfassendes Prozess- und Beteiligungsprogramm[8] ging es in dem Wettbewerb vor allem um die Revitalisierung der Innenstadt unter Rückeroberung und Transformation der überdimensionierten Verkehrsräume. Rund fünfzig Jahre nach Ihrem Entstehen soll die autogerechte Stadt in Hannover de facto revidiert werden.

3 STADTGESTALTUNG IN DER SMART CITY

In dem fortwährenden Diskurs über die Smart City wird oftmals von einer Veränderung des öffentlichen Raums durch die Integration neuer IKT[9] oder einem möglichen veränderten städtebaulichen Entwurfsprozess unter dem Einsatz digitaler Medien ausgegangen[10]. Mit dem Rückblick auf die Integration historischer Technologien, auch wenn diese in der Regel materieller, physischer Natur waren, lässt sich die Annahme, dass Technologien einen Einfluss auf die Stadtgestalt haben primär stützen, auch wenn noch nicht geklärt ist welche Auswirkungen unter den aktuellen Einflüssen zu erwarten sind. Im Folgenden werden daher zwei aktuelle Vorhaben zur Smart City auf ihre Aussagen zur Stadtgestaltung befragt.

[8] HANNOVER, Baudezernat Hannover: Hannover City 2020+ - Der Wettbewerb. Hannover, 2010. Online: http://www.hannover.de/Leben-in-der-Region-Hannover/Planen,-Bauen,-Wohnen/Stadtplanung-Stadtentwicklung/Konzepte-Projekte/Hannover-City-20202 (letzter Zugriff: 23.03.2016)

[9] BBSR, op. cit.

[10] STREICH, Bernd Streich: Subversive Stadtplanung. Wiesbaden, 2014

3.1 Smart-City-Strategien in deutschen Städten und am Beispiel Berlin

In vielen deutschen Großstädten (z.B. Hamburg, Köln, Dresden, Berlin) sind bereits Absichtserklärungen, Leitbilder, Strategien oder Förderprogramme für eine zukünftige Entwicklung hin zur Smart City entwickelt worden. Die meisten Städte haben hierbei folgerichtig erkannt, dass es einer übergreifenden, ganzheitlichen Strategie bedarf um die vielfältigen Themenbereiche der Smart City für die Qualifizierung Ihrer Bestände aber auch für die neu zu errichtenden Quartiere nutzbar zu machen. Im groben Vergleich der Strategien lässt sich eine auffällig hohe Analogie in den Themen feststellen, weshalb hier als Musterbeispiel auf die Strategie der Stadt Berlin eingegangen wird.

Am 21.04.2015 hat die Berliner Senatsverwaltung die "Smart City-Strategie Berlin"[11] beschlossen. In dem vierzig Seiten umfassenden Papier werden innerhalb von sechs Handlungsfeldern an die siebzig Themen behandelt. Darunter so unterschiedliche Ansätze wie: "Fortschreitende Digitalisierung der Geschäftsprozesse", "IT-Fachkräfte und Vermittlung von IKT-Kompetenz", "Kunst und Kultur", "Steigende Mieten", "Ambient Assisted Living", "Wohnungs- und Gebäudesicherheit", "Schnittstellen-Innovation", "Das Handwerk", "Kurze Wege", "Smart Grids" und das "Bürgertelefon 115". Die Strategie baut im Wesentlichen auf bereits bestehende Konzepte etwa zur Ressourcenminimierung oder das Stadtentwicklungskonzept 2030 auf und liest sich wie eine Optimierungsmaschine für eigentlich alle Lebensbereiche unter der (gelegentlichen) zu Hilfenahme von IKT. Bezogen auf die Stadtgestalt, die Gestaltung von öffentlichen Räumen oder zu einem veränderten Entwurfsprozess sind keine Aussagen zu finden. Hinweise etwa auf die Relevanz der Gestalt zur Akzeptanz dieser Technologien oder gar Vorschläge wie eine gestalterische Integration dieser Vielzahl an neuen Technologien in die Stadt gelingen soll – Fehlanzeige. Die Gestaltung spielt in der Smart City-Strategie Berlin keine Rolle und auch in diesem Fall kann das Berliner Beispiel leider als Muster gesehen werden, denn auch in den meisten anderen Städten sind in Bezug auf die Gestaltung kaum bis gar keine Aussagen zu finden.

3.2 Songdo City

Der Songdo International Business District ist als neue Planstadt ein Teil der südkoreanischen Metropole Incheon, welche ca. 40 km südwestlich von Seoul liegt. Der Masterplan für den auf einer Polderfläche angelegten Stadtteil stammt vom amerikanischen Architekturbüro Kohn Pederson Fox Associates und wird von dem koreanischen Unternehmen POSCO in Kooperation mit dem amerikanischen Bauträger Gale International realisiert. Für die Integration neuer IKT in die Planung und Ausführung wurde die Firma CISCO ausgewählt. Die Bauarbeiten für den Stadtteil wurden 2003 begonnen und sollen bis 2020 abgeschlossen sein. Im Herbst 2014 waren etwa 60% der geplanten Infrastruktur und Gebäude realisiert. [12]


Fig. 7 (links): Visualisierung Masterplan Songdo, KPF, Fig. 8 (rechts): Masterplan Songdo, KPF

[11] SMART CITY STRATEGIE BERLIN. Berlin, 2015. Online: http://www.stadtentwicklung.berlin.de/planen/foren_initiativen/smart-city/download/Strategie_Smart_City_Berlin.pdf (letzter Zugriff: 23.03.2016)
[12] BBSR, Bbsr: Smart Cities International. Bonn, 2015

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Die "smarte" und "nachhaltige" Stadt Songdo integriert hierbei ein hohes Maß an IKT und neuen Technologien in Ihre Stadtstruktur. So werden etwa ein pneumatisches Abfallsystem, Telepräsenzsysteme und ein zentrales Computernetzwerk für die Ver- und Entsorgung und die Steuerung des Verkehrswesen integriert. Die digitale Vernetzung soll hierbei einen hohen Ausbaustandard erreichen und vom Öffentlichen bis hinein ins Private reichen. Neben all diesen technologischen Innovationen bedingt der komplette Neubau des Stadtviertels aber auch einen städtebaulichen, stadtgestalterischen und architektonischen Entwurf.

Dem öffentlichen Raum soll in Songdo eine tragende Rolle zukommen, weshalb dieser etwa 40% der Fläche belegt. Erstaunlich ist in diesem Zusammenhang wie wenig, oder besser gesagt gar nicht die Gestaltung dieser Räume in Songdo durch die vielen technischen Innovationen beeinflusst wird. Der weitaus größte öffentliche Raum, der Songdo Central Park orientiert sich als Vorbild am New Yorker Central Park, welcher sicher nicht zwangsläufig als erste Idee erscheint wenn man an die Gestaltung der Smart City denkt. Die Liste lässt sich beliebig erweitern: Die Kanäle sind eine Reminiszenz an Venedig, die Skyline an Hong Kong, das Kulturzentrum an die Oper von Sydney und die Pocket Parks an die von Savannah (Georgia, USA). Kurzum, eine Gestaltvorstellung der Stadt und öffentliche Räume sind in Songdo vorhanden aber sie haben nichts mit einem veränderten Stadtraum, einem neuen Stadttypus oder einer veränderten Stadtgestalt zu tun, denn alle Integration neuer Technologien resultiert in Songdo in der Reproduktion bewährter Typologien.

4 GESTALTPOTENZIALE IN DER SMART CITY

Der kurze Überblick über aktuelle (Nicht-) Gestaltungstendenzen in der Smart City könnte zu der Vermutung führen, dass die Gestaltung in der Smart City keine Rolle mehr spielen wird und jene Kritiker recht hatten, welche die Ablösung der realen öffentlichen Räume durch den Cyberspace befürchteten.

Doch gerade unter dem Einsatz neuer digitaler Medien hat sich in den letzten Jahren eine wirkungsvolle, innovative und heterogene Szene aus Bürgern, Planern, Architekten, Entrepreneuren, Crowdsourcern und urbanen Pionieren entwickelt, deren erklärtes Ziel es ist die Stadtgestalt positiv zu beeinflussen. Es lässt sich hierbei eine Vielzahl digitaler Phänomene identifizieren, welche einen hohen Gestaltbezug aufweisen und deren Potentiale innerhalb der Smart City geborgen werden können.

4.1 Urban Crowdfunding

Das Crowdfunding ist eine Art der Finanzierung von in der Regel online organisierten Mikrokrediten oder Spenden einzelner Internetnutzer für konkrete Projekte. Wurde diese Strategie zu Beginn vor allem für digitale Werke wie etwa Filme, Musik oder Videogames angewendet, lässt sich in letzter Zeit auch ein vermehrter Einsatz für urbane Projekte feststellen, das sogenannte Urban Crowdfunding.

Fig. 9: Schrägluftbild des Luchtsingel mit den umligenden Stadträumen

In Rotterdam konnte unter anderem mittels einer Crowdfunding Kampagne 2015 das "Luchtsingel" ("Luftkanal"), eine hölzerne Fußgängerbrücke über eine sechsspurige Straße im Stadtteil Hofplein finanziert und in Betrieb genommen werden. Die 390 Meter lange Brücke befindet sich in einem zentrumsnahen Quartier, welches durch eine aufgelockerte Bebauung, sowie verwaiste Grünflächen und großzügig dimensionierte Verkehrsräume strukturiert wird [13].

Der stillgelegte Bahnhof Hofplein sowie einige leerstehende Bürogebäude konnten bereits ab den 2000er Jahren sukzessive von Kreativen-Nutzern reaktiviert werden, was zum Wunsch nach einer besseren fußläufigen Verbindung der einzelnen Nutzungen führte. Im Rahmen der "I make Rotterdam" Initiative der Stadt Rotterdam, welche die Bürger dazu aufrief Ideen für die Stadterneuerung einzureichen, konnte das Luchtsingel einen großen Zuspruch verzeichnen, worauf die Stiftung "Stichting de Luchtsingel" aus Vertretern der Stadt, der Wirtschaft und Kreativen gegründet wurde[14]. Mit Hilfe des Preisgeldes aus der "I make Rotterdam" Initiative und einer Crowdfunding-Kampagne, bei der die Nutzer einzelne Teile der Brücke erwerben konnte und auf denen als Gegenzug für die Finanzierung der Name der Käufer eingraviert wurde, konnte das Projekt letztlich realisiert werden. Mit dem Bau der Brücke profitieren vor allem die umliegenden Stadträume von den so geschaffenen neuen Verbindungen. So erfolgte nach Fertigstellung des Luchtsingels zum Beispiel die Konversion eines ungenutzten Parkplatzes in einen gemeinschaftlichen Innenhof und es konnten bislang ungenutzte Dachflächen als gemeinschaftliche Dachgärten initiiert werden. Auch ein Park mit neuen Spielplätzen ist im Umfeld des Luchtsingel entstanden und weitere Eigentümer überlegen sich an das Luchtsingel anzuschließen und neue Nutzungen in Ihren teils leerstehenden Immobilien zu erproben.

Fig. 10 (links): Blick auf das Luchtsingel und den Innenhof des Schieblocks, Fig. 11 (rechts): Detail, Bohlen mit Gravur

Ein weiteres, aktuelles Beispiel für das Urban Crowdfunding ist der +Pool in New York. 2011 starteten die Architekten von Family + Play Lab eine Crowdfunding Kampagne auf Kickstarter.com um die Vision eines schwimmenden Pools im Hudson River auf Realisierbarkeit zu überprüfen.

Fig. 12: Visualisierungen + Pool

[13] LUCHTSINGEL, Luchtsingel, Internetauftritt, 2016. Online: http://www.luchtsingel.org/en/about-luchtsingel/the-idea/ (letzter Zugriff: 23.03.2016)
[14] BROCKSCHMIDT, Rolf Brockschmidt: Ein Laufsteg als Ausweg, Tagespiegel Online vom 27.06.2015: http://www.tagesspiegel.de/wirtschaft/immobilien/make-city-in-rotterdam-ein-laufsteg-als-ausweg/11972182.html (letzter Zugriff: 23.03.2016)

Da die Idee des Pools in den digitalen Medien enormen Zuspruch erlangte und dadurch internationales Medieninteresse nach sich zog, folgte eine weitere Kickstarter Kampagne die 273.000 $ zur Realisierung eines Prototypen einbrachte. Derzeit befindet sich das Projekt in der Detailierungsphase, während eine dritte Crowdfunding Aktion läuft, in der Spender einzelne, mit Ihren Namen gravierte Fliesen des Pools erwerben können und so bereits weitere 362.000 $ an Kapital zur Verfügung stellten. Ziel ist es den Pool nach Klärung der technischen Fragen des Filterprozesses und der rechtlichen Grundlagen bald möglichst zu errichten[15].

4.2 Communities/Urban Crowdsourcing

Während das Crowdfunding eine sehr direkte Art der Stadtgestaltung unter dem Einfluss digitaler Medien darstellt bietet das Crowdsourcing eher diskursive, partizipative Möglichkeiten zur Einflussnahme auf die Stadtgestalt. In einer Vielzahl von Wikis und Blogs ist die Gestaltung das Hauptthema. Einige von Ihnen spezialisieren sich ganz konkret auf die Gestaltung der öffentlichen Räume und ermöglichen Ihren Nutzern Anregungen oder Vorschläge für Projekte zu initiieren. Ein Beispiel einer derartigen Community findet sich bei der Initiative "Frankfurt gestalten - Bürger machen Stadt".

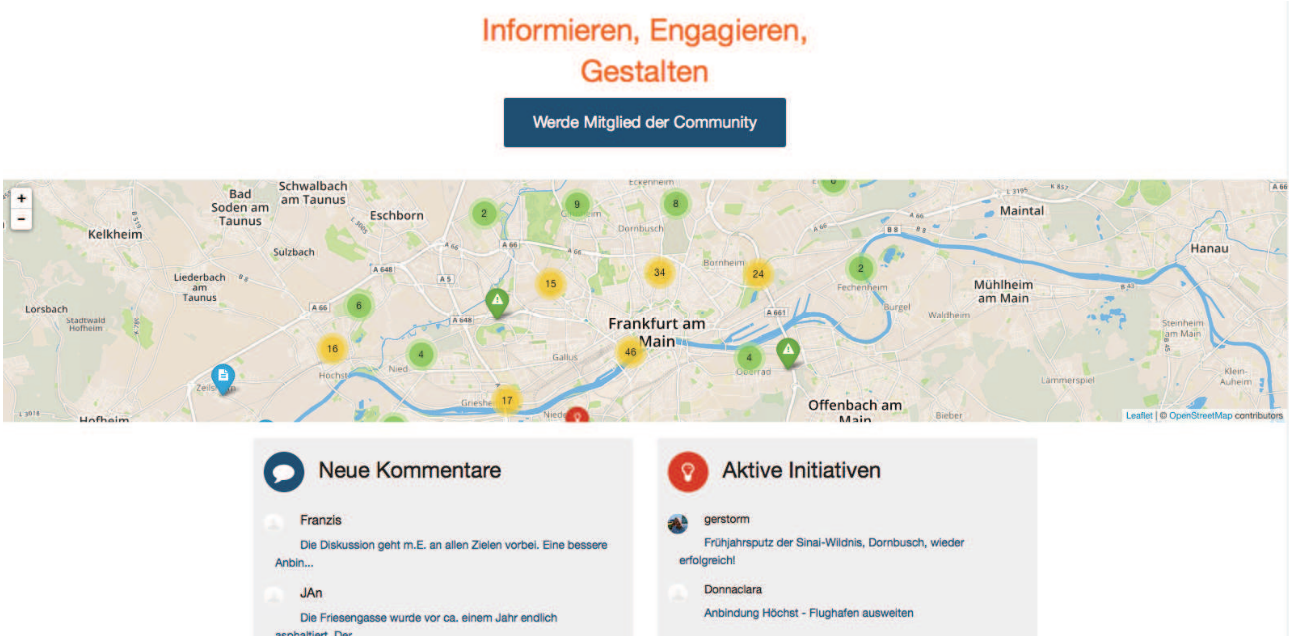

Fig. 13: Screenshot der Initiative "Frankfurt gestalten"

Die 2010 gestartete Open-Source Informationsservice von "Frankfurt gestalten" will die Transparenz der Lokalpolitik erhöhen und seine Mitglieder informieren, engagieren und zum aktiven Gestalten aufrufen. Hierzu kombiniert die Webseite die Daten aus dem Parlamentsinformationssystem mit georeferenzierten Informationen zu einem Mapping-Mashup, um die Daten auf einer webbasierten Karte auszugeben. Parallel hierzu können registrierte Nutzer eigene Initiativen starten und konkrete Gestaltungsideen für den öffentlichen Raum der Community präsentieren. Diese Initiativen werden georeferenziert visualisiert und können öffentlich eingesehen werden, sowie von registrierten Nutzern, kommentiert oder unterstützt werden. Derzeit sind über 100 aktive Initiativen mit einer großen Bandbreite an Vorschlägen zur Umgestaltung des öffentlichen Raumes in Frankfurt am Main auf der Seite verzeichnet.

Einen ähnlichen Ansatz wie "Frankfurt gestalten" verfolgt auch die Webseite "Stadtmacher.org", auf welcher ebenfalls Projekte im öffentlichen Raum gesucht werden mit dem Ziel diese aktive in die Stadtentwicklung einzubringen und zu realisieren. Im Unterschied zu "Frankfurt gestalten" wirkt Stadtmacher deutlich professioneller und scheint stärker an einer Realisierung der Projekte interessiert, ist aber nicht wie "Frankfurt gestalten" ehrenamtlich und Open-Source organisiert, sondern ein Ableger der kommerziellen Next Hamburg Plus UG[16]. Dennoch werden auch auf Stadtmacher Ideen und Projekte gesammelt, welche mit zunehmendem Bekanntheitsgrad die Chance bieten eine bottom-up Stadtgestaltung zu initiieren. Parallel zu

[15] PLUSPOOL, +Pool, Internetauftritt, 2016. Online: http://www.pluspool.org/about/ (letzter Zugriff: 23.03.2016)
[16] STADTMACHER, Stadtmacher, Internetauftritt, 2016. Online: https://www.stadtmacher.org (letzter Zugriff: 23.03.2016)

den Nutzergenerierten Inhalten versucht Stadtmacher auch Kommunen anzusprechen, die sich als Stadtmacher-Stadt registrieren lassen können und so von den Vorschlägen profitieren sollen.

5 FAZIT

Die Eingangs gestellte Frage nach den Auswirkungen digitaler Medien oder der Smart City auf die Stadtgestalt muss vor erst differenziert beantwortet werden.

Die Betrachtung der historischen Stadtentwicklung belegt, dass die Integration neuer Technologien in die Stadtstruktur deutliche Veränderungen an der Stadtgestalt im positiven wie im negativen Sinne hervorbringen kann. Vor allem die Integration neuer Stadttechnik hat in der Historie der europäischen Stadt zu teils massiven Veränderungen an der Stadtgestalt geführt, weshalb nach aktuellem Kenntnisstand davon auszugehen ist, dass auch die heutigen Technologien ihre Spuren in der Stadt hinterlassen werden. Auf Art und Umfang dieser Spuren ist nicht näher eingegangen worden, da hierzu eine detailliertere Betrachtung notwendig wäre um Maßstabsunterschiede in Abhängigkeit vom jeweiligen Auslöser deutlich zu machen.

Die Reflexion aktueller Smart City Vorhaben hat gezeigt, dass die Gestaltung in der Smart City bislang keine oder lediglich eine untergeordnete, bisweilen tradierte Rolle spielt. Diese Erkenntnis steht somit in deutlichen Widerspruch zu den Schlüssen aus der historischen Betrachtung, denn nachhaltige Ergebnisse haben sich vor allem dann erzielen lassen, wenn technologische Innovationen mit einer klaren Gestaltvorstellung einher gegangen sind (Hausmann, Lenné + Hobrecht). Große Risiken drohen hingegen wenn der Städtebau einseitig technologisch orientiert wird und die Stadtgestalt zu Gunsten monofunktionaler Betrachtungsweisen vernachlässigt wird (Autogerechte Stadt). In diesem Zuge sei auf Camillo Sitte verwiesen, der bereits 1889 in seiner Schrift "Der Städtebau nach seinen künstlerischen Grundsätzen" resümierte: "Selbst der Verzicht auf zahlreiche malerische Schönheiten und die weitest gehende Rücksichtnahme auf die Forderungen des neuen Bauwesens, der Hygiene und des Verkehres sollten uns nicht soweit entmuthigen, dass die künstlerische Lösung einfach aufgegeben wird und man sich mit einer blos technischen begnügt, wie bei dem Bau einer Landmaschine, denn die erhebenden Eindrücke, welche künstlerische Formvollendung unablässig ausströmt, können auch in unserem vielgeschäftigen Alltagsleben nicht entbehrt werden." [17] Oder anders ausgedrückt: Technik alleine reicht nicht! Für eine lebenswerte, nachhaltige und smarte Stadt ist die Einbindung neuer Technologien ebenso wichtig wie die Ausprägung ihrer damit einhergehenden Gestaltqualitäten. Ohne eine "schöne" Stadt wird jeder Versuch der Nachhaltigkeit, der Ressourcenminimierung oder der Optimierung vergebens sein, denn die Stadt ohne Gestaltqualität wird sich keiner dauerhaften Nachfrage und Resilienz (und dies besonders im Zuge der Digitalisierung) erfreuen können.

Die große Vorstellung von einer neuen oder veränderten Form der Stadtgestalt oder von einem Smart Design sind also bislang in der Smart City nicht zu finden. Jenseits dieser fehlenden übergeordneten Vorstellung lassen sich aber einige innovative Gestaltpotentiale unter dem Einsatz digitaler Medien identifizieren. Diese, in der Regel bottom-up organisierten, Ansätze zeigen eine hohe Affinität der digitalen Gesellschaft zu öffentlichen Räumen und stehen als Paradebeispiel dafür, dass eine andere, innovative und neue Art der Gestaltung öffentlicher Räume nicht nur möglich erscheint, sondern im Fall der Crowdfunding-Projekte bereits realisiert wird. Während im aktuellen Diskurs gelegentlich auf reine offline Phänomene (Open-Source-Urbanismus, DIY, Urban Gardening, etc.) des urbanen Handels verwiesen wird (Vgl. z.B. RAUTERBERG, aber auch Adam GREENFIELDs "Against the Smart City"), da diese geprägt vom digitalen Wandel die eigentliche Innovation seien, erscheinen die Gestaltpotentiale neuer digitaler Organisationsformen bei weitem noch nicht ausgereizt. Was wäre wenn Communities wie "Stadtmacher" stärker in die Stadtentwicklung integriert werden und mit anderen Formen der digitalen Wissensorganisation und Entscheidungsfindung, z.B. dem Crowdfunding oder der Augmented Reality kombiniert werden? Es ist dringend nötig diese Potentiale zu identifizieren und zu klassifizieren um sie auf ihre Qualitäten für die Stadtgestalt und die Stadtentwicklung aber auch bezüglich ihrer Risiken rechtlicher, sozialer und ökonomischer Art zu bewerten. So ließe sich vom kleinen zum größeren Maßstab hin sukzessive ein Bild zeichnen von dem was die Stadtgestalt in der Smart City sein könnte.

Smart City - Smart Design? Schwebezustand – Nicht mehr, noch nicht!

[17] SITTE, Camillo Sitte: Der Städtebau nach seinen künstlerischen Grundsätzen. Wien, 1889

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Abbildungen:
Fig. 1: Songdo International City, http://songdo.weebly.com
Fig. 2: Luchtsingel Bridge, Rotterdam, http://www.luchtsingel.org/locaties/brug/schiekade/
Fig. 3: Haussmann-Plan für Paris, 1851https://architokyo.files.wordpress.com/2012/06/1858_paristravaux_dubyp861.jpg
Fig. 4: Mietskaserne in Berlin um 1900, http://www.kripahle-online.de/unterricht/wp-content/uploads/2011/01/mietskaserne.jpg
Fig. 5: Der City-Ring in Hannover, Planung. DER SPIEGEL, 23/1959
Fig. 6: Hochstraße am Aegidientorplatz, HANNOVERSCHE ALLGEMEINEhttp://www.haz.de/var/storage/images/haz/hannover/themen/damals-in-hannover/bildergalerien-hauschild/es-war-einmal-in-hannover-aber-wo-genau/aegi-hochstrasse-1/52066130-1-ger-DE/aegi-hochstrasse-1_FullView.jpg
Fig. 7: Visualisierung Masterplan Songdo, KOHN PEDERSON FOX, http://www.kpf.com/projects/new-songdo-city
Fig. 8: Masterplan Songdo, KPF, http://www.kpf.com/projects/new-songdo-city
Fig. 9: Schrägluftbild des Luchtsingel mit den umligenden Stadträumen, DER TAGESSPIEGEL, http://www.tagesspiegel.de/images/01_luchtsingel/11977502/3-format1007.jpg
Fig. 10: Blick auf das Luchtsingel und den Innenhof des Schieblocks, DER TAGESSPIEGEL, http://www.tagesspiegel.de/images/07_luchtsingel/11977496/2-format1007.jpg
Fig. 11: Detail, Bohlen mit Gravur, DER TAGESSPIEGEL, http://www.tagesspiegel.de/images/11_luchtsingel/11977526/2-format1007.jpg
Fig. 12: Visualisierungen + Pool, http://www.pluspool.org/images-and-video/
Fig. 13: Screenshot der Initiative "Frankfurt gestalten", http://www.frankfurt-gestalten.de

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Smart Data for Smart Government – a Show Case from Abu Dhabi Distribution Company

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1 ABSTRACT

Geographical Information Systems (GIS) has become an important and smart tool in planning, and serving the community, the local authorities and governments, decision makers and planners, etc.

This paper is a showcase of GIS application in planning and managing the water infrastructure system in Abu Dhabi, United Arab Emirates (UAE), in particular the maintenance. It emphasizes the importance of smart data in decision making and smart planning.

The paper presents first a description of the Abu Dhabi Distribution Company (ADCC), the data provider, and an overview of the use of GIS in its different departments, as an example of how Abu Dhabi government is going toward smart planning and sustainable development. The paper also explains in berif the causes/ types of damages that may occur in the water supply systems precisely the pipes.

The practical part of the paper presents the case study and explains the methodology. The research work consists of mapping by using GIS the locations of the accidents that happened in the water pipes in different time periods in the Abu Dhabi central area. It also localised and mapped the types of damages identified as technical or caused by a third party. This represents the uniquness of the paper, as it presents this data for the first time as a geopatial information to a decision maker at ADDC, unlike the non-spatial data that was used before. The paper ends by discussing the findings and presents the results of the discussion with one of the decision makers at ADDC Company, and includes some recommendations.

The objective of the work presented in this paper is to show through a case study how Smart Data can help Governance to be Smart.

Keywords: Abu Dhabi, GIS, Government, Smart data, Smart planning

2 INTRODUCTION

2.1 Overview of ADDC

Abu Dhabi Distribution Company (ADDC) was established in November 1998. Its role is to distribute water and electricity to all customers in the emirate of Abu Dhabi and guarantee the high quality of its services. It covers the three regions: Eastern Region (Mussaffah and Baniyas), Western Region (Liwa, Silla) and Abu Dhabi Island. ADDC's is responsible for the planning, design, construction, and operation of the Abu Dhabi water and electricity distribution network. ADDC is owned by the government of Abu Dhabi through the Abu Dhabi Water and Electricity authority (ADWEA), which determines all business relating to the formulation, development and implementation of the policy of the government in relation to the water and electricity sector in Abu Dhabi. However, ADDC continues to operate within the overall policy framework set by ADWEA, particularly in the areas of personnel, procurement and financial policy.(ADDC website, 2016)

2.2 An ArcGIS Database for Water Supply/Demand Modelling and Management in Abu Dhabi

An ArcGIS Database is used in ADDC to provide real-time data for Water Supply/Demand Modeling and Management. It was done by a water resource scientist and its team in Abu Dhabi Emirate, UAE

A supply-demand model balance up to year 2020 has been developed by a water resource scientist and its team in Abu Dhabi Emirate, UAE (Fig.1). They linked the demand locations to the supply sources to predict the future water surpluses and shorts. While GIS is widely use in managing the water and electricity supply system, it is less used in the maintenance operation. The system still relies on numeric data such as the street number in a format of excel sheets to locate the damages (Table 1 and Table 2). Hence, the necessity of mapping the geospatial information in order to offer the decision makers a good visibility and a better understanding of the situation.

The aim of this paper is to provide a smart data that not only save time and efforts in its collection and representation, but offers the right information in a the best way possible to produce smart governance, that mean to be intelligent, fast, efficient, sustainable and right.

The following section: methodology explains what was the data proposed to the decision makers and how it could help them in their governance.

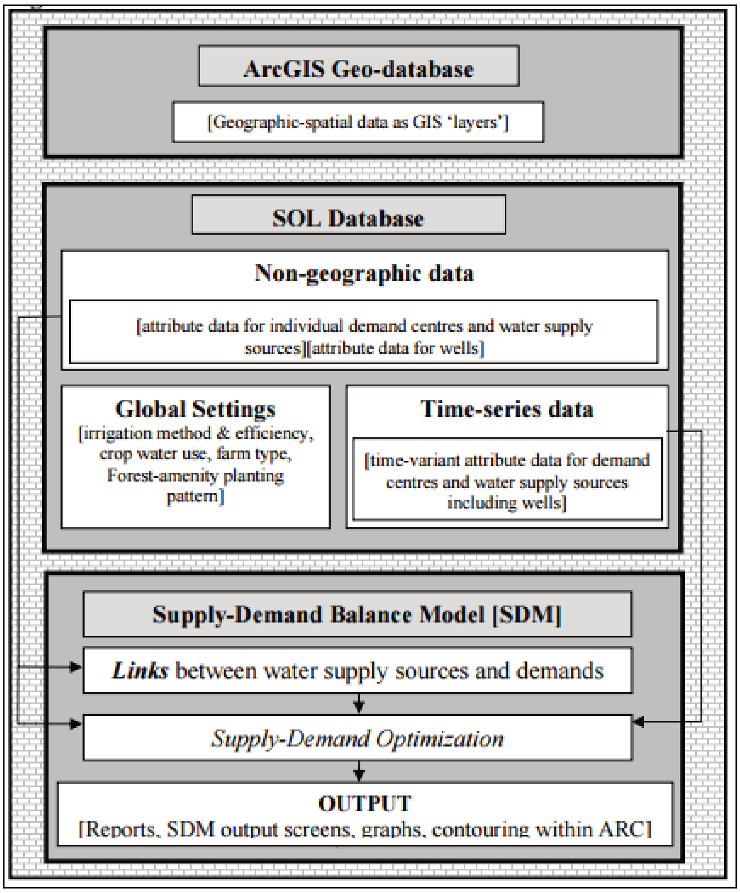

Fig. 1: Example of Numerical Database of Water pipes damages in Central Abu Dhabi Area.

2.3 General description of the types of damages in water pipes

According to the literature, observations and interviews with technicians and managers at ADDC, the damages in water pipes maybe caused by several factors, some of them are purely technical, others are related to nature and catastrophes and the rest are caused by humans. Hereunder, we mention the most known ones:

- Technical, such as an unexpected high pressure of water that exceeds the capacity of the pipes.
- Some unusual continual flow in the water pipes causes Burst pipe risk.
- Material used affects the "life' of the pipes. Some materials become rusted after short times.
- Aging and deterioration of the pipes cause leaks and damages.
- Neglecting the monitoring of the ambient temperature of water flow leads to some damages in the pipes. For example, if the temperature falls below 3 degrees there is a risk of freezing, which is not applicable in our case since there is no snow in UAE.
- Natural disasters such as floods and earthquakes, explosions, breakage in the pipes.
- A third party factor that might intentionally cause damages to the pipes such as during constructions.

3 METHODOLOGY

This research is about mapping the damages of the water supply pipelines in central Abu Dhabi area, in UAE from 2006 to 2013 having an equal time intervals of 3-4 years that was chosen for convenience purpose.

With the corporation of the Abu Dhabi distribution company (ADDC) we got the GIS data that needed for this application, which is related to the plots and divisions, the rods, the pipes and main pipes network. The excel sheets that stored the following information (Table.1) have also been provided:

- The year of the damage stored in the database as day, month and year.
- The type of the damage
- The location of the damage saved as district and division, identified by numbers and characters (Table 2)
- The number of damages per year was figured out from the initial data.

Description	Work Type	Location/Tag	Status	Target Start	Scheduled Start	Resp. Section	Failure Class
Damage Caused by third party, Supervise the Work by Water O&M Directorate NO.P-1/Case:	CM	DW-AUH-W35-PLSM-200DI	CLOSE	23/11/2013 07:00	23/11/2013 07:00	W-CEN	PIPE
Damage Caused to Water Main Pipeline, Repair by Water O&M Directorate:at Plot No. P - 37 Case No.	CM	DW-AUH-E22-PLSM-150DI	CLOSE	18/11/2013 14:00	18/11/2013 14:00	W-CEN	PIPE
Damage Caused by third party, Supervise the Work by Water O & M Directorite at Plot No. C - 33 Case No.	CM	DW-AUH-E13-PLSM-150DI	CLOSE	18/11/2013 11:00	18/11/2013 11:00	W-CEN	PIPE
Damage Caused to Water Main Pipeline, Repair by Water O&M	CM	DW-AUH-W0401-PLMN-100DI	CLOSE	21/11/2013 14:00	21/11/2013 14:00	W-CEN	PIPE
Damage Caused by third party, Repair by Water O&M Directorate: at Plot No. 138 Case No.	CM	DW-AUH-W1801-PLSM-150DI	CLOSE	20/11/2013 01:30	20/11/2013 01:30	W-CEN	PIPE
Damage Caused by third party, Repair by Water O&M Directorate at Plot No. Opposite AL Helal Bank Case ID.	CM	DW-AUH-W12	CLOSE	10/11/2013 15:00	10/11/2013 15:00	W-CEN	PIPE
Damage Caused by third party, Repair by Water O&M Directorate at plot no. A 28 Case no.	CM	DW-AUH-W50-PLSM-150DI	CLOSE	25/11/2013 14:00	25/11/2013 14:00	W-CEN	PIPE
Damage Caused by third party, Supervise the Work by Water O&M Directorate at plot no. 2	CM	DW-AUH-W1803-PLMN-300DI	CLOSE	07/04/2013 14:00	07/04/2013 14:00	W-CEN	PIPE
Damage Caused by third party, Supervise the Work by Water O&M Directorate at plot no. 4	CM	DW-AUH-W20-PLSM-150DI	CLOSE	08/04/2013 09:15	08/04/2013 09:15	W-CEN	PIPE
Damage Caused to Water Main Pipeline, Repair by Water O&M Directorate:	CM	DW-AUH-W0401-PLMN-100DI	CLOSE	10/04/2013 07:00	10/04/2013 07:00	W-CEN	PIPE

Table.1: Example of Numerical Database of Water pipes damages in Central Abu Dhabi Area.

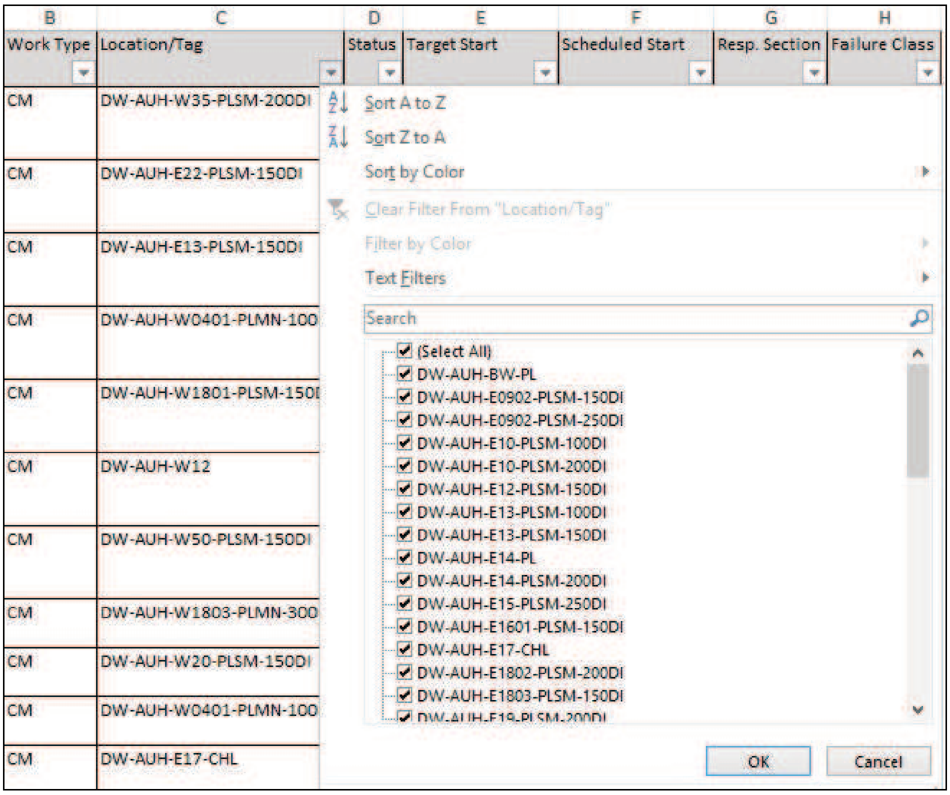

Table 2: Location of the Damaged Water Pipe Stored as a numerical Data.

Three years: 2006, 2010 and 2013 were chosen according to the available data, and the software used is ArcGIS, version 10.2.

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Firstly, the location of the damages on each year based on the SQL (select by attributes) was found and layers for the chosen years were produced. Then, the layers of the different years were compiled in one general map named: Location map of water pipes damages (Fig. 2).

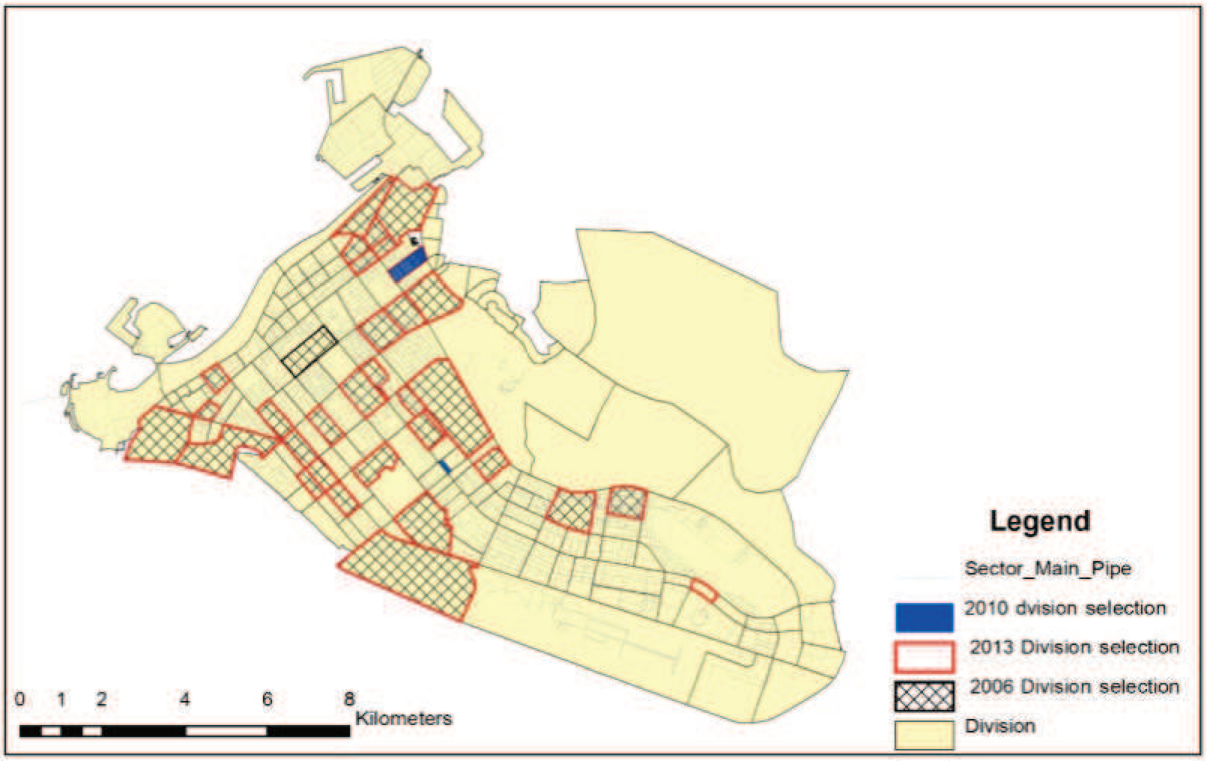


Fig. 2: Location Map of Water Pipes Damages in Abu Dhabi Central Area.

Secondly, the types of damages were mapped for the three years (Fig. 3) and complied in one map called: Types of water pipes damages map.

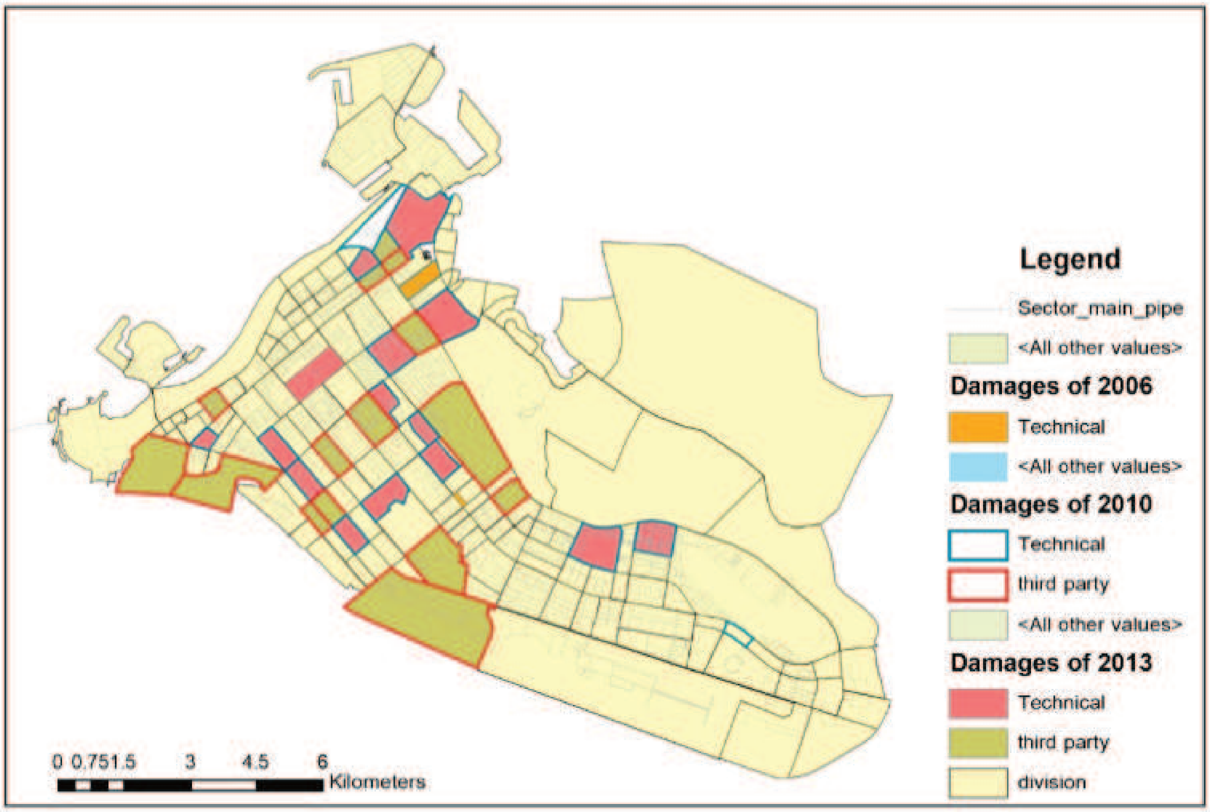
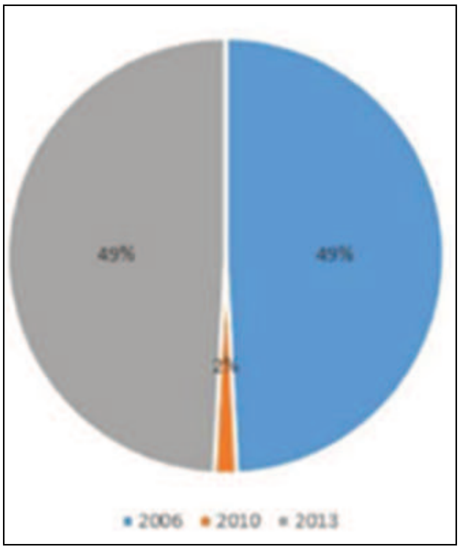


Fig. 3: Types of Water Pipes Damages Map in Abu Dhabi Central Area.

After that, graphs representing non-spatial data were produced (Fig. 4 and Fig. 5) and combined with the spatial data (map produced in order to create a better visualization and understanding of the situation to the decision makers at the ADDC.



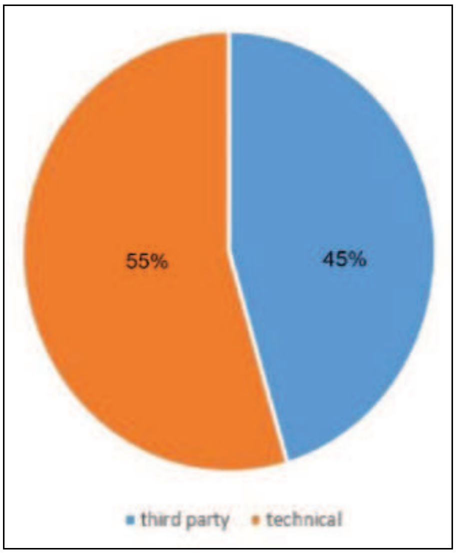


Fig. 4 (left): Percentage of Water Pipes Damages per Year. Fig. 5 (right): Percentage of Water Pipes Damages per Type.

It is important to note here that the records related to the water pipes damages are stored as an excel sheet and mapping of damages location was not done before or used in the decision making process. These two maps represents a smart data produced by a smart planning support tool: GIS for a smarter/more intelligent

4 FINDINGS

The GIS maps show that the water pipelines damages happened mainly in Al Bateen area, Bainunah street, and the area around Al Salam street. This is because of the constructions that happened in these areas during the interval period 2006 to 2013, due to the urban developemnt that follows the Abu Dhabi 2030 masterplan. These constructions, which are either new developments or belong to renovation projects caused the accidents and damaged the pipelines. The Analysis also shows that the third party caused more damages due to the constructions that happened during the study period 2006 to 2013 as explained earlier.

It is important to note here that showing the results of the analysis to a decision maker at ADDC, has helped her getting a better understanding of the situation: location of the damages through year and their causes/ types. This inspired her to think about the following points in order to find a solution to decrease the number of accidents and damages:

- It is sometimes easier for a rich contracter who intentialy damages the pipe to pay the penality amount without any problem, hence a second thought has to be given to the financial penalty imposed to third party after causing damages.
- The legislative penalty Might not be enough or strong.
- Maybe there is no enough control onsite from the ADDC or other governmental entity to check and control the construction project in order to avoid the pipe damages while digging.

5 CONCLUSION

The literature review and the several applications of GIS through years since the end of the 70's have shown its importance not only as a mapping, modeling, spatial analysis and visualization tool, but also as an effective and smart tool in the planning and strategic-decision making process.

Beside its main advantage, which is saving money, time and efforts, GIS can facilitate the visual communication between the company and the customer; help the decision makers to take the proper actions in the right time and place, hence think and act smart!

This research was a showcase of using smart data for smart decision making process and smart governance in the Abu Dhabi Distribution Company (ADDC).

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The water pipes Damages that occurred in 2006, 2010 and 2013 were mapped and the types of damages either technical or caused by a third party were localized and spatially represented. The uniqueness of this research is represented through the initiative of mapping for the first time and spatially representing this information that was used only as numerical one.

The geospatial data produced by the author of this research, was presented to the responsible person in the ADDC to take actions, and was smart and very useful. It made a big difference in understanding the situation and looking for solution comparing with a non-spatial data that has been used.

Nowadays many governmental institutions and private entities from different scale and nature in Abu Dhabi and the whole United Arab Emirates (UAE), are using GIS to store their meta-database and to represent their data. The GIS is getting widely used as a smart planning support tool to achieve a smart and sustainable planning.

The ADCC is launching more GIS applications and projects in the coming years to fully use the power, high capacities, and advantages of GIS. The goal is to increase the efficiency of the company in supplying the customers and to raise the quality of its services to the community at the international standards, based on the advanced technology.

6 ACKNOWLEDGMENT

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Smart Energy Supply Conception for the Urban Development Area of Aspern Seestadt (Vienna)

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1 ABSTRACT

The paper describes the Smart Energy Supply Conception for the northern part of the urban development area aspern Seestadt in Vienna. It illustrates concrete options and potentials by different scenarios for the actual implementation of a future innovative energy system. The final conception was elaborated in the framework of a research project (Transform+)[1] in cooperation with local key stakeholders and experts in the field of planning and energy research, public administration, including Vienna´s energy supply company and the responsible development agency. With the transformation of the former airfield of Aspern, the city of Vienna aims for a new quality in urban development, providing a new urban area with major central functions which is supposed to stimulate neighbouring quarters as much as the way urban development is being done in general. One of the main priorities in this context is the strive for high quality of life for future residents, combined with the important aspect of affordability. The masterplan foresees the development of a multifunctional area with a mix of residential, office, scientific, research and educational uses. By 2030, the area of aspern Seestadt (223 ha) shall be developed for 26,000 residents and offer 23,000 jobs.

The masterplan for aspern Seestadt as well as the activities and measures set by the development agency Wien 3420 Aspern Development AG have been guided by the vision of an ecological, resource-friendly and climate neutral city from the beginning. This aim is also in accordance with the ‘Smart City Framework Strategy of Vienna’ passed in 2014[2] after the start of the implementation of aspern Seestadt (first phase).

Within the context of the project Transform+, different options for a smart energy supply have been elaborated for the second implementation phase of urban development, named aspern Seestadt North. Here, in an area designed for 7,000 new apartments and 14,000 jobs, it was the main challenge to take the step from research on innovative future energy systems to a complete roll-out in an urban area to be developed in near future. In order to estimate future energy consumption (heating, cooling, electricity) and different options of energy supply and local renewable energy production, several ‘smart city’ scenarios were elaborated and compared against a ‘business as usual’ scenario.

An important component in all ‘smart city’ scenarios is the share of renewable energy, for which a quantitative target has been defined in the Smart City Framework Strategy for the city of Vienna (50% until 2050). To contribute to Vienna´s Smart City aims, aspern Seestadt North should strive to gain a high share of its energy from locally available renewable energy sources and also offer high flexibility to make use of additional sources (e.g. from potential future waste heat) in a later phase of implementation. In addition, total energy consumption and according CO_2 emissions were critical factors for defining the final energy system configuration of the ‘smart city’ scenarios.

As result, the elaborated ‘smart city’ scenarios show considerable potential for reducing energy consumption and significantly higher shares of renewable energy use compared to the ‘business as usual’ scenario, and therefore greatly reduced overall CO_2 emissions. By implementing the ‘smart city’ scenarios, total energy consumption could be reduced by 39% against technical standards as in the ‘busines as usual’ scenario. Due to a higher use of local renewable energy supply the best ‘smart city’ scenario shows an overall CO_2 emission reduction potential of up to 75%. Through the intensive cooperation process of the research team and the key stakeholders responsible for the development of the area, the Smart Energy Supply Conception laid a solid foundation for the relization of innovative future energy systems in aspern Seestadt.

Keywords: energy, governance, integrated energy and urban planning, renewable energy, urban development area

[1] The project was funded by the Austrian Climate and Energy Fund (KLIEN) within the research program “Smart Cities – FIT for SET”. Project website: www.transform-plus.at

[2] MA18 (Department for urban planning), 2014 (https://smartcity.wien.gv.at/site/files/2014/09/SmartCityWien_FrameworkStrategy_english_doublepage.pdf)

2 URBAN DEVELOPMENT CONTEXT

Until 2030, 223 ha of land will be developed providing space to some 26,000 people plus about 23,000 workplaces. The Masterplan for aspern Seestadt foresees the development of a multifunctional district with a mix of residential, office, scientific, research and educational uses. A lake of 5 ha will be at the centre and give the new city district its characteristic name. Green – and public spaces, the proximity to the Natural re¬serve Donau-Auen and high quality urban infrastructures should guarantee high quality of life in this newly built part of Vienna.

The area of aspern Seestadt is located in the north-eastern fringe of Vienna in close proximity to two old village centres of Aspern and Eßling, with the vast factory area of Opel Austria GmbH on its southern side, and the railway Vienna-Marchegg-Bratislava enclosing the development area in the North.

Housing uses are foreseen mostly in the south- and north-eastern part of aspern Seestadt (yellow), with a projected development of 4,600 residential units south of the lake and 7,500 residential units in the northern part of the lake. Since October 2013, aspern Seestadt is connected by subway to the public transport network. Two subway stations – one in the North and one in the centre of aspern Seestadt – are connecting the new city district to the rest of Vienna. The extension of the subway line U2 prior to the settling in of the first residents was conceivesd as an engine of urban development and stimulate the use of public transport.

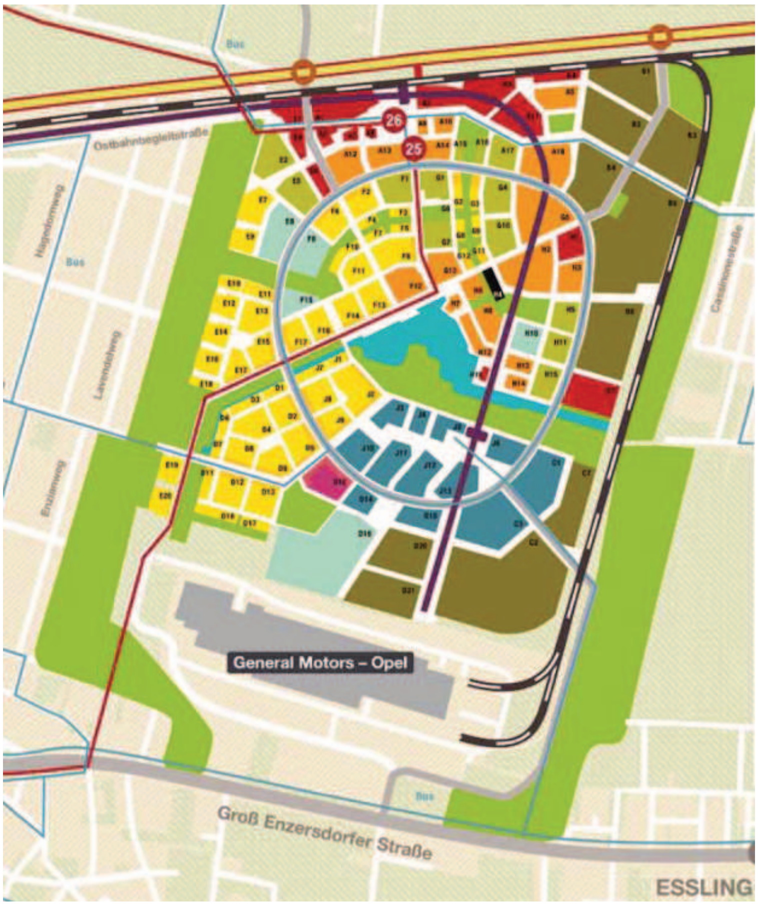

Fig. 1: Area map aspern – Donaustadt, Source: aspern+ citylab (2010): Vision + Wirklichkeit. Die Instrumente des Städtebaus. Ein citylab-Report von aspern Die Seestadt Wiens.

Within the context of the projects TRANSFORM[3] and Transform+ a new tool, named **'Implementation Plan'**, has been developed for new construction or transformation of districts into low energy districts. This tool was applied at aspern Seestadt North, to elaborate short to medium feasible possibilities for future energy systems.

[3] TRANSFORM – Transformation agenda for low carbon cities (http://urbantransform.eu/) was a European FP 7 rese-arch project in which the city of Vienna took part as a project partner together with the cities of Amsterdam, Copenhagen, Genoa, Hamburg and Lyon, together with industrial and research partners such as the ÖIR.

Although the city of Vienna has a lot of experience in the fields of urban construction and transport planning, it lacks holistic planning procedures and methods for innovative, resource-friendly energy supply and energy system planning – combining spatial planning and energy system planning. The Implementation Plan developed in the course of Transform+ triggered the development of new planning procedures and methods for aspern Seestadt North.

As an important framework condition of the planning process, the 'Smart City Framework Strategy of Vienna' (municipal council resolution 2014) has become an important new basis for a future sustainable development of Vienna from an overall perspective. This strategy constitutes the long-term objectives of Vienna concerning climate change and energy. Most important for the developmen of aspern Seestadt are the following objectives:

- overall goal: 80% reduction of CO_2 emissions per capita till 2050 (1990 reference), at least 35% till 2030
- energy efficiency to reduce energy consumption per capita by 40% in 2050 (2005 reference)
- 50% gross energy consumption coming from renewable 2050, 20% already in 2030
- 2,000 Watt steady power supply per capita, 1 ton CO_2 per capita
- zero energy standard for new buildings from 2018/2020

These quantitative targets were considered when elaborating the alternative 'smart city' scenarios for the future development of the area. Another, very important framework condition is the fact that nearly 80% of the housing development will be built under the economic and technical standards of social housing, which means – in the case of Vienna – a modern, low to middle income urban development of high building quality but with very limited construction costs.

In the project Transform+, a so called 'energy group aspern Seestadt' was formed, consisting of the Wien 3420 aspern development AG, Wien Energie (the city´s energy company), MA 18 (urban development and planning), MA 20 (energy planning), ETA environmental management GmbH, ÖIR (Austrian Institute of Regional Studies and Spatial Planning) and the AIT (Austrian Institute of Technology). The group discussed and defined the scenarios, focusing on mid-term, concrete measures for implementation, comprising the (energy) system architecture, costs and financing and calculation of emissions. Legal and organizational aspects and barriers for implementation also were discussed and recommendations for the development partners elaborated. Thus the Transform+ energy group aspern Seestadt developed scenarios as a foundation for the energy supply planning at aspern Seestadt North.

The implementation of these ideas already will start in 2016. An important actor for this implementation is "Wien 3420 Aspern Development AG" (subsequently named 'Wien 3420'), which was founded to develop and to promote aspern Seestadt as fully equipped, mixed-use urban development. The company owns the land and cooperates closely with the city administration. Acting as comprehensive developer, 'Wien 3420' draws up planning and design concepts, defines planning guidelines and offers consultancy for individual projects development, and subsequently sells off or leases property. In this comprehensive developer role, it is therefore responsible also for the realization of the Implementation Plan´s energy concept, together with the city administration and relevant energy companies.

3 DEVELOPING A SMART ENERGY SUPPLY CONCEPTION FOR ASPERN SEESTADT

At the beginning of Transform+, Wien 3420 aspern development AG faced the challenge to submit a feasible and realistic energy supply concept for the entire Seestadt North area as an input for the Environmental Impact Assessment (EIA). At the same time this concept was supposed to determine a long-term development vision, which considers adjustment possibilities to future technical solutions (already today).

For the northern part of aspern Seestadt there is currently only a master plan outlining the different building areas and the planned timeline for construction, which will start in 2016 and last until 2028. It is very likely that during this rather long period of time framework conditions, energy markets and financial constraints will change drastically. But it is hard to predict how and when. This makes it difficult to design a robust and resilient energy system for aspern Seestadt North.

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However, to continue with the development process, Wien 3420 needed to apply for the environmental impact statement (EIS) already in the beginning of 2016, which will after approval, determine the baseline parameters for the energy supply for aspern Seestadt North. That means on the one hand that there is a need for an energy supply concept, which can be implemented parallel to the starting construction phase beginning in 2016. But on the other hand there is also a need for a longer term ‘smart city vision’, taking into account future obligations and opportunities.

In order to meet these challenges, the Transform+ energy group developed a foundation for this energy supply concept (business as usual, named ‘BAU’ scenario) as well as three Smart City scenarios which build on and refine the basic structural assumptions taken in the ‘BAU’ scenario.

3.1 Future energy demand levels as a basis for Smart City suppy conception

In a first step, two demand levels – named ‘BAU’ and ‘efficiency’– were developed in order to estimate the future energy demand (heating, cooling, electricity). These demand levels focused on assumptions concer¬ning the thermal quality of the building envelope, the use of hot water as well as on energy efficiency in terms of electricity use (energy efficiency of devices and user behavior).

In comparison to the demand at ‘BAU’ level, the ‘efficiency’ level set higher demands concerning the con¬sumption side, defined as a basis for the ‘Smart City’ scenarios (see following chapter) – relating to the objective of a ‘2,000 Watt society’ according to the Smart City Framework Strategy of Vienna). Regarding the future energy demand, the set ‘efficiency’ levels for the ‘Smart City’ scenarios includes a more innova¬tive and resource- efficient building development with higher standards for building envelopes (better quality of the thermal hull) and a much higher awareness in terms of energy consumption by tenants and working population (through good quality electric devices and energy saving user behavior, e.g. by lower room temperatures during the heating season, energy saving use of electricity etc.).

Thus, two consumption side based levels of energy demand formed the basis for the elaboration of alternative ‘Smart City’ energy systems for aspern Seestadt North:

- the demand level of ‘business as usual’ (BAU) includes building standards according to legal require¬ments as of 2020 (nearly zero energy buildings), in the BAU scenario this level is combined with an energy supply that meets the predefined standards by the city´s energy authority.
- the ‘efficiency’ demand level as a basis for the ‘Smart City’ scenarios assumes the construction of buildings with a higher thermal quality and a more efficient use of energy, in the Smart City Scenarios this level is combined with a more innovative heat supply concept.

The following estimations on energy demand describe the demand for the entire area of aspern Seestadt North, except the construction sites at the eastern edge, which are desigated for industrial usages (where no closer details on industrial branches and their future energy uses are available yet).

[GWh per year]	Business as usual demand level	Efficiency demand level	Potential for demand reduction
Heat demand (space heating and hot water)	91	56	-38%
Electricity demand	61	36	-41%
Total energy demand (heat and electricity)	152	92	-39%

Table 1: Estimations on energy demand for aspern Seestadt North – business as usual level versus efficiency level, Source: T+ Energy group aspern Seestadt

When comparing the ’business as usual’ with the ‘efficiency’ demand level, the potential overall energy saving (on consumption side) amounts to approximately 39%. Thus, a reduction in energy demand (without cooling) from 152 GWh/ year (’business as usual’ level) to 92 GWh/ year (‘efficiency’ level) seems possible (see table 1).

3.2 Alternative ‘Smart City’ scenarios concerning the future heat supply

As part of the Implementation Plan, different conceptions for the future heat supply at aspern Seestadt North were discussed. In general, the aspern Seestadt energy group recommended a local low-temperature grid as basic infrastructure. It allows a more flexible use of many different – and partly still unknown – local renewable energy sources and can balance energy generation and energy consumption spatially and temporally to some extent.

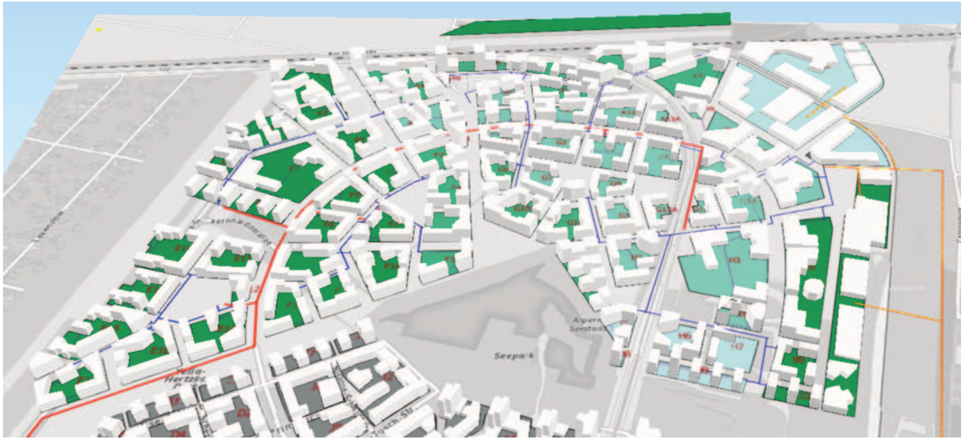

Fig. 2: Exemplary Building Construction of Aspern Nord (including pipes of district heating and gas supply), Source: AIT in Transform+ Deliverable 3.4 – Implementation Plan aspern Seestadt, December 2015

In terms of the conception of the heat supply, a business as usual scenario and three different options for Smart City scenarios were compiled.

3.2.1 The 'business as usual' scenario as a basis for the EIS

In the 'BAU' scenario, energy used for space heating and hot water together should not cause emissions exceeding 150 g CO2 per kWh. This limit had been set by the city´s energy authority. Based on this requirement, a so-called 'minimum scenario' was developed by Wien Energie (the municipal utility) under the assumption that the company Wien Energie should be able to provide the proposed energy supply as soon as 2016.

The scenario proposes 3 local heat grids for the supply of the heat demand according to 'BAU' demand level:

- Heat grid east (65°C forward temperature), supplied by a natural gas powered heating plant
- Heat grid west (65°C forward temperature), supplied by the municipal district heating grid
- optionally a groundwater heat grid north (12°C forward temperature), supplied by ground water and combined with heat pumps.

The following figure illustrates the overall concept for the heat supply system in aspern Seestadt North according to the 'BAU' scenario, as proposed in the Environmental Impact Statement (EIS). Due to the (probable) partially high temperature requirement by industial users, the 'business as usual' scenario assumes a connection to the gas network for the industrial area in the East, which can be used for a heating plant as well.

As potential optional extension of the 'BAU' scenario, the heat grid north can be supplemented by ground water heat pumps for space heating and hot water supply (submitted as optional in the EIS), but realization is depending on its economic feasibility and it is therefore not considered in the 'BAU' scenario results (see table 2, below). The size will depend on the expected minimum of usable geothermal energy from the ground water stream in the area. Furthermore, the installation of photovoltaic appliances in the entire area is foreseen (and included in the 'BAU' scenario), but relization is not necessarily covered by Wien Energie.

The BAU scenario would cause CO_2 emissions of 132 g per kWh (for space heating and hot water provision), but only as an overall average for the whole area. Parts of the area, e.g. the natural-gas supplied heat grid east, exceed the limit of 150g per kWh by far[4]

[4] A full supply of aspern Seestadt North with heat from the municipal district heating network was economically not feasible from Wien Energie's point of view at the time of the project. This has been explained mainly by the need for a connection from the south-western corner (aspern Seestadt South) to the existing main supply pipeline, while construction for aspern Seestadt North starts in the North-east. This would cause the need for pre-financing of a main district heat supply pipeline from the South-west to the North-east.

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Fig. 3: Heat supply conception aspern Seestadt North, business as usual scenario, Source: Transform+ Deliverable 3.4 – Implementation Plan aspern Seestadt, December 2015

3.2.2 Three 'Smart City' scenarios

The 'Smart City' scenarios were elaborated by the "aspern Seestadt energy group", combining knowledge from experts in energy and urban planning, authorities, the development agency and the energy supplier.

The conception of 'Smart City' scenarios is an attempt to come up with innovative and ambitious design options for the energy supply for aspern Seestadt North. It is based on the long-term aim of Vienna – as stated in its Smart City Framework Strategy 2014 – to follow the idea of a '2,000 Watt society' (which equals 17,500 kWh primary energy consumption per capita for the whole energy demand) and to lower CO_2 emissions to maximum of 1t per person.

Furthermore, the goal is to cover as much of the energy demand as technically feasible from renewable sources. This is only possible if the energy demand from residents and businesses can be considerably re¬duced. Therefore, the 'Smart City' scenarios are based on the lower 'efficency' level energy demand (heat and electricity) of 92 GWh annually, compared to 152 GWh at the 'BAU' level.

Based on this lower energy demand the proposed 'Smart City' energy supply concept should be able

- to use local renewable energy sources to a high extent (mainly solar energy, ground water and local waste heat sources of different temperature levels);
- to be flexible enough to cope with the large uncertainty of future usable waste heat in the area (future industrial uses are still unknown and therefore also the amount and temperature levels of available waste heat);
- to allow a stepwise development of the energy supply network parallel to the ongoing urban develop¬ment of the area, allowing for the use of growing knowledge, technological innovations and the use of available waste heat;
- to provide considerably lower specific CO_2 emissions than the 'BAU' scenario in order to show the range of feasible reduction.

The three listed 'Smart City' scenarios give a short overview on the possible contributions and influencing components. The three scenarios build on each other in stepwise improvement: the higher the proportion of renewable energy sources, the more reduction of CO_2 emissions can be achieved. Where, scenarios 1 and 2 solely use locally available renewable energy potentials, scenario 3 additionally considers the use of biomass.

- ‘Smart City’ scenario 1, based on ‘BAU’ system scenario, combines a groundwater heating network for office buildings (in the north of the area) with medium deep probes (as a support for the domestic hot water production).
- Smart City scenario 2, combines Smart City scenario 1 with solarthermal heat from appliances installed at the roofs in the industrial area (about 50% of roof surfaces) and with PV-installations for the electricity need of heat pumps (used for increasing the heat level from probes and the groundwater net¬work, about 30% of roof surfaces).
- Smart City scenario 3, combines Smart City scenario 2 with a biomass heat plant for covering the baseload of heat demand (instead of the natural gas fired heat plant).

3.3 Smart City scenarios – results relating to Smart City objectives

The three Smart City scenarios show the potential of significant energy savings (due to consumption side measures) as well as a considerable higher proportion of renewable energy – this twofold approach allows for a substantial reduction in CO_2 emissions.The following tables on results only refer to energy demand for heat, including energy for heating and (residential) hot water provision.

Energy demand for heat supply	Business as usual BAU scenario	Smart City scenario 1	Smart City scenario 2	Smart City scenario 3
Energy demand (GWh/a)	91	72	72	72
Necessary power for heat supply (MW)	72	55	55	55
CO_2-factor (g CO_2/kWh)	132	117	88	43
t CO_2/a	11,973	8,560	6,320	3,070

Table 2: Reduction of total heat demand, power and CO2 emissions of Smart City scenarios versus business as usual scenario (heating concepts aspern Seestadt North), Source: T+ Energy group aspern Seestadt

The analysis of the different development scenarios of aspern Seestadt North show, that a reduction of the specific CO_2 emission values from 132 g/kWh (‘business as usual’ scenario) to 43 g/kWh (Smart City scenario 3) can be achieved (scenario 3 including the groundwater heating network for office buildings, medium deep probes, solar thermal heat from the industrial area, electricity from PV for heat pumps and biomass base load), if a resource-friendly conception on the production side is applied. The Smart City scenario 2, using solely local renewable energy, still achieves a reduction of its specific CO_2 emission values to 88 g/kWh.

Total CO_2 emissions can be reduced by the combination of consumption (demand level) and production side (heat supply concept) measures from nearly 12,000 tons CO_2 to about 3,000 tons CO_2,:

in % compared to BAU scenario (heat supply)	Smart City scenario option 1	Smart City scenario option 2	Smart City scenario option 3
Energy demand (GWh/a)	-20.7	-20.7	-20.7
Necessary power for heat supply (MW)	-23.0	-23.0	-23.0
CO_2-factor (g CO_2/kWh)	-11.4	-33.3	-67.4
t CO_2/a	-28.5	-47.2	-74.4

Table 3: Reduction potential of heat demand, power and CO2 emissions of Smart City scenarios versus business as usual scenario in % (heating concepts aspern Seestadt North), Source: T+ Energy group aspern Seestadt

In relative numbers, the heat demand decreases in all ‘Smart City’ scenarios according to the ‘effficiency’ demand level as a basis of Smart City scenarios (-21%). The best Smart City scenario option shows a reduction of nearly -75% of CO_2 emissions when compared to the ‘BAU’ scenario, scenario 2 (using only local renewable energy) achieves a reduction of about -47% of CO_2 emissions.

4 CONCLUSIONS

The cooperative elaboration and testing of alternative energy system concepts, carried out by an interdiscipli¬nary working group (’Transform+ energy group’) has proven to be a best practice example. This group, consisting of representatives from the development company, the city urban planning and energy planning departments, the city owned energy supply company and research institutions such as ÖIR and AIT, was established with the aim to develop a technically and economically feasible energy concept for aspern Seestadt North.

As a main input for the so called 'Implementation Plan', a thorough analysis of all relevant energy supply options including the local potential for renewable energy and aiming at maximum CO2 savings, is an essential step for the realization of urban energy systems which contribute substantially to the achievement of climate and energy targets.

This is especially true for the ambitious targets set by the Smart City Framework Strategy of Vienna (2,000 Watt society until 2050, 1 t CO_2 per person): In terms of the quantitative targets for renewable energy, the Smart City Framework Strategy aims at a share of 50% (mainly locally available) until 2050. In order to achieve these targets overall, urban quarters will have to be transformed by using a appropriate strategies to their starting situation and development perspectives: Existing quarters need ambitious transformation concepts, while new urban developments will have to achieve best results, surpassing the overall targets for the city.

Following the experiences from Transform+, there should be similar working processes and considerations for all other development districts, including the elaboration of alternative scenarios for energy systems and detailed calculations for costs and benefits relating to the CO_2 objectives of the Smart City Framework Strategy. The following conclusions summarize the results and seem also relevant for the energy system development in other urban districts:

- The commitment of the city of Vienna to become a 'smart city' and the general targets defined in the re¬cently adopted Smart City Framework Strategy are a most relevant guidance for the development com¬pany, Wien 3420. However, this high-level framework strategy is not enough to secure high smart city standards to be implemented, since Wien 3420 has to consider a number of different, often conflicting objectives and requirements. This is also true for Wien Energie, the city´s energy company. A differentiated set of targets, taking into account the variation of given urban structures and functions of urban quarters is necessary, but still missing (quantified, not only the CO_2 factors). Together with a clear backing from cities' authorities for implementation processes, well-defined administrative responsibili¬ties and an ongoing monitoring process, the urban transformation towards smart city objectives should take up momentum.
- A tailor made, area-focused and integrated planning approach for the construction of new or the refur¬bishment of existing buildings, including energy supply, (local) energy production, urban planning and development is needed. For new urban development districts, it is also necessary to coordinate compre¬hensive energy supply concepts (reaching beyond the supply for single buildings or building blocks) and the use of district heating (at lower temperature levels), waste energy and groundwater resources in larger area context.
- Integrated planning and agreements between involved stakeholders are of major importance in order to achieve higher liability of planning when developing new urban quarters with respect to energy and climate protection targets. For this challenge, specific requirements and guidelines, planning security and financing matters represent core issues. In any case, investment costs shall be compared with achievable long-term savings (life-cycle cost-analysis):
    - Investors on all sides need clear, area-specific frameworks for decision making and implementation. A number of legal conditions are forming barriers for the development of efficient and economically feasible energy systems: The hampered use of own electricity production across building sites, the lack of contractual agreements between urban planning and energy system development, heat tariff regulations which prevent differentiation between areas in the city.
    - To overcome these barriers it seems necessary to establish an urban, area-specific process providing
        - alternatives for integrated energy systems,
        - a choice of a preferred alternative,
        - a competition between providers (infrastructures and operation),

- a selection of the best provider by the city and a related concession for a reasonable time span (e.g. 25 years),
- an obligation by the investors and end-users to comply with the energy system in the specified area.

o Based on such an approach, energy service providers for larger areas will be enabled to present an approach for the effective organization of a local area energy system, balancing varying financial benefits and losses within the overall system in a given area.

- In the high urban density of aspern Seestadt, the energy demand exceeds the supply potential of local renewable energy by far. This will be the case in many other densely built urban areas, therefore, the city of Vienna will not be able to supply its energy demand by local renewable energy only. Complementing local efforts, an approach of a common energy region (matching demand and supply) should be considered in Eastern Austria, forming a larger energy supply area together with regions Lower Austria and Burgenland. Such an approach was recently chosen by the 'Northern Germany' region (Hamburg and Schleswig-Holstein) in the model project 'NEW 4.0'.
- To achieve the Smart City objectives, a change of the population's energy consumption behavior is essential. Therefore, it is necessary to develop and implement support measures for changing energy consumption awareness and behaviour in addition to technical measures.

The development of a greenfield area of the size of aspern Seestadt into an attractive urban neighbourhood is a challenging task. It requires high quality planning, openness for technical and social innovation and a strong and committed management, especially with regard to the broad variety of stakeholders and the timeline of over 20 years of development.

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reviewed paper

Smart Governance, the Backbone of Smart Planning. A new Strategic Plan for the Cluj-Napoca Metropolitan Area

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1 ABSTRACT

Smart Governance is one of the six smart city pillars, as governance is widely considered to be key in ensuring the sustainable development of cities and regions. In the last decades, spatial planning has evolved from a regulatory approach, focused on the delivery of land use plans, to a holistic activity, a meta-governance centred on the coordination of different sectoral policies. According to UN-Habitat, spatial planning is now more than a technical instrument – it is an integrative and participatory decision-making process, a central element in the new paradigm of urban governance. Governance of metropolitan areas is currently one of major concerns for planners all over Europe, major cities (e.g. Berlin, Paris, Rome) are defining schemes for governing this key-scale of action and definition of urban policies.

In the case of the European Union, the changes from traditional planning to strategic planning have also been triggered by the fact that strategic plans have often become a prerequisite for accessing structural funds at local level. This was also the case for the Cluj-Napoca metropolitan area, comprising Cluj-Napoca, the second largest city in Romania, and 18 rural communes, with a total population of around 400,000 inhabitants. The metropolitan area, although created through the voluntary association of communes, was an artificial structure, lacking any governance and collaboration mechanisms. In June 2015, we were appointed to design the metropolitan area's new integrated development strategy for 2016-2020 – a prerequisite for accessing funds from Romania's Regional Operational Programme.

The design of the strategic plan was based on a participative planning approach, already tested as a methodology within the STATUS Project (SEE 2007-2013)[1]. As a result, a series of thematic workshops were held with local stakeholders, ranging from local and county public authorities to decentralised institutions, utility suppliers, NGOs, cluster associations, universities and private companies. The aims of these workshops were twofold: to gather information from the local stakeholders regarding the issues in the metropolitan area and potential solutions, as well as to encourage the collaboration between stakeholders facing similar issues.

The ideas expressed in the workshops were distilled by the project team into nine development axes for the strategic plan. We considered governance to be the plan's central axis, with the success of the other eight sectoral axes (housing, mobility, energy, environment, etc.) greatly dependent on its progress. Our main proposal was the creation of a Metropolitan Task Force, composed of the main stakeholders participating at the workshops, that would be in charge with monitoring the implementation of the plan and ensuring the coordination between the projects in the metropolitan area. The Metropolitan Task Force would function in a Metropolitan Center – a venue encouraging the debate on the future development of the metropolitan area and inviting all interested stakeholders in expressing their ideas on this matter.

In the end, we realized a self-assessment of the final strategic plan, rating the innovation and smartness of our proposals (flagship projects, soft projects and complementary projects) for each of the nine development axes. The conclusion was that the governance, housing and social axes were characterized by a great degree of innovation – with proposals such as the realization of a metropolitan housing plan or the creation of CLLD initiatives to combat urban poverty –, while the mobility and leisure/tourism axes were considered to be the least innovative.

The strategic plan of the Cluj-Napoca metropolitan area is more than a vision accompanied by a list of projects. It is just the start of a process aimed at fostering collaboration and dialogue between different stakeholders, that need to make the transition now from the co-design of the plan to the co-implementation of its projects. Smart Governance is the backbone of Smart Planning, as our recent initiatives in the Cluj-Napoca metropolitan area – mainly mobility and energy projects – highlight the fact that a wide stakeholder

[1] More information available at: www.seecityplatform.net

involvement can bridge the gap between industry and public administration and lead to integrated project ideas aimed at fostering territorial development.

Keywords: Eu Urban Policies and Programmes, Participatory Planning Processes, Planning for Metropolitan Areas, Smart Governance, Strategic Planning

2 INTRODUCTION

2.1 Governance and planning – an overall view in the case of metropolitan areas

A transition from government to governance can be observed in the last two decades, as the former, seen as the domination of formally organized and hierarchic state power, is being replaced by the latter, fostering on complex relatios through the involvement of new actors from outside the political arena (Davoudi et al, 2008). At the same time, challenges like the growth in socio-economic and demographic disparities (Walsh and Allin, 2012) has determined a transtition of spatial planning from normative and bureaucratic approaches to strategic approaches focused on implementation and development (Albrechts, 2006). Consequently, urban and territorial planning becomes more than a technical instrument – *it is an integrative and participatory decision-making process which promotes local democracy, participation and inclusion, transparency and accountability, with a view to ensuring sustainable urbanization and spatial quality* (UN Habitat, 2015, p. 8).

Consequently, strategic planning is presently heading towards strategic design processes which allow both the participaton of diverse stakeholders and multiple-source financing (Ciaffi, 2005). Governance allows the horizontal and vertical integration of actors and initatives, including citizens, companies, local public administrations, through the design and implementation of common projects (Weeber et al, 2011). The focus on place and territory in regional development strategies is underlined through the concept of territorial governance, defined as the design and implementation of public policies, programme and projects targeting a specific place or territory (Janin Rivolin et al, 2014).

Smart Governance is considered to be one of the six smart city pillars, alongisde smart economy, smart people, smart mobility, smart environment and smart living (Giffinger et al, 2007). In this context, planning can be regarded as a meta-governance which aims to spatially coordinate different sectoral policies level (Vigar, 2009).

In this paper, we aim to present smart governance as the backbone to smart planning, as we consider that the succesful construction of governance models is key to ensuring a sustainable development of cities and regions. In this regard, we focus on metropolitan governance, as it is a matter still under considerable debate at international level.

The development of metropolitan areas is a process which can be closely related to globalization (Lefèvre, 2010), with these new structures becoming more and more attractive through their offer regarding high-tech production potential, metropolitan services or transportation nodes (Jurczek, 2008). Governance of metropolitan areas is currently on of the major concerns for planners all over Europe. In France, a series of legislative reforms undergone at the beginning of the 2000s aimed at promoting the voluntary association of LAU 2 units for the common development of services (Booth, 2009), further strengthening the existing *communautés urbaines* which have a broad range of competences (Korom, 2014). In Italy, recent legislative reforms seek to establish metropolitan cities as a new institutional administrative level (Lingua and Servillo, 2014).

Nevertheless, in Romania, strategic planning development has been mostly triggered by the possibility to acces EU structural funds (Florescu and Mitrea, 2015), with the creation of metropolitan areas as voluntary association of LAU 2 units being influenced by urban development funds for Growth Poles in the 2007-2013 programming period (Elisei and Pascariu, 2012).

2.2 Methodology: previous experiences and new challenges

The design of the strategic plan was based on a participative planning approach, already tested as a methodology within the STATUS Project (SEE 2007-2013). This section presents an overview of the STATUS project experiences, as well as the context of the need for a new strategic plan for the Cluj-Napoca metropolitan area in the summer of 2015.

2.2.1 STATUS project

Funded under the South East Europe cooperation programme 2007-2013, the STATUS (Strategic Territorial Agendas for Small and Middle-sized Towns and Urban Systems) project focused on the development of strategic plans through participatory planning instruments, with the creation of Urban Task Forces for the design and implementation of the strategies closely ressembling Arnstein's planning committees or the URBACT Local Support Groups (Dimitriu et al, 2015). Introducing a participatory approach was a challenge especially in post-communist countries, more accustomed to top-down approaches and being characterized by overall weak local governance systems (Elisei, 2014).

The main result of the project was the design of ten strategic agendas for ten small and middle-sized towns and urban systems in South East Europe countries – Italy, Greece, Montenegro, Serbia, Romania and the Republic of Moldova. The STATUS methodology was centered around a participative planning approach, the strategies being drafted as a result of three workshops which encouraged the participation of a broad range of local stakeholders: public authorities, universities, NGOs, private companies. The workshops focused on: *(1) problem identification in a set of planning domains, (2) identification of solutions through the creation of local working groups helped by international experts in town and regional planning and (3) design of the final strategic planning document and graphical representation (poster plan)* (Dimitriu et al, 2015, p. 1665).

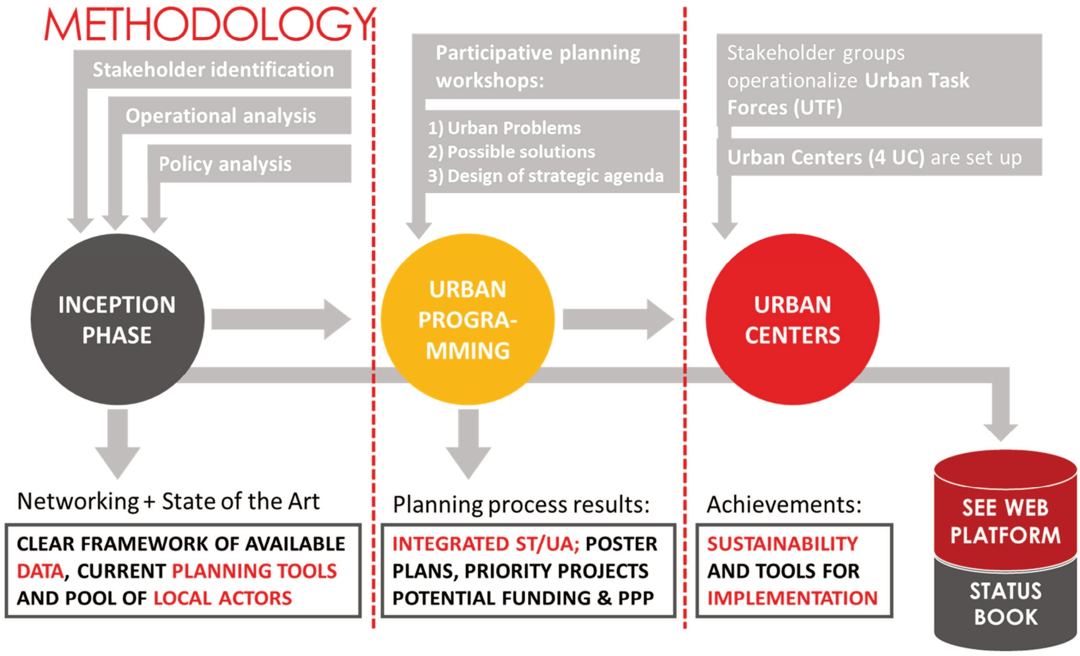

Figure 1. STATUS project methodology (Dimitriu et al, 2014)

The final step was the consolidation of an Urban Task Force, formed from the stakeholders involved in the workshops, and the realization of an Urban Center, as a physical place promoting the city's projects and programmes, collecting the ideas received from the civil society and a platform for discussing urban projects (Ginocchini, 2014).

2.2.2 A new challenge: the Cluj-Napoca metropolitan area

In June 2015, we were appointed to design the Cluj Napoca metropolitan area's new integrated development strategy for 2016-2020 – a prerequisite for accessing funds from Romania's Regional Operational Programme. The metropolitan are comprised Cluj-Napoca, the second largest city in Romania, and 18 rural communes, having a total population of around 400,000 inhabitants. Nevertheless, the metropolitan area was mostly an artificial construction, inherited from the compulsory Growth Pole structures in the previous (2007-2013) programming period, a structure created without taking into account the real functional relationships between settlements at territorial level.

The appointment was a chance to test the STATUS methodology within a different context – we were no longer facing small and middle-sized cities and their socio-economic development challenges, widely

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discussed in European literature (see OIR, 2006 or Servillo et al, 2014). The Cluj-Napoca metropolitan area represented the second most important economic center of the country, the only Growth Pole that registered both economic and demographic growth between 2007-2013 and a city with European aspirations, also being serviced by the second most important airport in terms of international passengers in the country.

Nevertheless, we also faced the challenge of a metropolitan area with conflicts between the central city and the surrounding rural communes, conflicts which mainly stemmed from the fact that most metropolitan area projects in the previous programming period had been implemented in the city of Cluj-Napoca, with the rural area being disregarded. Furthermore, the strategy had to be drafted in just six months, in order to have the strategy ready by 2016, for the first calls for projects funded through the national operation programmes.

3 DESIGN PROCESS OF AN INTEGRATED TERRITORIAL AGENDA

We based our design of the integrated territorial agenda of Cluj Napoca's metropolitan area on the same principles of the STATUS project: having an integrated territorial approach and realizing a co-design of the strategy, alongside interested local stakeholders, in order to foster a participative planning culture and ensure that the liaisons created can be also capitalized upon during the implementation of the strategy, within a newly created Metropolitan Task Force, working in the Cluj-Napoca Metropolitan Center.

3.1 A participative planning approach

A series of thematic workshops were held with local stakeholders, ranging from local and county public authorities to decentralised institutions, utility suppliers, NGOs, cluster associations, universities and private companies. The aims of these workshops were twofold: to gather information from the local stakeholders regarding the issues in the metropolitan area and potential solutions, as well as to encourage the collaboration between stakeholders facing similar issues.

For the first two workshops (Workshop 1: Identifying metropolitan problems and Workshop 2: Envisaging solutions for the identified problems) the discussions were organized around six major themes: (1) metropolitan governance and living, (2) environment and public utilities, (3) mobility, (4) economy, (5) social issues, education and health and (6) culture and local tourism, with facilitated debates taking place amongst relevant stakeholders identified at county and local level. Before the 3rd workshop (focused on discussing the strategy's projects), we decided to broaden our participative approach, as many important stakeholders did not attend the first workshops. As a result, preliminary consultations on the theme of metropolitan governance took place with representatives of local public authorities, as well as representatives of the clusters and universities from Cluj-Napoca. An international workshop was also organized, aiming to better explain the instrument of the Metropolitan Center to local stakeholders.

The idea of creating a Metropolitan Task Force, responsible with the implementation of the strategy and discussing project ideas within a Metropolitan Center, was sustained from the beginning and was subsequently supported by both decision-makers and respresentatives of clusters and other economic associations.

3.2 The structure of the strategic plan

The ideas expressed in the workshops were distilled by the project team into nine development axes for the strategic plan. These axes became the nine strategic objectives of the strategic plan, focused on the themes of: (1) metropolitan governance, (2) housing, (3) environmental quality, (4) mobility, (5) energy, (6) economic competitiveness, (7) tourism and leisure, (8) social services and (9) culture and local identity.

The strategic objectives were further developed into 26 indicative actions and more than 90 priorities, thus creating the plan's overall strategic framework. As far as the operational part of the strategy was concerned, we delimited soft projects (mostly refering to policies and plans needed to be developed by the metropolitan area in order to ensure a succesful implementation of the hard infrastructure projects, including the creation of the Metropolitan Center)) from the metropolitan area's flagship projects, which enlisted the major strategic interventions for the 2016-2020 period. These included important mobility-related projects (refering to the east-west accessibility of the metropolitan area), as well as other projects such as the regional hospital, strenthening of the natural protected areas network, urban regeneration of high-rise housing estates or the Cluj IT City initiatives. While the thematic flaghsip projects corresponded to a single strategic objective, the transversal projects represented integrated projects tackling multiple metropolitan issues.

Overall, 9 soft projects were included in the final version of the strategic plan (including the Metropolitan Center projects for improving metropolitan governance), as well as 17 flagship projects. These projects are intended to be implemented until 2023, with the strategic plan also containing a development vision for 2035 which aims to draw out the main coordinates for the metropolitan area's long-term territorial development.

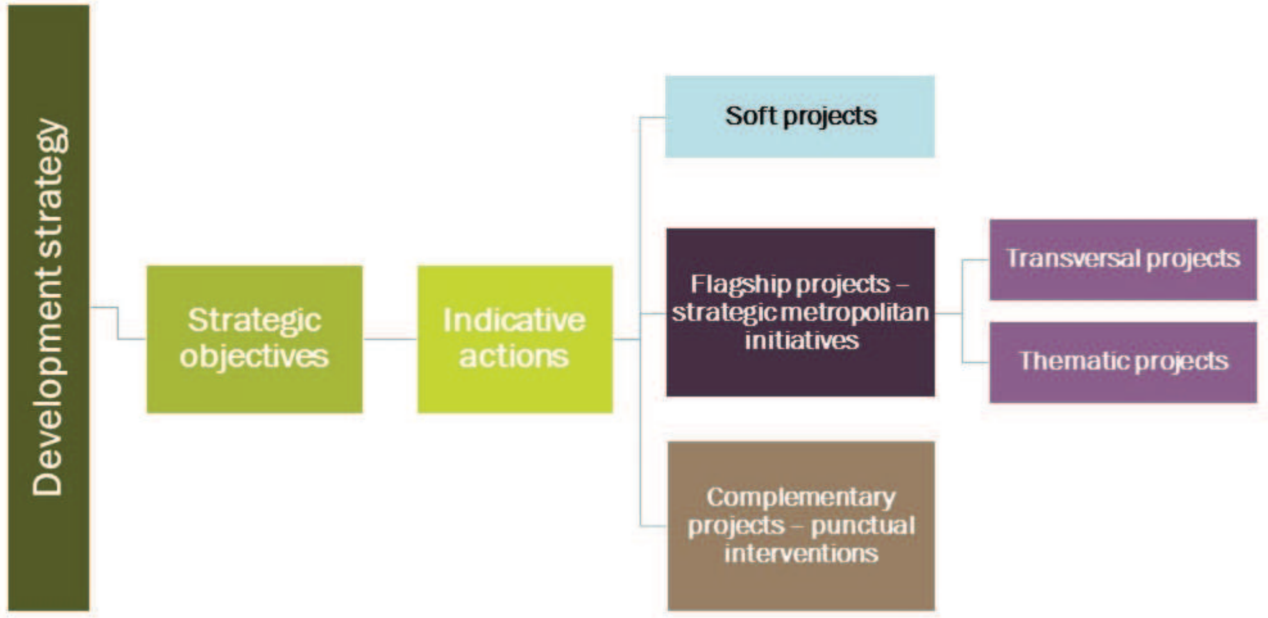

Figure 2. Overall structure of the strategic plan.

3.3 Governance as the backbone of the strategic plan

We considered governance to be the plan's central axis, with the success of the other eight sectoral axes (housing, mobility, energy, environment, etc.) greatly dependent on its progress. Our main proposal was the creation of a Metropolitan Task Force, composed of the main stakeholders participating at the workshops, that would be in charge with monitoring the implementation of the plan and ensuring the coordination between the projects in the metropolitan area. We identified the municipality of Cluj-Napoca, the County Council and the North-West Regional Development Agency as the core elements of this Metropolitan Task Force, however other interested parties can also join this task force, either to oversee the entire implementation of the strategy or to participate in specific projects.

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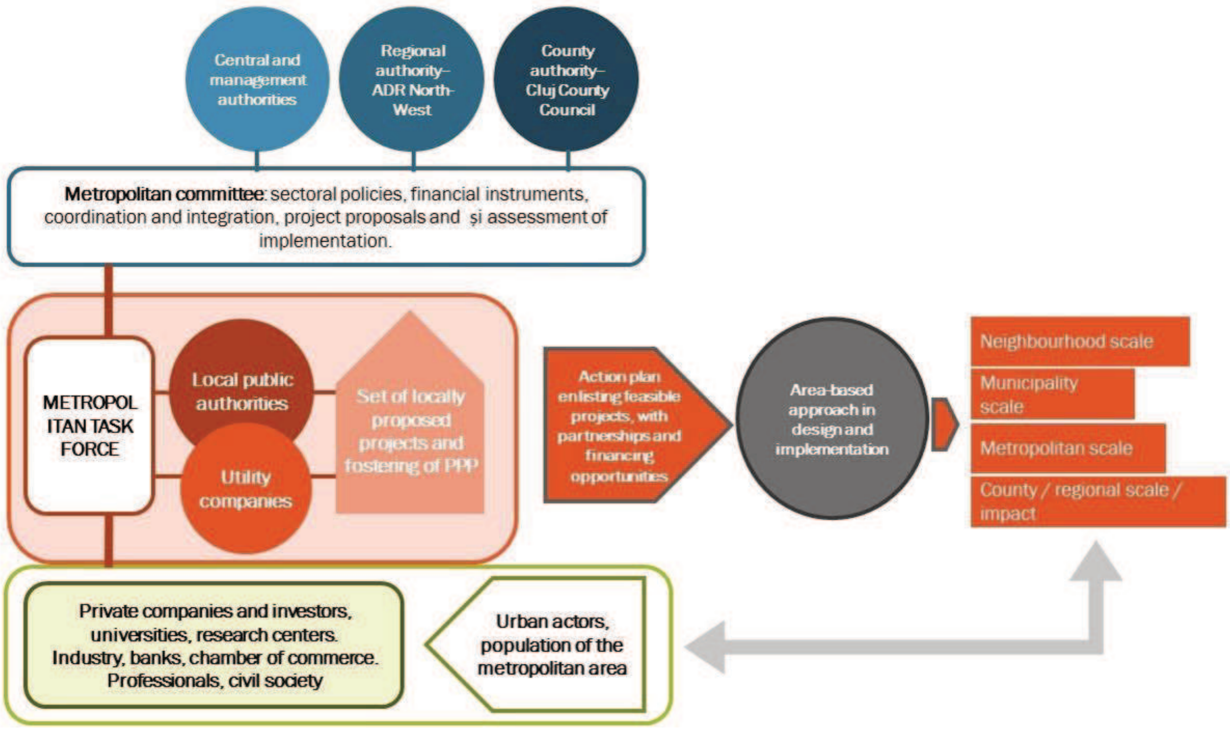

Figure 3. Proposed governance structure for the Cluj-Napoca metropolitan area.

The main idea is for the Metropolitan Task Force to become a structure ensuring the connection between top-down (Ministry of Regional Development, County Council) and bottom-up (NGOs, universities, clusters) initiatives regarding the development of the metropolitan area, while at the same time ensuring a place-based approach in the implementation of these initiatives. The Metropolitan Task Force would function in a Metropolitan Center – a venue encouraging the debate on the future development of the metropolitan area and inviting all interested stakeholders in expressing their ideas on this matter.

Figure 4. Strategic objectives – Governance at the core of the Cluj-Napoca Metropolitan Area Strategy

3.4 Self-assessment of the plan

In the end, we realized a self-assessment of the final strategic plan, rating the innovation and smartness of our proposals (flagship projects, soft projects and complementary projects) for each of the nine development axes. We believe that the soft projects proposed – the Metropolitan Center, a housing plan at metropolitan level, an urban regeneration plan for Cluj Napoca's historical center or an integrated GIS system for the territorial and environental planning of the metropolitan area – have had an important role in the overall innovative character of some of the plan's development axes.

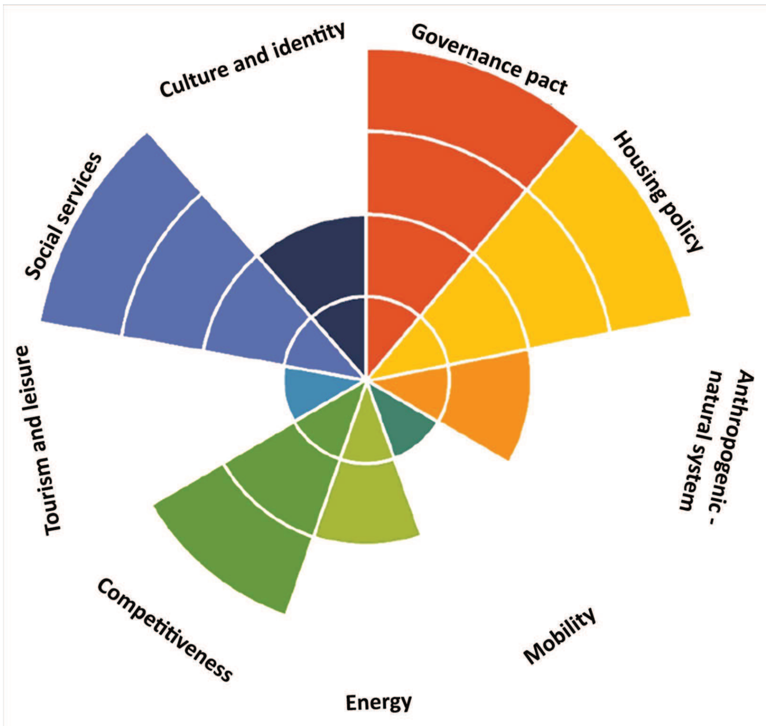

Figure 5. Self-assessment of the Strategic Plan in terms of innovation

As a result, we considered that the governance, housing and social axes were characterized by a great degree of innovation – with proposals such as the realization of a metropolitan housing plan or the creation of CLLD initiatives to combat urban poverty –, while the mobility and leisure/tourism axes were considered to be the least innovative. The reason for the latter was that, even though the plan had a strong focus on mobility-related issues, the proposed solutions were classic ones (construction of a ring-road, linking suburbia with the city center through a tram line etc.), inspired from best practice examples from Europe (for example, the tram line in Karlsruhe).

4 CONCLUSION

There are many challenges for urban governance both in metropolitan and small/medium sized towns, such as the effectiveness in limiting urban sprawl and in better ruling the urban-rural fringe development, the creation or reinforcement of socially-cohesive, inclusive and culturally diverse neighbourhoods and peripheries, the management of urban data, the management of urban functional areas that extend over several administrative jurisdictions, the resistance to change of highly fragmented institutional frameworks, the harmonization of norms, and also the role of participatory frameworks and platforms for multi-actor involvement in making effective, efficient and democratic decisions.

We tried to tackle some of these challenges in the case of a metropolitan area, but also having the support of our previous experience with small and medium-sized cities. The result, the new strategic plan of the Cluj-Napoca metropolitan area, is more than a development vision accompanied by a list of projects. It is just the start of a process aimed at fostering collaboration and dialogue between different stakeholders, that need to make the transition now from a first succesful step, the co-design of the plan, to the next steps that require the co-implementation of its projects.

Smart Governance is the backbone of Smart Planning, as our recent initiatives in the Cluj-Napoca metropolitan area – mainly mobility and energy projects – highlight the fact that a wide stakeholder involvement can bridge the gap between industry and public administration and lead to integrated project ideas aimed at fostering territorial development.

Nevertheless, the design of contemporary governance schemes should not just address eviden phenomena such as metropolisation. It also has to consider small and medium-sized towns and cities, as they also

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deserve planning strategies that enable them to remain competitive, sustainable and liveable amongst new challenges such as urban shrinkage. A balanced territorial development will also require the development of governance schemes capable of mitigating rural-urban migrations, often connected to poverty issues in rural areas. As a result, urban poles tend not to create but to attract poverty – this is a challenge that governance will have to tackle in upcoming years.

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reviewed paper

Smart Government in Wien

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1 ABSTRACT

Smart City und Smart Government sind in Wien seit Jahren ein großes Thema. Es gibt zahlreiche Aktivitäten in Wien die im folgendem Näher beleuchtet werden sollen. In einer großen Stadt wie Wien gibt es zu diesem Thema viel Akteure in der Verwaltung, Wirtschaft und Zivilgesellschaft. Besonders Verwaltung und Wirtschaft sind gefordert sich auf die neuen Begebenheiten vorzubereiten und die Strukturen entsprechend anzupassen. Einige Beispiele sowie Ausblicke in die Zukunft runden das Thema ab.

Keywords: Stadtplanung, Digitale Agenda, Open Government Data, Smart City , Smarter Together

2 SMART CITY

2.1 Smart City – Innovative Projekte

Im 22. Gemeindebezirk im Nordosten Wiens entsteht aspern Die Seestadt Wiens – die Stadt des 21. Jahrhunderts. Was sie einzigartig macht, ist ihre vielfältige Nutzung. Die Seestadt wird ein Ort sein, der alles hat, was modernes Wirtschafts-, Arbeits- und Privatleben ausmacht. Ein fünf Hektar großer See liegt im Zentrum und gibt dem neuen Quartier seinen Namen. Großzügige öffentliche Räume und die Nähe zum

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Nationalpark Donau-Auen einerseits sowie hochwertige Infrastruktur und nachhaltige Urbanität andererseits schaffen eine neue Qualität des Wohnens und Arbeitens.

In fünfzehn Minuten ist man künftig am Flughafen Wien Schwechat und in einer halben Stunde in der City oder in Bratislava. Innerhalb der Seestadt erfahren Fußgängerinnen und Fußgänger, Radfahrerinnen und Radfahrer und der öffentliche Verkehr eine Aufwertung. Ein hoher Anteil der Grundfläche ist dem öffentlichen Raum vorbehalten, für Plätze, Grün- und Erholungsflächen.

Das Areal wird etappenweise bis 2027 bebaut und dient als „Urban Lab der Smart City Wien". Als ein Ort, wo intelligente Ideen, Konzepte und Technologien unter realen Bedingungen ausprobiert werden können. aspern Die Seestadt Wiens wächst in Zusammenarbeit mit der Wiener Bevölkerung heran. Ein eigenes Stadtteilmanagement unterstützt seit 2014 die Pionierinnen und Pioniere der Seestadt beim Ankommen sowie beim Aufbau einer neuen Gemeinschaft und guter Nachbarschaften.

Eines der wichtigsten Zielgebiete des Stadtentwicklungsplanes 2005 (STEP 05) ist der Hauptbahnhof Wien und der ihn umgebende neue Stadtteil: Quartier Belvedere und Sonnwendviertel. Mit Eröffnung des neuen Hauptbahnhofes im Jahr 2014, der bereits jetzt zu den Knotenpunkten des transeuropäischen Schienenverkehrsnetzes zählt, wurde die entscheidende erste Bauphase abgeschlossen.

Der notwendige Umbau des internen Straßennetzes sowie die Verbindung zu den angrenzenden Straßen erfordern in den folgenden Bauphasen weitere wichtige Schritte, welche von der MA 28 und den Einbautendienststellen heuer weitergeführt werden. Die Abteilung Wiener Wasser (MA 31) hat das Rohrnetz im Bereich des Hauptbahnhofes hergestellt beziehungsweise im Umfeld des Hauptbahnhofes erneuert.

Die IT ist seit mehren Jahren mehr eingebunden da dies ein wichtiger Bestandteil einer smarten Stadt darstellt. Sowohl das Rechenzentrum der Stadt Wien als auch die lokalen IT Dienstleister werden verstärkt mit diesen Themen konfrontiert und sind gefordert effiziente Lösungen zur Verfügung zu stellen.

2.2 Die Strategie

Die Stadt Wien hat eine Smart City Wien Rahmenstrategie. Hier werden die wichtigsten Treiber, Kennzahlen und Herausforderungen für die Stadt präsentiert.

Weil Wien seit Generationen "smart" handelt, ist die Stadt heute schon einer der weltweit besten Plätze zum Leben. Das soll so bleiben. Jetzt geht es darum, aktuelle Herausforderungen wie Klimaschutz oder den ungebrochenen Run auf die Städte zu meistern.

Bürgermeister Michael Häupl: "Wien ist schon seit Generationen smart. Unser Trinkwasser oder die Gemeindewohnungen zeigen das. Aber auch wir müssen uns ständig neu erfinden und werden mit mehr Innovation weiter Weltspitze bleiben. Der Unterschied zu anderen: Wir in Wien lassen dabei niemanden zurück."

Vizebürgermeisterin Maria Vassilakou: "Wien verschreibt sich dem Klimaschutz und der Innovation. Wir wollen viel Gutes noch besser machen - im Verkehr, im Wohnbau, in der Stadtentwicklung, im Umweltschutz. Wien kann Vorreiter sein beim Klimaschutz mit höchster Lebensqualität und größtmöglicher Schonung unserer Umwelt und unserer Ressourcen."

Seit 2011 läuft ein von Bürgermeister Häupl initiierter Prozess, der nun in die Smart City Wien Rahmenstrategie mündete. Diese wurde am 25. Juni 2014 im Wiener Gemeinderat beschlossen.

Die "Smart City Wien Rahmenstrategie" ist eine langfristige Dachstrategie bis 2050. Umgesetzt wird dies mit zeitlich gestaffelten, konkreten Zielen, die einer permanenten Kontrolle unterliegen.

Das Dokument steht der Öffentlichkeit als Download in den Sprachen deutsch und englisch sowohl in der Langfassung als auch als kompakte Kurzfassung zur Verfügung.

https://www.wien.gv.at/stadtentwicklung/studien/b008380.html

2.2.1 Handlungsfelder

Das Leitziel 2050 der Smart City Wien lautet daher: Beste Lebensqualität für alle Wienerinnen und Wiener bei größtmöglicher Ressourcenschonung. Das gelingt mit umfassenden Innovationen. Dazu wurden drei Handlungsfelder definiert:

- Ressourcen
- Lebensqualität
- Innovation

2.2.2 Ausgewählte Ziele im Detail

- Reduktion der CO_2-Emissionen von derzeit 3,1 Tonnen pro Kopf auf circa eine Tonne: minus 80 Prozent von 1990 bis 2050
- Energie: Bis 2050 kommen 50 Prozent der Energie aus erneuerbaren Quellen. Der Primärenergieeinsatz sinkt von 3.000 auf 2.000 Watt pro Kopf.
- Mobilität: Senkung des motorisierten Individualverkehrs von derzeit 28 auf 15 Prozent bis 2030. Bis 2050 fahren alle Autos innerhalb der Stadtgrenzen mit alternativen Antriebstechnologien.
- Gebäude: Reduktion des Energieverbrauchs für Heizen, Kühlen und Warmwasser um ein Prozent pro Kopf pro Jahr.
- Innovationen:
  - Das Innovationsdreieck Wien-Brünn-Bratislava ist eine der zukunftsträchtigsten Regionen Europas.
  - Der Anteil der technologieintensiven Produkte am Export steigt von derzeit 60 auf 80 Prozent.
  - Wien ist eines der fünf Top-Forschungszentren Europas.
- Soziales und Gesundheit:
  - In Wien leben alle Menschen unabhängig von ihrer Herkunft, sexuellen Orientierung und geschlechtlichen Identität friedlich und sicher zusammen.
  - Sicherstellung der medizinischen Versorgung auf höchstem Niveau
- Umwelt: Der 50-Prozent Grünanteil bleibt erhalten.

https://smartcity.wien.gv.at/site/

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Auch das Thema Internet of Things (IoT) spiel eine große Roll für die Zukunft. Es werden immer mehr Sensoren in der Stadt verbaut die miteinander verbunden sind. Zahlreiche Bauteile sammeln daten und liefern diese zur Steuerung und Auswertung an die IT Systeme. Die großen Mengen an Daten müssen natürlich auch entsprechend aufbereitet und zur Verfügung gestellt werden. Das Schlagwort lautet Big Data und wird in Zukunft die IT Dienstleister noch viel mehr beschäftigen. Damit verbunden auch das Thema Big Data. Es gibt aber auch Problemfelder die im Zusammenhang mit IoT beleuchtet werden müssen. Die zwei wesentlichsten Felder in diesem Zusammenhang sind Updates bei Sicherheitslücken sowie die Zugriffsregelung auf die zahlreichen Dinge.

2.3 Open Innovation

Wikipedia: Der Begriff Open Innovation bzw. offene Innovation bezeichnet die Öffnung des Innovationsprozesses von Organisationen und damit die aktive strategische Nutzung der Außenwelt zur Vergrößerung des Innovationspotenzials. Das Open-Innovation-Konzept beschreibt die zweckmäßige Nutzung von in das Unternehmen ein- und ausdringendem Wissen, unter Anwendung interner und externer Vermarktungswege, um Innovationen zu generieren

2.3.1 Smart City WIEN … aktiviert eine digitale Agenda

Alle Bürgerinnen und Bürger sind eingeladen, die zukünftige Strategie zur Informations- und Kommunikationstechnologie der Stadt Wien mitzugestalten. Das Dokument ist als „To-Do-Liste“ für die Stadt zu verstehen. Sie fasst zusammen, welche Projekte und Aktivitäten im Bereich der Informations- und Kommunikationstechnologien (IKT) auf der Tagesordnung der Stadtverwaltung stehen.

Die Digitale Agenda Wien eine logische Ergänzung der bestehenden Strategiedokumente im Bereich die Forschungs-, Technologie- und Standortpolitik Wiens. Letztlich wirkt sie aber auch weit darüber hinaus, denn die digitalen Technologien nehmen in immer mehr Bereichen des Stadtlebens eine entscheidende Rolle ein.

Das Wort „Agenda“ stammt aus dem Lateinischen und bedeutet so viel wie „das zu Tuende“ bzw. „was getan werden muss“. In diesem Sinn kann die Digitale Agenda Wien als „To-Do-Liste“ für die Stadt

verstanden werden. Sie fasst zusammen, welche Projekte und Aktivitäten im Bereich der Informations- und Kommunikationstechnologien (IKT) auf der Tagesordnung der Stadtverwaltung stehen. Darum ist die Digitale Agenda Wien kein starres Regelwerk, sondern ein Arbeitsdokument.

Eine Übersicht, die kontinuierlich weiterentwickelt wird. Das macht schon alleine deshalb Sinn, weil sich sowohl die Anforderungen der Bürgerinnen und Bürger als auch die technischen Möglichkeiten laufend verändern. Und die Digitale Agenda Wien will schließlich die Frage beantworten, wie die Stadt Wien mit diesen Anforderungen und Möglichkeiten umgehen soll. Wie können die Potenziale der neuen Technologien in den Dienst aller Wienerinnen und Wiener gestellt werden? Wie können die damit verbundenen Chancen genutzt, aber auch Risiken vermieden werden?

Durch die Beschäftigung mit diesen Fragen ist die Digitale Agenda Wien eine logische Ergänzung der

bestehenden Strategiedokumente im Bereich die Forschungs-, Technologie-und Standortpolitik. .Wiens.

Letztlich wirkt sie aber auch weit darüber hinaus, denn die digitalen Technologien nehmen in immer mehr Bereichen des Stadtlebens eine entscheidende Rolle ein.

Die Nutzerinnen und Nutzerim Mittelpunkt Im Mittelpunkt der Digitalen Agenda Wien stehen die verschiedenen Nutzerinnen und Nutzer in der Stadt. Ihre Anliegen, Bedürfnisse und Interessen sind stets

die Richtschnur für die Festlegung von Schwerpunkten, die Umsetzung von Projekten und

die Gestaltung neuer Services. Darum ist die Einbindung der Nutzerinnen und Nutzer ein wesentlicher Baustein in allen damit verbundenen Prozessen. Auch der hier vorliegende Entwurf der Digitalen Agenda Wien ist so entstanden. Er wurde nicht im stillen Kämmerlein ausgeheckt sondern unter Beteiligung von hunderten Interessierten ausgearbeitet. Und selbstverständlich wird auch die Weiterentwicklung der Digitalen Agenda Wien in dieser transparenten und offenen Form erfolgen.

Das entspricht ganz den „Wiener Prinzipien", die im Zuge dieses Diskussionsprozesses entstanden

sind.

Dabei handelt es sich um neun Leitmotive, an denen sich die Stadt bei der Erschließung neuer

technologischer Potenziale orientiert. Neben Transparenz, Offenheit und Beteiligung zählen dazu auch Vertrauen und Sicherheit, Inklusion und soziale Nachhaltigkeit, Gendergerechtigkeit,

Bürgernnen- und Bürgerorientierung, die Stärkung des Wirtschaftsstandorts, Konsolidierung, Innovation sowie

Flexibilität und Lernen.

https://www.digitaleagenda.wien/sites/default/files/digitale_agenda_wien_12_06_15final.pdf

2.3.2 Bürgerbeteiligung – Partizipation – Kollaboration

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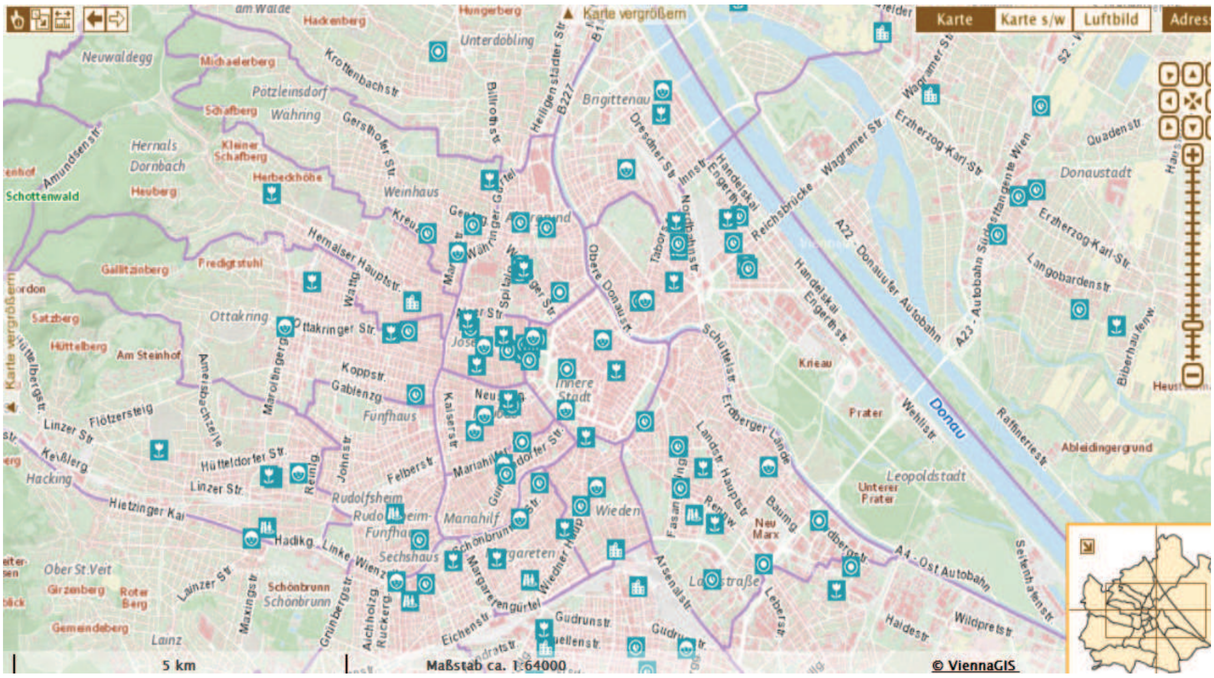
Die Stadt Wien hat in den beiden Regierungsübereinkommen von 2010 wie auch in dem von 2015 der BürgerInnenbeteiligung einen hohen Stellenwert eingeräumt. Beteiligungsmodelle auf Bezirks- und Grätzelebene sollen leichter initiiert und gefördert werden.

In der Kartenansicht sind die laufenden Partizipationsprojekte dargestellt, bei denen die Stadt Wien oder ein von ihr eingesetztes Unternehmen in einem Auftrags- oder Betreuungsverhältnis zu dem Projekt stehen:



https://www.wien.gv.at/stadtplan/grafik.aspx?lang=de-AT&bookmark=UW-cDRTIk3EVXlJJGzisLRv-a5R5lmnKnmkev2ps6ftJjB8NaQ2RyDqa8-b

2.3.3 Petitionen

Petitionen im Sinne des Gesetzes über Petitionen in Wien, LGBl. 2/2013 bieten Bürgerinnen und Bürgern die Möglichkeit, konkrete Anliegen an den Gemeinderatsausschuss für Petitionen und Bürgerinnen- und Bürgerinitiativen (Petitionsausschuss) heranzutragen. Petitionen können hier elektronisch eingebracht und unterstützt werden. Voraussetzung dafür ist die Vollendung des 16. Lebensjahres zum Zeitpunkt des Einbringens sowie der Wiener Hauptwohnsitz und ein gültiger Identitätsnachweis. Bei elektronischer Abwicklung erfolgt der Nachweis über die Bürgerkarte oder Handysignatur. Für die Behandlung im Petitionsausschuss sind mindestens 500 Unterstützungen erforderlich.

http://www.petitionen.wien.at

2.3.4 Open Data

Open Government Data bezeichnet die Idee, dass von der Verwaltung gesammelte öffentliche Daten frei zugänglich gemacht werden. Diese Daten sollen der Bevölkerung in maschinen-lesbarer Form zur Verfügung gestellt werden, so dass die Daten auch automatisiert verarbeitet werden können. Offene Standards bei den Schnittstellen und der Software ermöglichen mehr Transparenz, Partizipation und Kollaboration. Neben den technischen Schnittstellen muss seitens der Verwaltung ein rechtlicher Rahmen geschaffen werden.

Beispiele für diese öffentlichen Daten sind etwa Geo-Daten, Verkehrsdaten, Umweltdaten, Budgetdaten oder statistische Daten. Personenbezogene Daten werden dabei keine veröffentlicht.

Open Data bietet Nutzungsmöglichkeiten auf verschiedensten Ebenen. Unternehmen sowie Bürgerinnen und Bürgern können mit den angebotenen Daten selbst neue Anwendungen und Dienste erstellen. Auch die Beteiligung der Bürgerinnen und Bürger an politischen Entscheidungsprozessen wird durch Open Data gefördert. Wissenschaft und Forschung profitieren ebenfalls vom vereinfachten Datenaustausch.

https://open.wien.at

OG-Datensätze-Beispiele:

- Echtzeitdaten der Wiener linien
- Geodaten
  - Points of Interest (Krankenhäuser, Schulen, Sehenswürdigkeiten, …)
  - Themen (Parks in Wien, Wahlsprengel,…)
- Statistikdaten
  - Wanderungen von und nach Wien nach Migrationshintergrund
  - Wirtschaftsindikatoren für Wien: Zeitreiehe
  - Budgetdaten zum rechnungsabschluss

Kooperationen von Open Government Data

Das Bundeskanzleramt, die Städte Wien, Linz, Salzburg und Graz gründeten am 13. Juli 2011 gemeinsam die „Cooperation Open Government Data Österreich“, kurz „Cooperation OGD Österreich“. Bund, Länder, Städte und Gemeinden wollen in Kooperation mit den Communities, Wissenschaft, Kultur und der Wirtschaft die Basis für die Zukunft von Open Government Data in Österreich legen. Durch die Einigung auf gemeinsame Standards sollen effektive Rahmenbedingungen geschaffen werden, die zum Nutzen aller Interessensgruppen sind. Das Zusammenwirken im Raum Deutschland – Österreich – Schweiz – Liechtenstein (DACHLI) wird forciert. In dieser Cooperation werden die Interessen von Ministerien, Ländern, Städten und Gemeinden vertreten, also all jener Akteure, die eine Open Government Data-Plattform betreiben, planen, erstellen oder sich daran beteiligen möchten. Das Bundeskanzleramt bildet die Verbindung zum Kompetenzzentrum Internetgesellschaft (KIG) und der Plattform Digitales Österreich

Schwesternportal zu data.gv.at:

2.4 Projekte der Zukunft

Wien erhielt in Kooperation mit München und Lyon den Zuschlag für das Projekt "Smarter Together - gemeinsam gscheiter" - dem modernen, smarten Stadterneuerungsprojekt für Simmering. Mitte Dezember 2015 hat die EU-Kommission die Förderverträge unterzeichnet. Wien erhält damit über sieben Millionen Euro an Förderungen für dieses smarte Konzept.

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Wohnbaustadtrat Michael Ludwig: "Wien hat sich mit der 'Smart City Rahmenstrategie' ambitionierte Ziele gesetzt. Das betrifft sämtliche Lebensbereiche, beim Wohnen nicht nur den Neubau wie etwa in aspern Seestadt sondern vor allem den Bestand. Mit diesem Projekt wollen wir zeigen, wie mit thermisch-energetischen Sanierungen von Wohnhausanlagen, aber auch durch nachhaltige Mobilität und dem Ausbau umweltfreundlicher und erneuerbarer Energie die Lebensqualität deutlich gesteigert werden soll."

Der Start von "Smarter Together gemeinsam gscheiter" erfolgt im Februar 2016 mit einer Projektdauer von drei Jahren, der eine zweijährige Evaluierungsphase folgen soll.

Hinter "Smarter Together" stehen Leuchtturmprojekte, durch die die Stadterneuerung weiterentwickelt wird. "Smarter Together" zählt mit zu den spannendsten Vorhaben in Wien. Durch die Projekte, die in Simmering Nordwest durchgeführt werden, können insgesamt sechs Millionen Kilowattstunden jährlich an Energie und 550 Tonnen Kohlenstoffdioxid eingespart werden. 900 Arbeitsplätze können gesichert und zum Teil neu geschaffen werden. Die Heizkostenersparnis für die Bewohnerinnen und Bewohner in den Wohnhausanlagen, die saniert werden, wird jährlich bis zu 400 Euro ausmachen.

Die Stadt Wien hat für dieses ambitionierte und zukunftsweisende EU-Projekt das Gebiet Simmering Nordwest ausgewählt. Es liegt zwischen zwei Stadtentwicklungsgebieten - dem Sonnwendviertel im Nordwesten und dem Gasometer-Vorfeld im Nordosten. Um dieses Ziel zu erreichen, wird das Leuchtturmprojekt in Wien unter der Federführung des Wohnbauressorts in Zusammenarbeit mit mehreren Magistratsabteilungen der Stadt, TINA Vienna, Wiener Stadtwerke, Wien Energie, Siemens, Kelag, Wiener Linien, Österreichische Post AG, Austrian Institute of Technology, Neue Urbane Mobilität Wien sowie Sycube umgesetzt.

Weitere Maßnahmen

Neben der Sanierung gibt es noch weitere Maßnahmen, die umgesetzt werden:

- Verdichtung der Fernwärme - Steigerung der Anschlusswohnungen
- Fernwärme - Integration von Solarthermie und Abwärme

- Nahwärme - Integration von Solarthermie und lokale Speicher
- eMobility im Werksverkehr der Siemens-Anlage im Gebiet und im Lieferverkehr der Post
- Nachbarschafts-eCar-Sharing
- "Urban Living Lab" - Information und Beteiligung der Bewohnerinnen und Bewohner: Info-Point am Simmeringer Markt; Workshops in Zusammenarbeit mit lokalen Partnerinnen und Partnern wie der VHS und GB*, Mobility-Points*

3 WIEN EINE LEBENWERTE STADT

4 REFERENCES

https://smartcity.wien.gv.at/site/
https://www.digitaleagenda.wien/de/
https://open.wien.gv.at/site/
https://www.petitionen.wien.at

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reviewed paper

Smart Planning: Different Participation Methods for Evaluating Spatial Attractiveness

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1 ABSTRACT

The smart city approach provides many promising advantages considering overall planning efficiency in response to societal and ecological challenges. A smart city may only be as desirable as its performance in increasing the quality of life of its citizens. One benchmark is the level of citizen well-being and if they feel comfortable within the given space. This raises the question as to how an overall self-perceived well-being or "spatial attractiveness" can be measured and compared. In this study, different participatory concepts and methods were applied in order to measure and quantify spatial attractiveness. Firstly, a questionnaire-based survey was conducted. In the second step, a web map application for online participation was created and promoted using touchscreen devices. Additionally, ArcGIS for Desktop was used for gathering data as well as an analogue map on which citizens were ask to draw on. The questionnaire-based survey provided the most detailed information on citizens demands and the analogue map was the most easy-to-use method. However, data post processing for these surveys might be time consuming. As ArcGIS for Desktop required some prior GIS knowledge to be used properly, it proved to be less suitable for participative data collection. Results show that the web map application was suitable to gather considerable amounts of data in a relatively short time period. Consistent with the smart planning approach, the collected participation data can be accessed online in real time and effectively be implemented into sustainable urban planning. In a case study, the collected data were analyzed in combination with walking distances to facilities of basic goods and services. Plausibility checks were iteratively carried out in dialogue with local planning authorities and decision-makers. This study demonstrates approaches to merge citizen participation and spatial analysis into novel geospatial tools and to increase urban planning efficiency.

Keywords: Participation, Participatory Planning, Smart Planning, Spatial Cybernetics, Spatial Simulation

2 INTRODUCTION

In the 21st century urban decision makers find themselves simultaneously faced with a plethora of societal and ecological challenges, such as matters of antithetical land issue interests (Dai et al., 2001; Rojas et al., 2009), effects of urban heat islands (Oke, 1967; Arnfield, 2003), heavy rain and flood risk mitigation (Tyrna & Hochschild, 2010), the ecological conditions of freshwater bodies (EC 2000), clean drinking water supply (Kummu et al., 2010), consequences of demographic change (Champion, 2001; Danielzyk et al., 2010) and demand-adapted local supply with basic services (Libbe et al., 2010). Many of these issues seem to be best understood as interconnected components of a complex system, which is the city (Klein & Müller, 2012; H2020, 2015). One mayor advantage of the smart city approach is that it matches the interconnected nature of these complex systems with a holistic perspective which might create a basis for addressing urban challenges in an integrated way. This approach usually comprehends the smart city as a datafied self-monitoring and ICT-driven system which allows for real-time emergency response and highly efficient use of resources (e.g. Bowerman et al., 2000; Allwinkle & Cruickshannk, 2011). In addition to these rather technological aspects, human and institutional factors of smart cities have been emphasized which might augment community-based and humane policies and ensure an innovative and creative atmosphere (Nam & Pardo, 2011a, b; Neirotti et al., 2014). As promising as this approach might be, citizens might share concerns regarding the datafication of their city, namely overly technocratic governance, dependency on few large companies, susceptibility to software failures or cyber-attacks, enforced digital social inequities and privacy issues to the degree of over-surveillance of citizens (Chourabi et al., 2012; Kitchin, 2014). These concerns should be taken seriously and emphasize that smart cities can only be convincing for their citizens if the prime normative objective is to increase their overall quality of life.

One benchmark for this is the level of self-perceived well-being and if citizens feel comfortable within the given space. The perception of whether a place is attractive or not is highly subjective, individually different and geographically bound. This raises the question as to how spatial attractiveness can be quantified, compared and best integrated in a participatory way into everyday policy and decision making, such as traffic planning, notification of deficiencies or general reshaping of municipalities. In this meta-study, we applied and compared different participatory concepts and methods in order to measure and quantify spatial attractiveness. For the study area of Herdecke (Southern Ruhr-Area, North Rhine Westphalia, Germany) we investigated the advantages and drawbacks of (a) a questionnaire-based survey, (b) a web map application, (c) an offline map application and (d) drawing on an analogue map. We compare and assess the representativity of certain target groups, the willingness for participation, the level of detail of the obtained data and privacy issues for each of these methods. We furthermore evaluate the suitability of each method within the scope of the smart city approach.

Ultimately, we demonstrate as to how participation data can be merged with additional spatial information in order to develop a novel and smart geospatial analysis tool. For this purpose, we combine the obtained participation data with accessibility analysis for local facilities of basic services. Drawing on this example, we show how highly ICT-based aspects of the smart city concept can be used for augmenting citizen participation and providing new insights for a more evidence-base smart governance.

3 METHODS

3.1 Study Area

The city of Herdecke is located at the river Ruhr at the southern rim of the metropolitan Ruhr-Area, south of the larger cities of Bochum and Dortmund in Western Germany. The Ruhr-Area is an agglomeration of several larger and medium sized cities. It covers an area of approximately 4,436 km² and is inhabited by approximately 5 million citizens which results in a population density of about 1,200 citizens per km² (RVR, 2016). The city of Herdecke itself is inhabited by approximately 24,200 people. It is particularly affected by demographic change which can be observed in the whole region. Around the city center, 39.9 % of the total population is older than 60 years while this share of the population is even increasing. At the same time the total number of people living in this area has decreased by approximately 30.9 % in 10 years from the 2000 to 2010 (Lüneborg, 2013).

3.2 Questionnaire-based survey

This motivated the city’s administration to launch a questionnaire-based survey in the summer of 2015 which primarily focused on living comfort for senior citizens but also the accessibility of local facilities. One questionnaire was sent to each of the 13,461 households within the city’s boundaries. The questions were stated as multiple choices, Likert scales and free text. One Likert-scale question went into the “Wohlfühlfaktor” which is a German term describing the overall self-perceived well-being. As most of the questionnaires could be georeferenced on street-level or at least on the city-district-level, the “Wohlfühlfaktor” might be regarded as comparable to the term of “spatial attractiveness”. Since the possibility to fill in the questionnaire online was only taken up by approximately 30 people, most of the questionnaires had to be digitized, categorized, georeferenced and organized in a excel-file as well as explicitly in space using a Geographic Information System (GIS). In order to assess the representativity of this survey, the numbers of participating citizens per demographic group and city district were compared to data provided by the local citizen registration office.

3.3 Web map application

In a second step, a web application was designed as one of three additional methods for citizen participation which were promoted by the local press and during two Christmas markets in Herdecke in December 2015. The main objective of this method was a very short participation time period of a maximum of 10 seconds in order to motivate as many citizens as possible of various demographic groups. In order to achieve this, the application was easy-to-use and stated only one obligatory question. After reassuring that the participants were citizens of the city of Herdecke, they were asked to evaluate the spatial attractiveness by using a topographic base map to point out where they would “feel good” or “not feel good” (Fig. 1). In addition, participants had the non-obligatory option to leave a comment and to assign themselves to one or more of the target groups “family with child up to the age of 11”, “youngster up to the age of 18”, “student or apprentice”, “single or childless couple”, “senior or mobility restricted citizen”, “migratory background”, “female”, and/or “male”. While conducting this survey, the interviewers aimed at specifically reaching out equally to all target groups which was facilitated by face-to-face communication. The application was prepared in ArcGIS 10.2 for Desktop, uploaded into a web map in ArcOnline and integrated into the final web application using the Web AppBuilder by Esri. Using touchscreen devices during face-to-face interviews considerably enhanced the usability of the application. Additionally, flyers with QR-codes and URLs were handed out to citizens allowing to participate using mobile phones or home computers.

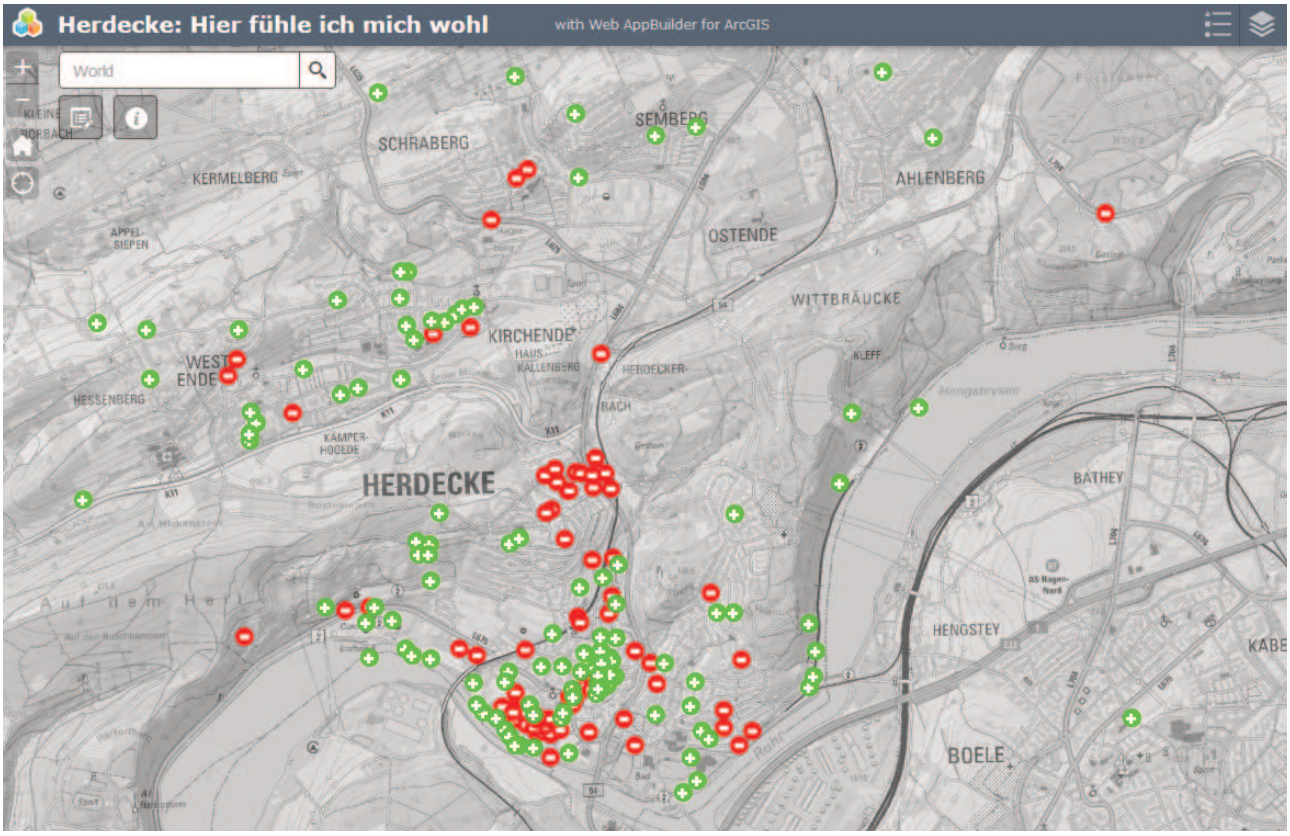

Fig. 1: User interface for the web map application to evaluate the spatial attractiveness in the study area (created with Web AppBuilder for ArcGIS by Esri; base map: WMS by Geobasis NRW).

3.4 Offline map application

Using five touchscreen devices at the same time generated a considerable volume of data of approximately 200 MB in one hour. This data had to be transmitted via an active internet connection. Given these large data volumes, a mobile internet connection proofed to be impractical. As Wi-Fi was only available at few spots in the city and within a limited radius around these spots, an offline version of the described web map application (section 3.3) was created directly in ArcGIS 10.2 for Desktop. For this purpose, base maps were downloaded from WMS-services in various resolutions and stored locally. Visibility scale ranges were applied to respective resolutions for a cleaner appearance and more intuitive use. The functionality of the online and offline versions of the application was the same, nonetheless, the offline version was not touch-optimized and required some prior GIS knowledge in order to be used properly.

3.5 Analogue map

It was assumed that the use of a touchscreen device might cause irritation and fear of contact by some participants, especially senior citizens, who might not be as familiar with these devices as the younger population. It was hypothesized that this might lead to a reserved participation and an underrepresentation of this target group. In order to avoid this and to involve these citizens, a fourth method was applied which was supposed to set the barrier to engagement and fear of contact as low as possible. For this purpose, an analogue map was printed out, on which citizens were asked to draw. This constituted the most simple and straightforward method of this study. The terminology of the stated questions were the same as in the online and offline versions of the map application (sections 3.3 and 3.4) which focused on spatial attractiveness.

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4 RESULTS

4.1 The surveys' representativities

For the questionnaire-based survey, the city administration of Herdecke sent one questionnaire to each of the city's approximately 13,461 households of which 2,060 valid questionnaires were sent back for analysis. This corresponds to a satisfactory participation ratio of around 15.3 %. Comparing the number of valid questionnaires by city district to population numbers provided by the local citizen registration office shows that no city district is considerably over- or underrepresented in this survey (Fig. 2). In contrast to this, comparing the relative participation per age groups to demographic data of the citizen registration office reveals that 18 to 67 year olds are highly underrepresented while senior citizens are considerably overrepresented in this survey (Fig. 3). As only one questionnaire was sent to one household and the age was given as the age of the oldest and youngest persons of this household, respectively, a comparison of these two datasets provides rather a broad overview than an exact picture of the representativity of each age group. As no additional demographic information, for instance, on gender, social status or migratory background was given in this survey, their respective representativity cannot be assessed.

The same holds true for the online and offline map applications and the analogue map. Too few participants assigned themselves to a target group in order to numerically assess the representativity of demographic groups. Nevertheless, face-to-face communication with citizens allowed the interviewers to consciously reach out to various demographic groups and also address non-German speaking participants, which might be important as about 10.6 % of Herdeckes population have a migratory background. This was very well perceived by the interviewed citizens and increased the overall willingness to participate. In the latter surveys, some places were more frequently evaluated as “feel good” or “not feel good” as others as can be seen in Fig. 4 in the next section (4.2). This is useful for further analyses and provides an informative picture for local decision makers. Although the distribution of the evaluated places is not homogenous, the whole study area is covered. In addition, the surveys were repeated at two sub centers of the city, assumingly reaching out to various target groups. Consequently, the spatial representativity is assumed to be high for the map applications and the analogue map.

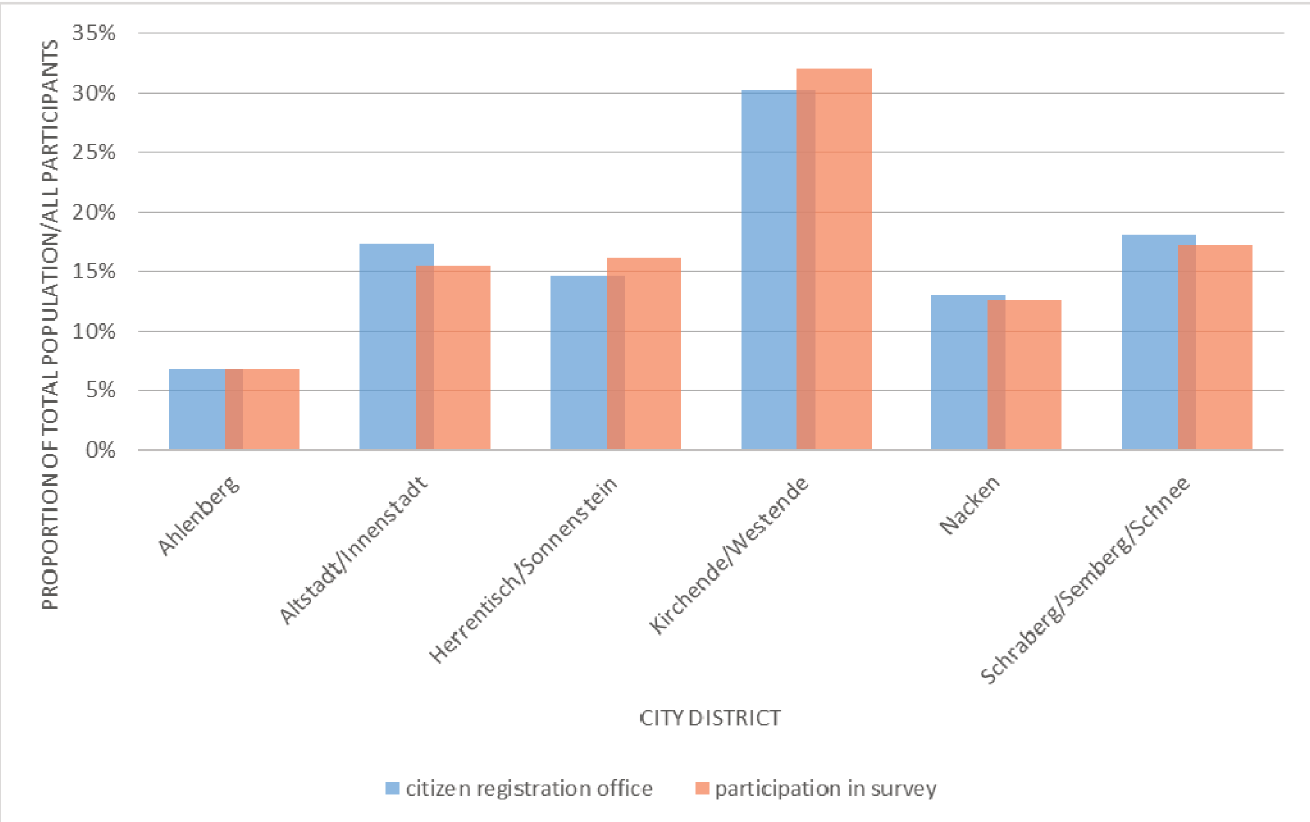

Fig. 2: Participation in the questionnaire-based survey by city districts compared to the actual population distribution as derived from citizen registration office data.

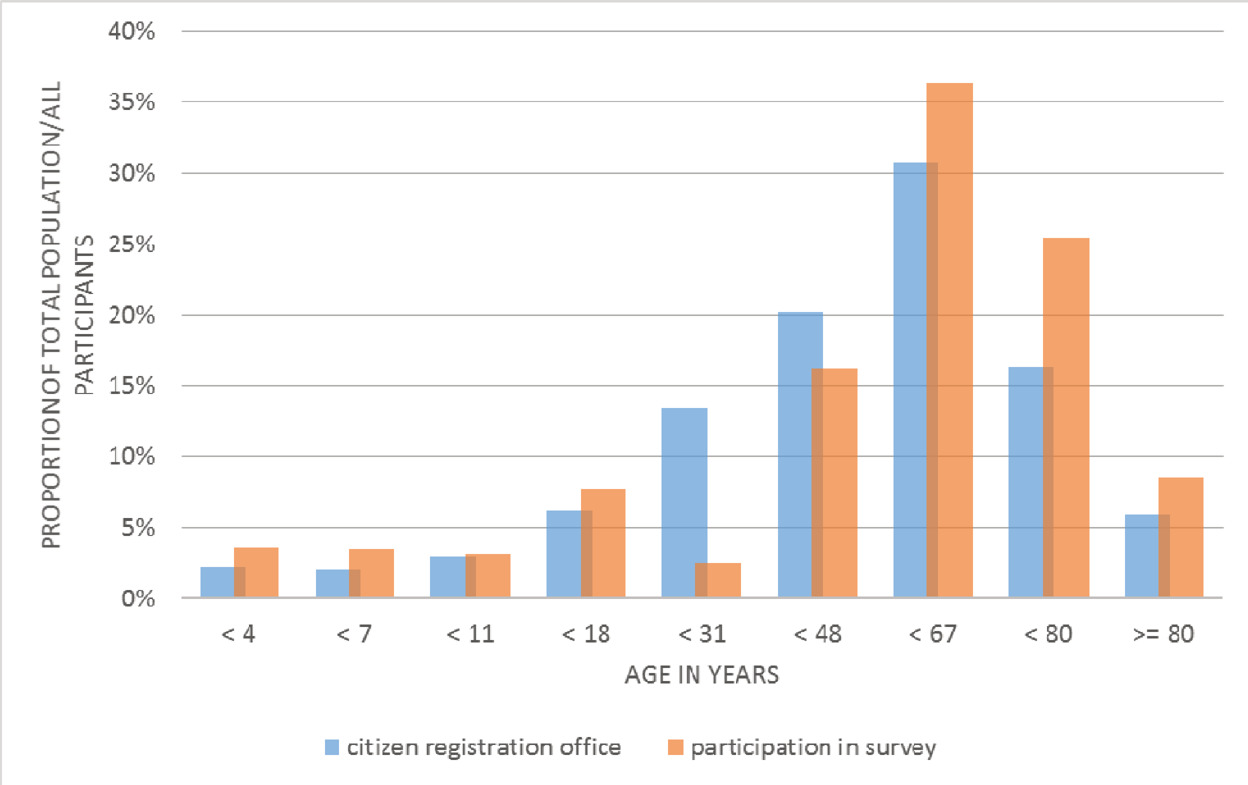

Fig. 3: Participation in the questionnaire-based survey by age groups compared to the actual age group distribution as derived from citizen registration office data.

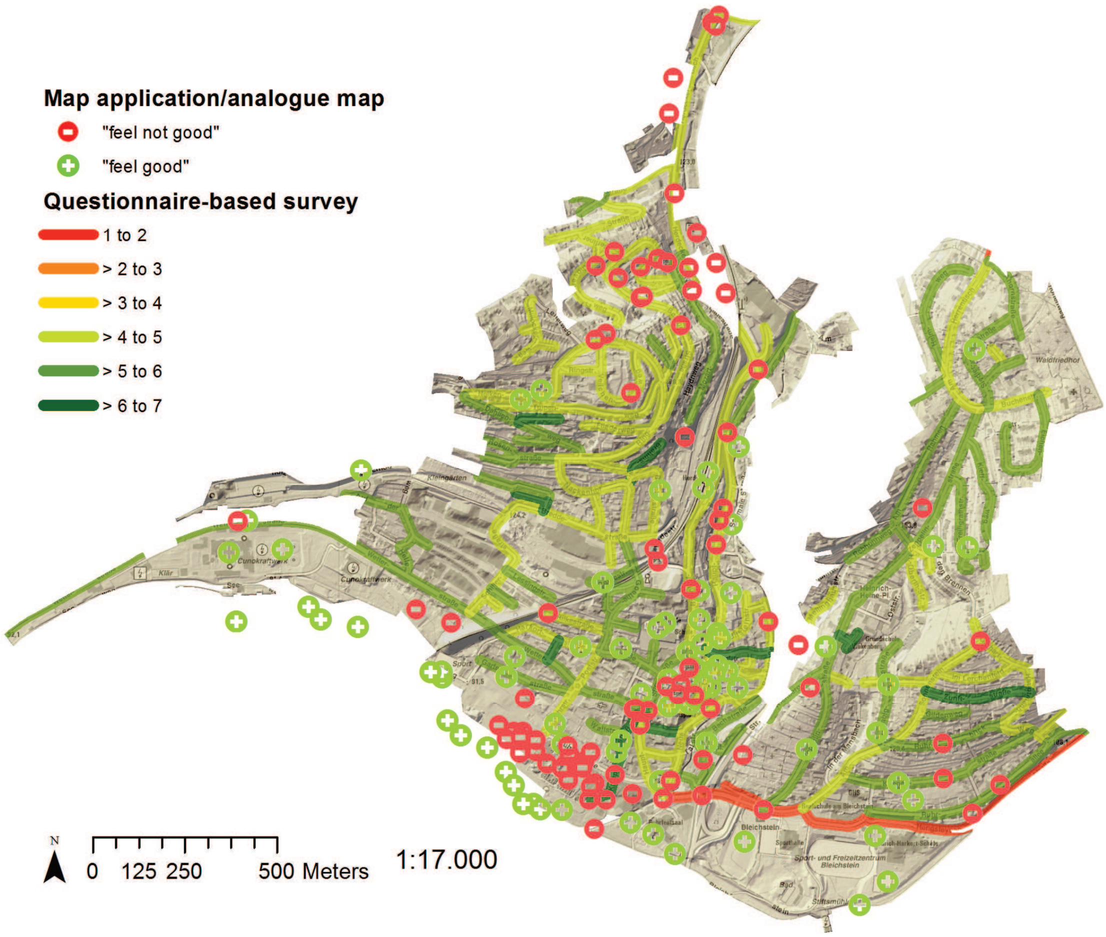

Fig. 4: Spatial attractiveness and "Wohlfühlfaktor" in the city centre of Herdecke as it was evaluated by the online and offline map applications, the analogue map and the questionnaire-based survey, respectively. For the latter, the medians on a Likert-scale from 1 (not attractive) to 7 (attractive) are shown per street (base map: WMS by Geobasis NRW).

4.2 Spatial attractiveness in the study area

As can be seen in Fig. 4, the spatial attractiveness of the city center of Herdecke as evaluated by the questionnaire-based survey (shown as lines) can be assessed as overall positive (median = 5, on a 1 = negative, to 7 = positive scale). The inner city center and eastern parts of the city were evaluated as particularly attractive by the respective households. In contrast, one street in the south-eastern part of town which was often associated with noise from a nearby motorway received low and medium ratings by the inhabitants, just like northern parts of the city center which were often associated with lower social status and where recently a supermarket was closed.

In the map applications and the analogue map surveys (shown as points) the citizens of Herdecke were asked to evaluate places in the city rather than the own places of residence. Similar to the questionnaire-based survey, the inner and eastern parts of the city center were often rated as attractive while the described noise-stressed areas in the south-eastern parts and the northern parts of the city center were often perceived as not attractive. In addition, these surveys revealed that the river Ruhr which borders the city center to the south was frequently evaluated as attractive while participants would often state that they would not feel good near big construction sites which can be found on the riverside in the south of the city center and near the inner city.

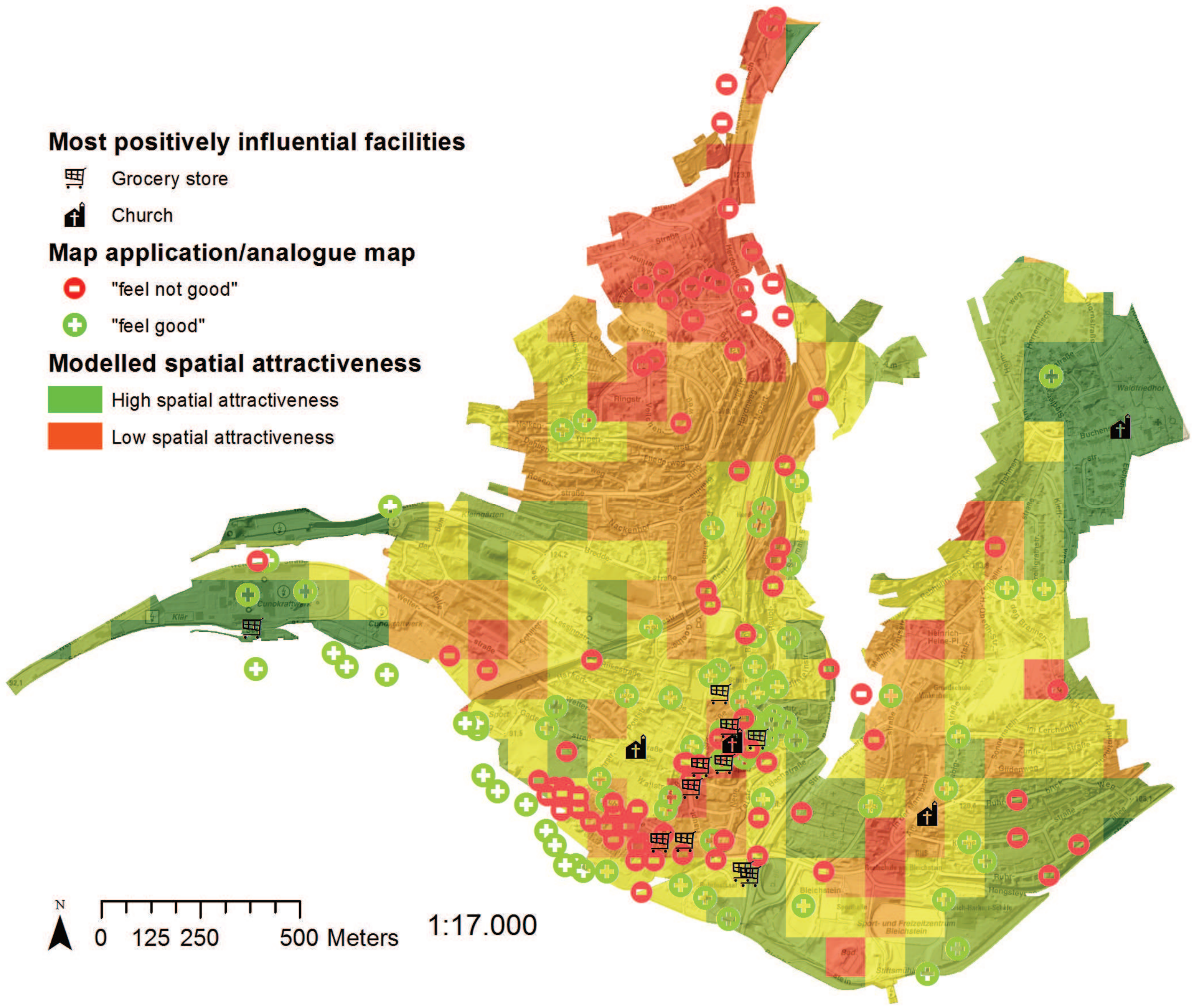

Fig. 5: Spatial attractiveness in the city centre of Herdecke as it was modelled by multi-variate spatial autoregressive analysis (SAR) considering network accessibilities of facilities as independent variables (sample size = 115, $F \approx 8.77$, $p < 0.001$, $R^2 \approx 0.33$, adjusted $R^2 \approx 0.29$, $\lambda \approx -0.63$, Likelihood ratio ≈ 2.46, p (LLH-test) ≈ 0.12; base map: WMS by Geobasis NRW).

5 USE-CASE: SPATIAL ATTRACTIVENESS AND ACCESSIBILITY OF FACILITIES

Data obtained with the offline version of the map application (section 3.4) and the analogue map (section 3.5) were integrated into the online dataset which was fed by the web map application (section 3.3). This integrated online dataset could be accessed in real-time. To demonstrate a use-case for this data source, the participation data was analyzed in combination with additional data sources, namely OpenStreetMap data and municipal data on facilities providing basic goods and services. For this purpose, an analysis grid with a cell size of 100 x 100 meters was defined and participation data were aggregated to this analysis grid. Using the Network Analyst extension for ArcGIS 10.2, the walking distance on roads and paths to the next respective facility, including stations of public transportation, was calculated for each grid cell midpoint. In a multi-variate spatial autoregressive analysis (SAR), the dependency of spatial attractiveness on the accessibility of facilities was investigated in R 3.2.1. As this dependency might decrease logarithmically with increasing distance, the logarithmic values of each walking distance was used as independent variables. Furthermore, only variables were used which showed no significant multi-collinearity (VIF value < 10).

This analysis provided a numeric description of spatial attractiveness as a function of walking distance to facilities. The R^2 value for this model was approximately 0.33 and the adjusted R^2 value was ca. 0.29, respectively (sample size = 115, $F \approx 8.77$, $p < 0.001$). The model did not show significant spatial autocorrelation ($\lambda \approx -0.63$, Likelihood ratio ≈ 2.46, $p \approx 0.12$) or heteroscedasticity (Breusch-Pagan-test: $BP \approx 7.57$, $p \approx 0.27$). With a cross-validation value of approximately 0.17 the model can be evaluated as satisfactory stable.

As can be seen in Fig. 5, the derived regression equation could be used to extrapolate spatial attractiveness values to the whole study area. For this purpose, walking distances were multiplied according to the respective coefficients as they were given by the regression equation. For the study area, the facilities with the highest coefficients, thus the most positive influence on spatial attractiveness, were grocery stores and churches (~ 0.14 for both facilities).

6 DISCUSSION

The questionnaire-based survey provided local decision makers with a broad picture of citizens' demands on the street-level. In addition, the map applications and analogue map surveys shifted the study focus to a broader thematical and spatial scope, increased the spatial resolution and added some factors to the drawn picture, for instance to influences of the bordering river and that of bigger construction sites.

In this meta-study we assessed the advantages and disadvantages of four methods for citizen participation within the scope of the smart city approach (summarized in Table 1). In order to analyze the data obtained from the questionnaire-based survey, about 2000 questionnaires comprising 33 multiple choice, Likert-scale and hand written free-text answers of varying length had to be digitized, categorized, organized and georeferenced. This added up to a considerable task which was tackled over a time period of several months. The results constitute a broad data source for local decision makers on the citizens' demands on the street- or at least district-level. However, pre and post processing expenses do not allow for frequent repetitions of this survey or even real-time data acquisition and the interoperability with other data sources within the scope of the smart city approach is limited. As far as total population is concerned, the overall representativity of this survey of approximately 15.4 % of all households can be evaluated as high. The same holds true for the representativity on the spatial scale regarding participation per city district and also street level. Obtaining data on the address level might raise privacy issues and decrease the willingness to participate in the survey. Age groups were not represented in accordance with the actual demographic distribution. Furthermore, as the questionnaire was in German, it can be assumed that no non-German speaking citizen was considered in this survey. As no additional demographic information were given in the questionnaires, assertions about the representation of other demographic groups could not be made.

In contrast to the questionnaire, the spatial resolution and focus in the web map application, its offline version and the analogue map was shifted from the "Wohlfühlfaktor" as assessed by households to an evaluation of the spatial attractiveness of specific places in the city. Furthermore, the experimental design of only three purposeful stated questions was set out for a very short participation time period which would eventually increase the response and willingness of participants at the cost of level of detail of the obtained data. Accordingly, 266 points in space were evaluated in approximately six hours of which 168 points were obtained by the web map application, 75 by the offline map application and 23 by the analogue map. In addition, data pre and post processing expenses were low for the offline map application and even more straightforward for the web map application. This allows for frequent repetition and therefore a high spatial resolution of the data obtained by the offline map application and even real-time data acquisition by the web

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map application. Moreover, the latter provides high interoperability with other data sources and re-use for advanced geospatial analysis as was demonstrated in section 5. In contrast to this, post processing expenses for the analogue map method are high as each data point has to be digitized and integrated manually into databases in order to be further analyzed. Nevertheless, this method of directly drawing on a printed map was very well perceived by the participants due to its non-technocratic, intuitive and straightforward nature. Especially senior citizens took up on this opportunity of expressing themselves who might be not as familiar with touchscreen devices as younger participants. Therefore, the analogue map constitutes a reasonable supplement to the digital survey methods, especially the web map application. In contrast, the offline map application required some GIS experience for a proper use and was not touch-optimized. Additionally, due to its poor data interoperability, the suitability of the offline map application within the smart city approach has to be evaluated as low.

	(a) Questionnaire-based survey	**(b) Web map application**	**(c) Offline map application**	**(d) Analogue map**
Assessed parameter	“Wohlfühlfaktor” in the context of living comfort for senior citizens	Spatial attractiveness	Spatial attractiveness	Spatial attractiveness
Spatial resolution	District- and street-level	Points in space	Points in space	Points in space
Sample object	Households	Places as points	Places as points	Places as points
Sample size	2060	168	75	23
Overall participation rate	~ 15.3 %	not applicable	not applicable	not applicable
Time required for participation	Very long	Very short	Short	Very short
Privacy issues	High (for very high spatial resolutions, such as addresses)	Low	Low	Low
Willingness of participants	Low	High (in face-to-face contact)	High (in face-to-face contact)	High (in face-to-face contact)
Spatial representativity	Very high	Assumed to be high	Assumed to be high	Assumed to be high
Target group representativity	Low / Assumed to be low	Assumed to be high (in combination with d)	Assumed to be high (in combination with d)	Assumed to be high (in combination with b or c)
Pre and post processing expense	Very high	Very low	Low	High
Data interoperability/ re-use	Low	Very high	Low	Low
Applicability for frequent repetition	Very low	Very high (real-time)	High	Low
Level of detail of obtained data	Very high	Low (but purposeful)	Low (but purposeful)	Low (but purposeful)
Overall suitability within the smart city approach	Low	Very high	Low	Medium (in combination with b)

Table 1: Comparison of the four assessed methods for citizen participation within the scope of the smart city approach. Green (red) backgrounds indicate high (low) suitability within a smart city.

Combining the collected data with additional data sources for geospatial analysis resulted in a statistical model which numerically describes spatial attractiveness as a function of walking distances to local facilities.

This model can be used to extrapolate the collected data on spatial attractiveness to larger areas, identify most influential facilities and assess consequences for future planning, such as the establishment or closure of a specific facility at a given location. This constitutes an example as to how the presented methods can be integrated in all three layers of a smart city according to Su et al. (2011), i.e. the perception layer (detecting spatial attractiveness as it is perceived by citizens), the network layer (providing the collected data online and in real-time) and the application layer (analyzing the data in combination with other big data sources). The moderate exploratory power of the model (adjusted $R^2 \approx 0.29$) might be due to the fact that solely walking distances to facilities and no additional aspects were considered to be influential on spatial attractiveness. For instance, the demographic structure, housing prices and psycho-socially aspects should be included in future analyses.

7 CONCLUSION

The questionnaire-based survey provided a broad data source with in-depth information on the demands of citizens on the district and street-level. Nevertheless, it might not be considered suitable for the smart city approach as data post processing, lacking interoperability and data re-use do not allow for a frequent repetition of this survey or, still less, real-time data acquisition. The offline map application in ArcGIS 10.2 for Desktop required some GIS experience for proper use which could have negative effects on the representativity, especially when no face-to-face communication with citizens takes place during the survey. Therefore, it might only be regarded as an emergency solution for citizen participation projects, if no internet connection can be established.

Within the scope of the smart city approach, applying web map applications in combination with analogue mapping methods can be recommended for engaging citizens to participate in urban planning. Promoting these methods in face-to-face communication with citizens proofed to be particularly beneficial as this allowed citizens to express themselves ingenuously, created a considerable deal of attention to the project and presumably increased the representativity of the collect data as interviewers were able to actively reach out to different target groups. In accordance with the smart city approach, these methods can enforce the feeling of ownership by the citizens, increase the evidence-base for local planning and greatly contribute to its transparency and acceptance (Mayer-Schönberger & Cukier, 2013; Kitchin, 2014). Furthermore, we demonstrated how the collected participation data can be merged with other data sources for geospatial analysis in a novel way which might lead to new insights for increasing urban planning efficiency.

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Smart Sustainable E-Solutions for Implementation and Enforcement of Smart Cities in India

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1 ABSTRACT

In the present knowledge and information age Indian towns and cities are expanding rapidly in spatial and demographic terms. Moreover, spatial information are not correlated with the complex urban integrated problems, as data generated at various level for urban planning and management remains uncoordinated and redundant to support decision-making and leading to poor urban governance and timely implementation of the master plan. Hence, there is an urgent need to create common platform so as to address problems and issues in the right perspective to assist cities in coping with economic realities and, thereby, produce high quality responsive environment and demonstrate successful urban solutions. Thus, in order to address these issues in a holistic manner, the Ministry of Urban Development has launched the Smart City Mission for 100 cities on 25th June, 2015. However, due to the absent of any basic “Smart E-Solutions Model” for implementation and enforcement of sustainable development plan in India, the present paper is an attempt to evolve the concept of “Smart E-Solutions Model”.

At first the present paper discusses about the smart sustainable solutions at design level. Thereafter, the paper evolves a “Smart E-Solutions Model” to establish intelligent online system for implementation and enforcement of sustainable development plan design. Hence, to define the success of Smart City Scheme in India, the present paper pursing a vision of sustainable smart cities by exploring the possibilities of different innovative solutions through designing of Smart Comprehensive Development Plan (SCDP) through virtual world.

GIS based SCDP will facilitate the cities to compete in the global competitive world. In India designing SCDP will act as E-solution tool to ease out new challenges and opportunities for urban planners and managers to design the various dreams, ideas and hopes of urban community and translate the same into the spatial terms. In all this paper will thread common ground to address problems and issues in the right perspective to assist urban planner, manager in coping with economic realities and, thereby, produce high quality responsive environment and demonstrate successful sustainable urban solutions for implementation of Smart Comprehensive Developemnt Plan through “Smart E-Solutions Model“.

Keywords: E-Solutions, Smart Cities, Smart Enforcement, Smart Implementation, Sustainable Development

2 INTRODUCTION

When the world is gearing up for transforming the urban community to a smart and sustainable community, India is also committed to transform cities for better responsive quality of life through the application of Information and Communication Technologies (ICTs). With the establishment of the Urban and Regional Information System Department in Town and Country Planning Organisation, New Delhi, during the 1980s, India has never look back on involving ICTs for Planning and designing of Indian cities and towns. The computation technologies became an integral part of the urban and regional planning and data management system. However, during the last ten years, dramatic changes have been manifested by Indian planners and urban managers with the development and launching of the National Urban information system scheme in India by the Town and Country Planning Organisation under the Ministry of Urban Development. Moreover, during the mid 1990s, the department of Space has set up by the National Natural Resources Management System with the basic objective to utilise natural resources in a sustainable manner and protect the environment. Hence, the fusion of ICT and sustainable development of cities and towns were already in the thinking process towards effective decision making for smart urban and regional planning in India.

In the present knowledge and information age Indian towns and cities are expanding rapidly in spatial and demographic terms. Moreover, spatial information is not correlated with complex urban integrated problems, as data generated at various levels for urban planning and management remains uncoordinated and redundant to support decision-making and leading to poor urban governance and untimely implementation of the master plan. Hence, there is an urgent need to create a common platform so as to address problems and issues in the right perspective to assist cities in coping with economic realities and, thereby, producing high quality responsive environments and demonstrate successful urban solutions. Thus, in order to address these issues in a holistic manner, the Ministry of Urban Development has launched the Smart City Mission for 100 cities on 25th June, 2015. However, due to the absence of any basic "Smart E-Solutions Model" for the implementation and enforcement of sustainable development plans in India, the present paper is an attempt to evolve the concept of "Smart E-Solutions Model" for Rourkela City of Odisha State in India.

In the present cyber era, the development of Web 2.0 technologies; customised and entrepreneur GIS; computer animations; and 3D cadastral information, dramatically changing the prevalent syntax and semantics of the urban and regional planning process. At the same time, a whole gamut of rapid development in network technologies; establishment of GIS labs at 153 towns and cities through NUIS Scheme; development of space technologies; disseminating knowledge by some of the high-profile websites like YouTube, MySpace, Google, Flickr, Facebook, Twitter, created a conducive environment to harness the virtual world technologies to design and find solution for complex urban problems in a smart way. Thus, smart cities are not only about application of ICTs for E-governance but should be open to multiple perspectives on smartness of Urban and Regional Planning. Hence, the present scheme of the Government of India to develop hundred smart cities is associated with innovativeness, knowledge, creativity, openness and inclusiveness (Careyannis and Campbell, 2010). In this context Rourkela Smart E-Solution Model will support the building of a responsive, intelligent sustainable city.

3 BACKGROUND OF ROURKELA CITY

Rourkela is an important commercial centre of Odisha State. In fact, the Rourkela Steel Plant (RSP), a unit of SAIL makes Rourkela one of the largest steel manufacturing towns in India. There are many small scale industries in Rourkela catering for the needs of RSP and other large industrial units. The literary meaning of 'Rourkela' according to the language of 'Sadri' is "Your Home". Moreover, the tribal community called 'Raulia' has been living in the village since times immemorial. The erstwhile revenue village of Rourkela is now popularly known as old Rourkela. The Rourkela Development Planning Area comprises Rourkela Steel Plant, Steel Township, Civil Township and 52 villages. The total planning area stretches over an area of 259.18 sq. km. with a total population of 2.59 Lakh (Census, 2001).

The Rourkela Development Authority (RDA) is looking after the execution of town planning schemes and also after development control aspects of the Rourkela Planning Area. As such two functionaries i.e. RDA and Rourkela Municipality under the administrative control of the Government are responsible for the overall Development of Rourkela Planning Area. The total Rourkela Development Planning Area covers 104 Mouzas out of which 52 units/ Mouzas in Rourkela Steel and civil township and 52 Mouzas in the surrounding. The area extends over 259.18 Sq Km of which the Civil Township area is 22.73 Sq. Km. constituting 8.76 % of the Steel Township area of 20.98 Sq. Km, while the rural area of 183.49 Sq. Km. is constituting 71 % of the total Planning Area for Rourkela. Reserve forests lie on the north and south of the Planning area and comprise of 11.37 Sq. Km, constituting 4.39 % of the total Planning Area.

The Rourkela Planning area is located at 22o – 12' N Latitude and 84o – 54' East Longitude. Most of the northern boundary is formed by the Koel River flowing from the east and meeting with the west flowing Sankh River just at the north-west corner of Rourkela Steel Township, flowing down southward as Brahmani River and dividing the Planning Area into three parts. The Brahmani River takes its course southwards through the region which borders the South-West, the Saranda forest in the South and vast agricultural land in the East.

The industrial potential of Rourkela town led to a sudden spurt of population increase after the establishment of the Steel Plant. The population of the Civil Township was less than 4000 persons in 1951 but by the year 1961 the population had increased to 35,000 persons. Since then the population has increased to 2,59,553 persons in 2001. This registers an annual growth rate of 16.04 % which is more than the urban population increase in Odosha State. If compared with the growth rate of population during the last decade Rourkela registered 69.99% of growth rate where as growth rate of the urban population in the State is 30.28 % for the same period. The main factor responsible for growth of the town is the availability of employment opportunity which benefits the agglomeration economics and makes Rourkela an economically vibrant town and attracts people from the hinterland.

4 CONCEPT OF 'SMART E-SOLUTION MODEL' FOR ROURKELA CITY

Apart from sustainable design of Rourkela there is a need to establish Smart E-governance with the help of emerging Information and Communication Technologies (ICTs). Smart E-Governance will not only improve service delivery but add efficacy to the function of the Rourkela Development Authority (RDA). However, successful implementation of 'Smart E- Governance Model' for RDA will put forth the new frontiers for multiple challenges on the role of leadership, process alignment, availability of right skills; designing, planning and enforcing sustainable land-uses; establishing a high end, state of art computer lab; and a participative responsive local community. Rourkela is facing ever more complex urban problems as regards competitiveness of the international business community and is well aware of the reactions of the tribal community which poses a challenge to making a success of the application of smart and sophisticated technologies in social terms.

As Rourkela is embedded in a tribal community, just to provide a simple and understandable "Smart E-governance Model" will not serve the purpose of socialising the Rourkela urban community, because, social boundaries go beyond the smart Physical Planning and Web 2.0 technologies E-Solutions. Hence, for RDA, as the planning and governance process is evolving around the social uncertain environment, a "Smart E-Solution Model" needs to be framed through collective intelligence, social intelligences and wisdom of local urban community.

Thus, with the help of crowd wisdom, a collective intelligence system will be evolved through Web2.0 technologies and RDA Planning participative E-Solutions Platforms. The interactive applications are also required to be framed for implementation and enforcement of RDA Planning services and government process to generate E-solutions. The adapted Smart E-Solutions Model will be presented to both Rourkela communities (Industrial and Tribal communities) by smart service delivering; smart traffic management system, smart planning process, smart approval by government authorities and smart peoples participation.

The Smart E-Solution Model (SEM) for Rourkela has been conceptualised by three elements, first, innovative technological solutions (both hard and soft), secondly, local community (leadership, responsive, intelligent and creative thoughts) and thirdly government (policy, rules, governance, political will). In a way SEM will transform the smart city approach from only application of ICT to urban planning (Anttiroiko 2012) to integrating s social system which enables society to create, solve, built, use, transform, need, secure, etc the smart city. Hence, the smart E-solution Model is framed by integrating physical planning design with the influence of the local community over a digital platform (Figure 1).

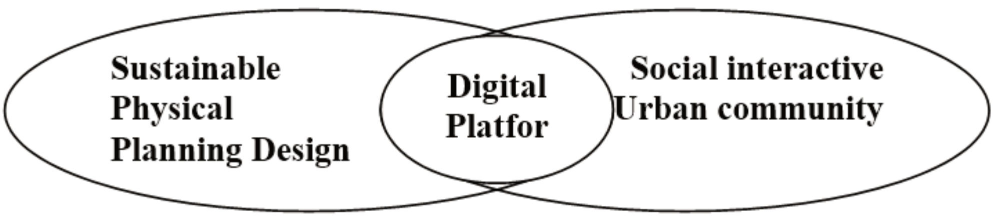

Fig. 1: Smart E-solution Model

Moreover, a Digital platform is required to be built at RDA to act as a Rourkela City System for the entire city, complemented by the sub-system which will be part of wider systemic whole. Rourkela City System will be based on the input-output model for measurement of sustainable development and quality of life. These sub-systems will consist of a smart transportation system, smart E-governance, smart ecological system, smart water management system, smart infrastructure system, smart community system, smart power management system, smart finance system, smart social development, smart economic development, smart environmental development system, smart creative community development system, smart housing system, etc. In the subsequent years after installation of the Smart E-solution system the success can be measured and will be able to transform itself, repair itself, and redesign the base of collective intelligence through the acting players.

The spatial planning designing concept of the Comprehensive Development Plan (CDP) of Rourkela is reflected in three interlinked layers. First, the Knowledge Core layer at the confluence of the Sankh and Koel Rivers and emergence of the Brahmani River where the Vaid Vayas Temple for spirituality is also located, Vedanta university for knowledge, Rourkela Airport for connecting with the outside world and dense forests and ecological reserves. Second, the Resting Middle layer for providing social space and residential and recreational land-uses. This middle layer connects the third Working Periphery layer. The working periphery will be designated for the growth of the economy, industrial boost or working areas. Thus outward movement of traffic will lead to economic growth and inward movement of traffic will lead to enhancement of social connectivity and inner peace (Figure 2).

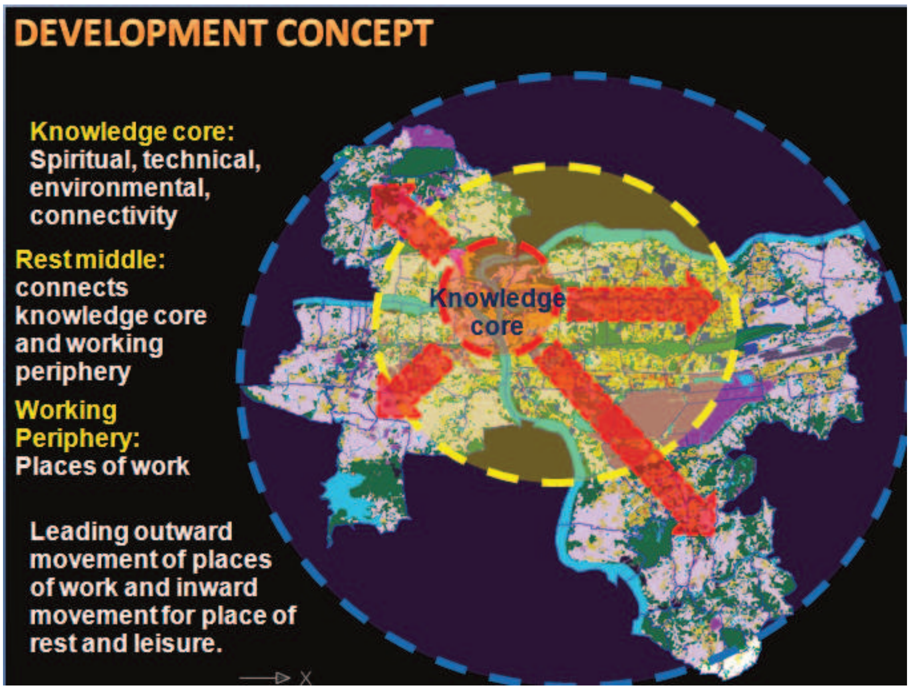

Fig. 2: Sustainable Development concept of Roukela City

Hence, during the physical planning design of CDP of Rourkela the centre of the townwill provide a social and knowledge sharing space for local community participation and inclusions and to react to the digitally created platforms. As in the Smart E-Solution Model, community participation takes the central role for governance and urban planning. Thus a crowd-sourcing model will take centre place in the Smart E-Solution Model and wisdom of crowds will create effective solutions do that the government can take a collective decision.

5 SUPPORTIVE TECHNOLOGIES FOR THE SMART E-SOLUTION MODEL

In order to disseminate information over the digital platforms Web 2.0 technologies provide limitless possibilities for social inclusion of the local community for making urban planning and design sustainable cites. Web 2.0 technologies are participatory web applications in which one can participate and where people can create their own content and communicate over map, sketch, picture with the local and worldwide governance system , irrespective of language difference. Infect Web 2.0 is a powerful tools for planners to communicate with the local community and vice-versa. Social networking sites, Google map Mashups, blogs, YouTube, are some of the effective example of Web 2.0 technologies.

Moreover, Web 2.0 technologies are also providing transparency to the governance system through interoperability of the urban planning. Transparent government system is the essential need for social inclusion and local community involvement in the planning process. In recent years, Central and State Governments are making extensive investments for E- governance and urban planning. One example is Haryana Urban Development Authorities E-governance project, eHUDA project. The main role of the project is to have automated functioning of various departments of HUDA. This will provide a quality services to the urban community of Haryana State and also make HUDA planning process transparent to local community. With the help of Web 2.0 technologies HUDA has created a Plot and Property

Management (PPM) system. Another example is 'Automated Building Plan Approval System' by Indore Municipal Corporation. It was envisaged to facilitate quick processing and disposal of pending building plan permissions, automation of the drawing scrutiny, standardisation of building fee and other changes for effective monitoring of the process. Local communities today are aware of their rights and expect efficiency, accountability and transparency in all areas which affect them.

Basic importance of the Web 2.0 technologies is that, all unconventional data, irrespective of its source, which have geo-located information, can be used for planning purposes. Thus, the use of this unconventional data to translate into planning solutions will define the Smart E-Solution Model for Rourkela or any other city. For example, data available on road side camera for traffic management will provide many important data if fixed with the Urban planning portal, banking transaction system, smart phone video recording and uploading on social networking sites, controlling social behaviour or traffic movement on roads through FM Radio, GPS installed on taxi and many innovative data mining techniques will measure the smartness for defining Smart Urban planning.

6 CROWDSOURCING WEB 2.0 TECHNOLOGIES FOR SMART E-SOLUTIONS MODEL

Smart E-Solutions Model will be using Crowdsourcing Web 2.0 platform at all stages of the planning process. Crowdsourcing will lead to the collective intelligence and, thereafter, creating web based solutions to complex urban problems. In the sequence to the Model,

(a) Identification of the problems: local community will communicate the problems over digital format and give the responsibility to disseminate the knowledge for different perspective of problems.

(b) Defining Goal: Creating a collective response over defining a goal and recording local community ideas to translate into the future design of the city by solving the problems and giving direction to the city development.

(c) Collection of Data: the process of collection of data first compounded through unconventional sources through identification of the Intelligent Crowdsourcing and creating crowdsoucing information platforms. Mobile and internet alert applications software should be put in place for reporting and collection of data.

(d) Analysis of data: Collective resources information generated by the Crowdsourcing information platforms should be connected with the different analysing computer models and translating the results for crowd computing. Local community should be mobilized to analyse the solutions of the problems and concluding the solutions over technical controlled but transparent platform.

(e) Designing solutions: Crowdsourcing should be encouraged to create designing solutions over online mapping and defining the content of the plan for creation of virtual plan.

(f) Implementation of the plan: Implementing virtual plan over real space will give pride and social satisfaction to the local community and even come forward with innovative idea for fund raising.

(g) Monitoring of the plan: Crowdsourcing Monitoring platform will provide easy access to the monitoring information and recording online efficiency of the concerned agencies.

(h) Evaluating of the plan: Evaluating Performa in relation with the plan should be displayed on the Authority web site for public reaction to the plan.

Overall designing a Smart E-Solution Model for Urban and Regional planning will reduce planners' dependency on time and space and over a period of time will transform the traditional planning process over virtual planning process for defining Smart Sustainable solutions for participatory, transparent Urban Planning.

7 CONCLUSION

Moreover, it is evident that Smart Rourkela City will not only use the application of ICT for the planning process but also reflect smartness for planning and design of Rourkela city. Thus, smart Rourkela Planning and designing approach is not only ICT oriented but also gives evidence to innovative ideas for the collection of data or information; people participation; knowledge base; creative economy; inclusiveness; and transparency. At first the present paper discusses smart sustainable solutions at design level. Thereafter, the paper evolves a "Smart E-Solutions Model" to conceptually frame an intelligent online system for the implementation and enforcement of sustainable development plan design. Hence, to define the success of

Smart City Scheme in India, the present paper is pursing a vision of sustainable smart cities by exploring the possibilities of different innovative solutions through designing a Smart Comprehensive Development Plan (SCDP) through the virtual world.

GIS based SCDP will facilitate the cities to compete in the global competitive world. In India designing SCDP will act as an E-solution tool to ease new challenges and opportunities for urban planners and managers to design the various dreams, ideas and hopes of urban communities and translate them into the spatial terms. In all this paper will thread common ground to address problems and issues in the right perspective to assist urban planner, manager in coping with economic realities and, thereby, produce high quality responsive environment and demonstrate successful sustainable urban solutions for implementation of Smart Comprehensive Development Plan through "Smart E-Solutions Model".

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Smart Urban Simulation Tools for Planning Decision Support Need Smart Data and Smart Data Gathering Methods

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1 ABSTRACT

Urban growth is a challenge for most cities all over the world, especially in less developed countries. This tendency is calling for for smart/innovative instruments to foster sustainable urban development. Decision support for urban planning is required in order to reduce costs and resources to better accommodate new population, willing to move into urban areas. Latin American countries e.g. went from being predominantly rural to predominantly urban within a few decades, leading to high concentrations of urban population. This urban growth is expected to continue leading to severe financial stress for city budgets in order to provide the required infrastructure. AIT - Austrian Institute of Technology has been contracted by the Inter-American Development Bank (IDB) to develop a smart "Urban Infrastructure Development Simulator" (UIDS) – a tool able to performe urban growth simulation and related infrastructure cost estimations, which can be used to support urban planning decisions. In order to enable the cities to make their decisions an Agent-based simulation model has been developed representing the urban growth by estimating dwelling behaviour of the cities' current residents and future residents coming from urban regions outside the city. The urban growth simulation tool is based on input data of different spatial and temporal resolution. Data from Geographical Information Systems (GIS), remote sensing data as well as statistical data are used to simulate scenarios for future development paths. To support the urban planning process such kind of tools need to have great flexibility concerning their data management, e.g. in providing different possibilities to import new (e.g. more accurate) data to calculate new scenarios. Beyond this common need, questions arise like: What happens if the data is not or only partially available and how might a data gathering process be supported by new tools and methods? This paper will introduce different innovative ways how urban planners might be supported to gain new data, which can be used in tools like the UIDS. The developed approaches enable urban planners to easily introduce important tacit knowledge about their city into the simulation tool. Additionally, a method will be depicted how citizens can be enabled to participate in the collection of such data. The paper will further elaborate on challenges the UIDS team encountered and on solutions to overcome these problems using data of different temporal and spatial resolution. The results depicted in this paper are based on experience gathered whithin several urban growth simulation projects performed for different regions in Europe and Latin America.

Keywords: Agent-based Simulation, Decision support tool, Smart Data, Urban Growth Simulation, Urban planning

2 INTRODUCTION

Urban areas can be seen as innovation ecosystems wherein solutions are created or deployed to accelerate the most often aimed transition to a more sustainable, resource efficient urban system. Citizens in this ecosystems can be pro-active catalyzers of innovation, shaping cities as actors of change.

Decision support systems, such as the one presented in this paper, are built to facilitate urban design processes. They may aim at providing the local government with knowledge about citizens' preferences in order to consider and/or include those preferences in the decision-making process for urban development plans. Preferences of, e.g., where to live or move within the city, can be visualized with scenario simulations using Agent-based modelling (ABM).

It is not enough, though, to build smart decission support tools, which are in principle able to facilitate the decisison whithout appropriate data to feed them. Over the last few years our experienc in this context has shown that it is not an easy task to define what kind of data should be used. One important challenge in this kind of simulation is how to gather citizens' preferences which can be used to retrieve the behavioral rules required for ABMs. There are different ways how this can be achieved: One way is extracting information through static data analysis. The downfall of this strategy is that data is often either not available in the required resolution/detail or not available at all and if information is available it might be outdated and therefore not useable. This paper will discuss the benefits of a different, smarter approach of gathering data, i.e. a participatory data gathering procedure.

The improvements in data analyses and data collection methods have been tremendous during the last few decades, nevertheless, especially in the context of analysing past trends, this new and often called smarter data is by no means per definition smarter. The focus of this paper lies in procedures that use remote sensing methods to gather new data. Today, these methods can record data in a spatial resolution of 1 to 1,000 m² cell sizes, but does a higher resolution always produce better information and how can a higher resolution be upscaled, if necessary? These are questions which will –at least briefly- be discussed in the following.

3 SMART URBAN SIMULATION TOOLS

URBANICA, formerly called Urban develoment and infrastructure cost calculator (UIDS), is a decision support tool based on several years of experience in urban growth simulation. It is currently under further development for the Inter-American Development Bank (IADB). The development of URBANICA started in 2014. Since then several different versions (prototypes) have been developed (Gebetsroither-Geringer and Loibl, 2014; Gebetsroither-Geringer and Loibl, 2015). But the question is: What makes a tool like URBANICA smart? In our perspective there are a few main characteristics a smart tool has to consider:

(i) Smart tools need to find a balance between all the features they can/need to provide and the necessary amount of time users need to get results from the tool. This challenge can be tackled by software development in close cooperation with the end user as well as creating different versions of the tool, i.e. to make a simpler version for standard users and an expert version for advanced users.

(ii) Another characteristic is to be flexible in the kind of data which can be fed into the tool or in the formats the results can be exported to. In the case of URBANICA, GeoTiffs, ESRI Shapefiles, KMZ files (Google Earth overlays), images (Portable Network Graphics (PNGs)) and CSV files are the most valuable ones.

(iii) A third characteristic is to be fast it creating results. Experince showed that users do not want to wait too long to see the results of their proposed urban planning decisions. URBANICA e.g. can calculate standard scenarios, simulating 20 years, whithin 2-3 minutes of calculation time. Important in this context is that it is not only a question of absolute calculation time, it is also the perceived impression of the user if nothing obvious is happening and they feel bored.

(iv) A last challenge is to take into account, on the one hand, the user's wish that every aspect of the simulation can be influenced, meaning, e.g., that -at best- all parameter settings can be changed manually, but on the other hand to have one "perfect" single solution (one proper decision) at the end, which hardly is the reality. If the latter is the case, other tools are often developed as "black boxes" with no insight into the "mechanisms" of the box and if the former is the case then the users often do not know how to decide what to do since the degrees of freedom are too high. Both extremes are not perceived as smart, nevertheless these are challenges model developers can hardly overcome.

The above list of characteristics is just representing the main challenges we have been facing during the development of URBANICA, it does not contain all the needs a smart decision support tool has to fulfil. But what more is needed?

4 SMART DATA

The following section presents our experience while tackling the challenge of finding appropriate data for URBANICA for different regions within Europe and Latin America. So far, the tool has been applied for four different cities and city-regions, with different data availability/credability.

4.1 The Latest Data is not Always the Smartest Data

The origin of the following challenge is that URBANICA calculates its trends on the basis of different land cover layers of past urban developments and uses these trends to create scenarios for the future. The input data for this procedure had been available at a 30m resolution in the past, but recently an example of a 1.5m (a higher, "better", "smarter"? resolution) as input for 2013 emerged, accompanied by two layers at 30m resolution (for the years 1986 and 2001). These datasets needed to be compared with each other.

On a 30m resolution it makes sense to define classes representing high, medium and low urban development categories[1], but at 30m it can be hardly determined if a pixel really contains manmade structures or only dry or barren soil (or a combination of them). Satellites delivering such resolutions – e.g. LANDSAT[2] – just allow concluding about the spectral properties of the 30m pixel, of course depending on the wavelength range of their sensors – which in itself is -per definition- a mixed pixel of different "real" objects like trees, buildings or roads. Generally, a single, classified land cover pixel alone does not say anything about the real land cover of this pixel, so it can be hardly estimated, which exact spatial composition is responsible for an actual spectral representation. E.g. it is possible that 50% high sealed soil and 50% grassland would lead to the same spectral 30m properties as a 90% loosely built-up area.

Only in a broader context of several pixels one can decide if a particular pixel is a part of an urban area or any other kind of land cover. So pixel based classifications depend strongly on the rules for this classification, and therefore on the experience of the classifier and the actual method he uses. This on the other hand depends, of course, strongly on the type of sensor that has been used to assess the input. This is, amongst others, one of the disadvantages of a pixel based classification and today one rather uses so called feature based classification methods which allow classification schemes on a vector base. By segmenting the survey and combining pixels with similar properties one gets so called image objects, which represent different land cover types. Nevertheless, if one needs data which is comparable with historical ones, pixel based classification still makes sense, but it has to be guaranteed, that one uses comparable sensors and seasons (e.g. before or after an explicit rainy season) so that the resulting classification is really comparable to older ones. Otherwise a particular region could be classified completely different apparently showing enormous land cover changes, although in reality hardly anything has changed.

Contrary to a 30m resolution, it is clear that on a resolution of just 1.5m one gets completely different content. Such classifications cannot generally be compared to 30m resolution data. At 1.5m it does not make sense to speak about high or low urban intensity, because this pixel representation only allows for a statement whether a soil pixel has a high or low degree of sealing. It is also not possible to decide whether a special pixel is part of a forested area or of open grassland. The only statement possible is that the pixel has a high or low vegetation index, again depending on the spectral properties of the used sensor. At such a high level of detail one should perform an object based image analysis (OBIA) rather than a pixel based analysis (Blaschke, 2010)[3]. Nevertheless, such high (spatial) resolution data sets can definitely present a surplus value, but only as additional data sets allowing to identify interesting regions and to discover why -on a lower resolution- a special land cover class has been identified. This problem is quite severe if these 1.5m (high resolution) classes use the same land cover categories as the 30m ones and should be used to compare different layers to calculate changes.

Of course, one can always try to resample such a classification up to 30m. There are indeed in most GIS platforms (tools like ArcGIS[4] or QGIS[5]) default RESAMPLE operations to do this. For discrete data, such as a land cover datasets, there are two common options:

(i) The nearest (neighbour) method does not change[6] the values of the input layers. It more or less uses the value of the originally central pixel within the new lower resolution cell (i.e. in our example the 30m).

(ii) The majority method determines the new value of the cell based on the most popular values within the filter window and tends to result in a smoother representation than the nearest (neighbour) method. Both have their pros and cons, but in many cases both of them just create new problems. The following figures show why.

[1] degree of soil sealing
[2] https://en.wikipedia.org/wiki/Landsat_program, checked 17.4.2016
[3] see e.g. http://gisgeography.com/image-classification-techniques-remote-sensing/, checked 17.4.2016
[4] https://www.arcgis.com/, checked 17.4.2016
[5] http://www.qgis.org/de/site/, checked 17.4.2016
[6] "A technique for resampling raster data in which the value of each cell in an output raster is calculated using the value of the nearest cell in an input raster. Nearest neighbour assignment does not change any of the values of cells from the input layer; for this reason it is often used to resample categorical or integer data (for example, land use, soil, or forest type), or radiometric values, such as those from remotely sensed images."
http://support.esri.com/en/knowledgebase/GISDictionary/term/nearest%20neighbor%20resampling

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Figure 1 shows the original 1.5m input and the result of the nearest option. For better identification of the problems that can occur with this option, the ArcGIS base imagery and a 300m reference raster have been used, as well as three blue marked 30m cells, which have been used to analyse/depict the problems.

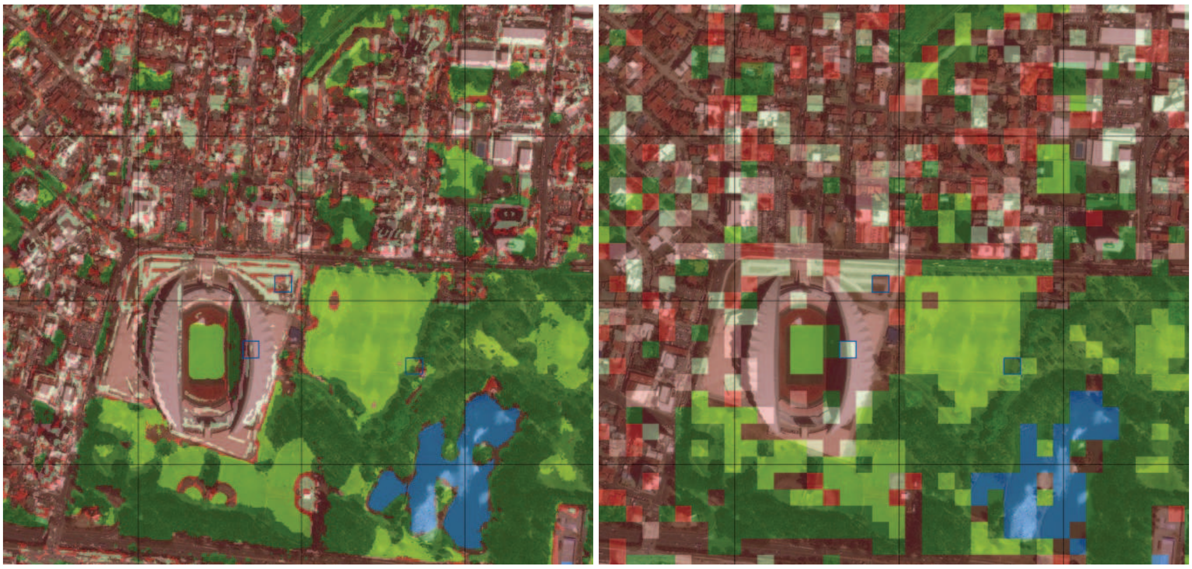

Fig. 1: Exemplary detail of a typical urban region represented by the original 1.5m land cover classification of 2013 (left) and the result of the nearest neighbour resampling to 30m (right)

Regardless of the quality of the 1.5m input the three blue marked cells (see also the white ellipses and black arrows) show very well the possible unexpected resample results using the nearest option. E.g. at the east stand of the stadium we encounter the following: After resampling, a 30m bare land cell occurs, which has not been expected when looking at the input. The reason for this is that the central 1.5m pixel within the new 30m representation is of this type. Although almost all other 1.5m pixels are of the category high density urban, the 30m cell becomes bare land because of the used resampling option. Similarly, in the park area above the legend of the map, a forested land pixel occurs, despite the majority of 1.5m grassland pixels.

With the majority option (method) shown on the left hand side in figure 2, no substantial improvement is achieved. Of course this method seems to generate a more realistic pixel representation – and that is true for this particular urban region – but in general it also intensifies the dominant class high urban density (compare table 1 further below).

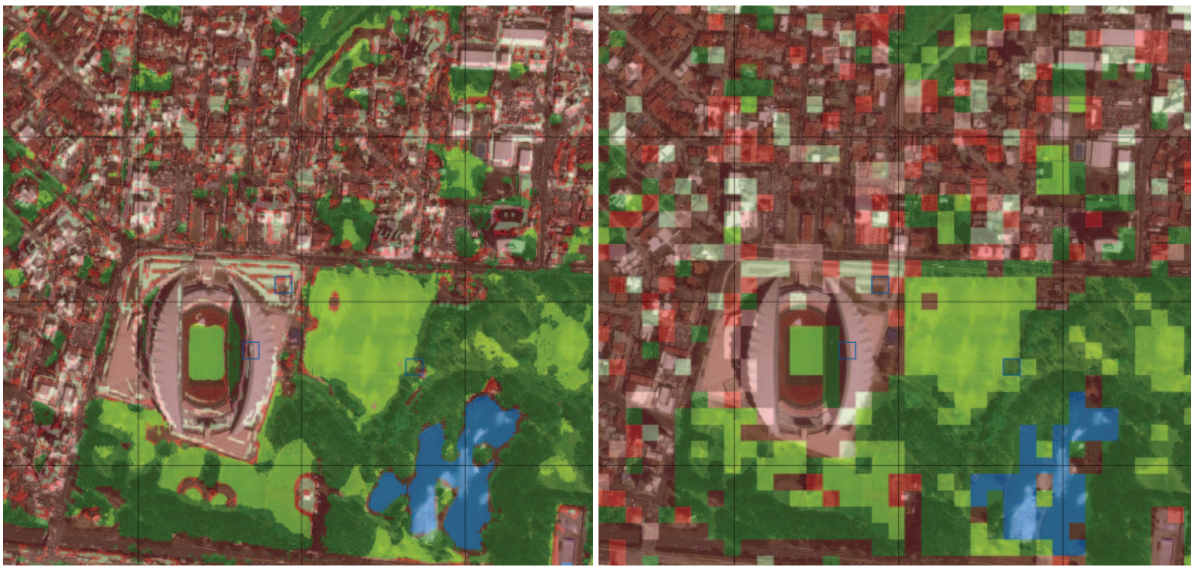

Fig. 2: Exemplary detail of a typical urban region represented by the original 1.5m land cover classification of 2013 (left) and the result of the majority resampling to 30m (right)

If the 1.5m classification uses the same land cover classes – especially for the urban density (high, medium and low) – the resampled cell will never represent a mixture of these classes. E.g. in the case of the above mentioned possible 50% high density urban and 50% grassland distribution, a 30m pixel could only be high density urban or only grassland pixel depending on the actual arrangement of the original 1.5m pixels and the resample option, but never a mixture of these classes - e.g. medium or low density urban as expected with an originally 30m classification.

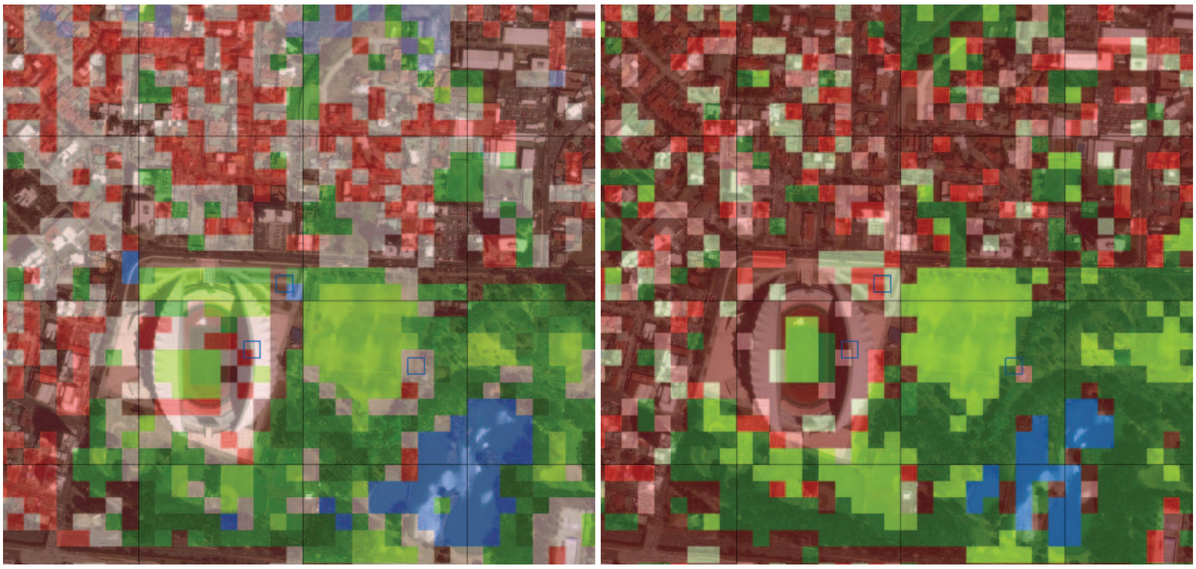

Fig. 3: Re-projected land cover 2001 (left) and resampled land cover 2013 after defining of a common processing extent

Additionally, another problem occurred that the two older land cover layers (1986 and 2001) were created using an entirely different sensor type. Since both, the original 30m data –LANDSAT –as well as the input for the land cover 2013 were not available and also no information about the classification rules and methods, it can only be speculated about the quality of the respective classifications.

We think that all of the above shows quite well that different sensors, resolutions, processing extents and projections for land cover layers should be avoided as far as possible. Otherwise these layers are not really comparable and no conclusions about accurate actual land cover changes can be made.

Thus, the 2013 land cover dataset thematically differs extremely from the two other datasets, although the used classes suggest that this would not be the case. The following table indicates this once again very clearly: While the growth of the total amount of all urban areas in the study area seems to be plausible, the distribution of the particular density classes is very unrealistic.

	study area 1986		**study area 1986**		**study area 1986**	
	hectare	% of urban	hectare	% of urban	hectare	% of urban
1 - high urban density	3558.8	16.8%	4406.0	18.5%	20379.4	78.8%
2 - medium urban density	5890.0	27.8%	6969.3	29.2%	3916.3	15.2%
3 - low urban density	11747.3	55.4%	12491.0	52.3%	1548.9	6.0%
	21195.3	**100%**	**23866.4**	**100%**	**25844.6**	**100%**

Table 1: Comparison of the amount of the three urban density classes of the original land cover layers within the study area

Looking at the distribution of the three urban density classes of the years 1986 and 2001, the order of the several classes is still comparable and the percentage increase of both denser classes at the expense of the third class is very plausible. However, the classification of 2013 draws a different picture: Now, not just about 20% are of high density urban, but almost 80%. The class low density urban on the other hand, which – in both cases – previously accounted for more than 50%, hardly occurs. In our view it is very unlikely that such a compression corresponds with reality. Rather, this comparison shows once more the fundamental incommensurability of the three classifications. As already mentioned above, using the majority resample option this apparent growth (or better: densification) would even be increased.

The following figure 4 shows the main problems once more depicted in a map. The upper panel shows the 2001 representation of the three urban classes, while the middle panel shows the result of the nearest option for the urban classes of 2013. Comparing these two one can easily discern the difference of the content of both classifications. The dark red high density urban pixels predominate in 2013 exorbitantly. For URBANICA this would have the fatal effect that from 2013 onwards just very few pixels would allow

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further densification, thus leading to an extreme overestimation of the need for new undeveloped areas and therefore unrealistic scenario results. The lower panel shows the result of an alternatively generated 30m land cover layer, developed to solve this problem. This will be explained further below, but in short, the development of this dataset was essentially based on a GIS operation called AGGREGATE (cp. RESAMPLE).

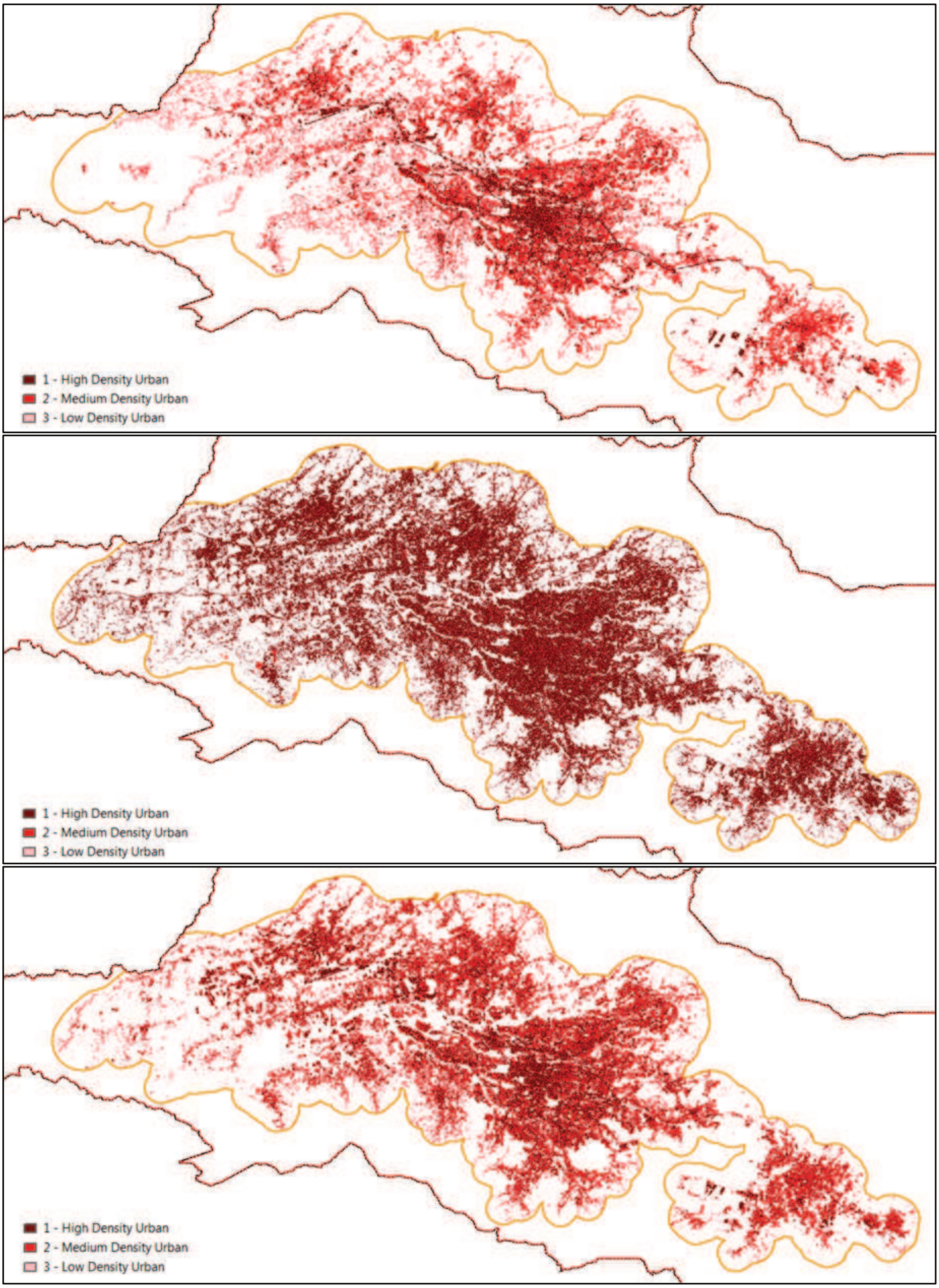

Fig. 4: Comparison of 2001 urban mask (above), the 30m RESAMPLED mask 2013 (middle) and the generated Layer using AGGREGATE for 2013 (below)

The middle panel of the figure above shows that the original situation was more than unsatisfactory. Nevertheless, in order to get a reasonable spatial distribution as input for the tool, we tried to create a more realistic and comparable land cover layer for 2013. As mentioned above, this procedure uses the GIS function AGGREGATE to create a 30m land cover. For this paper it would lead too far to describe this generation process in detail, but substantially the method uses single binary representations of each class. The function generates a reduced-resolution version of a raster (30m instead of 1.5m) by using a factor which is used to multiply the cell size of the input raster to obtain the desired resolution for the output raster. In our case this factor was 20, because the output cell size of 30m is 20 times larger than that of the input raster. We used the SUM option leading to a 30m raster containing the sum of original pixels within. This had to be done for each class separately. At the end we could examine the dominant class simply by division by the factor 400 (= 20 x 20 pixel). Using intelligent rules one can also generate comparable 30m mixture representations of a new cell. We used e.g. up to 33% of "sealed" pixels for low, 33 to 66% for medium and more than 66% for high urban density. Comparing the results of this process visually with the one of the resample method shows the substantial improvement. Now, 29% of the pixels were classified as high density urban, 44% as medium and at least 28% as low. Of course, this is still not a perfect solution: The high proportion of medium density urban areas still seems to be unrealistic, which calls for a further improvement of this approach and consolidates –once again- our warnings to use different data sources at all.

We think this section shows clearly that a certain operating expense is important to get reasonable, appropriate data inputs. Different data coming from different sources may lead to more effort in the end. In the worst case, unrealistic data input might not be detected at all leading to wrong end results. Thus, a higher resolved ("better") data set –using a more recent technology– does not always mean that this data is smarter.

4.2 A Smart Data Gathering Process

For UIDS a new approach was developed to gather data for the Agent-based simulation due to the lack of available data and, henceforth, unsatisfactory results from a common, statistical approach in a project carried out in the City of Ruse, Bulgaria. As this is already described in Gebetsroither-Geringer and Loibl, 2014 and Gebetsroither-Geringer and Loibl, 2016 we want to present here only a summary and a discussion what this data gathering process makes it smarter than others.

The first reason is that city administrations and urban planners are more and more interested in increasing their knowledge about the current preferences of their citizens, which can be hardly derived from data of the past. Processes that can be included in e-governance and e-government[7] were considered as becoming increasingly relevant. The ongoing development of mobile applications supporting this data gathering process increases the amount of available data, but can still be improved, mainly regarding the usability and appropriateness of the gathered data for modelling of urban development. In our approach we used an online questionnaire asking the citizens very few questions. We asked e.g. which areas of the city they:

(a) like most,

(b) could imagine to move to,

(c) do not want to live in at all.

Further we asked for permission to use this information as data input for a simulation to derive attractiveness maps of their city.

The calculation used to derive the attractiveness describes the citizens' attraction to target areas, defined as, e.g., urban raster cells or districts:

$CA_i = f(\sum posPr_i, \sum intPr_i, \sum negPr_i)$ Equation 1

with:

$negPr_i$ = negative preference at target area i

$posPr_i$ = positive preference at target area i

$intPr_i$ = intermediate preference at target area i

CA_i = Citizens' attraction to target area i

[7] eParticipation, 2016

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The probability Pi for a target area i to be chosen by a citizen is normalized to 1 for areas of highest attractiveness (i.e., areas where citizens would most probably move to):

$P_i = CA_i / MAX(CA_1;CA_2;\ldots CA_n)$ Equation 2

The derived attractiveness maps were published, e.g., using a Web Map Service (WMS), offering an added value to the citizens who could receive feedback through these maps. Keeping the derived attractiveness maps up to date requires very low effort: E.g., every 1 to 5 years, the same questionnaire could be used and the development since the previous investigation could be visualized. These further advantages make the approach smarter. Details on the approach, the implementation and a comparison to a more commonly used statistical approach can be found in Gebetsroither-Geringer and Loibl, 2016.

5 CONCLUSION AND OUTLOOK

This paper briefly discussed that smart tools (beyond the challenges regarding user-friendliness and the demand for high calculation speeds and credibility) need smart data as input. The example of high resolution remote sensing data is only one example, out of several, wherein supposed data improvements may lead to pitfalls. Thus, in the end, it is not easy to determine what smart data is and this question will always have to be answered on a case by case basis in the context of the data requirements of a software/use case. New data gathering processes are promising and the presented very simple approach will most probably be further extended as e.g. research projects like smarticipate are working on data-rich citizen dialogue systems, transforming public data into new intelligence The project aims to integrate bottom-up processes in the realm of city planning, using the full potential of citizens by sharing ideas in the co-production of decision making. Such kind of projects will open a wide range of new smart data resources, which can and should be used for urban decision support systems like URBANICA.

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reviewed paper

Stadtentwicklung im Untergrund. Skizzen aus der Schweiz

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1 ABSTRACT

Der Raum, der der Stadt für ihre Entwicklung zur Verfügung steht, ist begrenzt. Die Ansprüche der Menschen an Wohn-, Arbeits- und Erlebnisraum wachsen[1], ebenso steigt die Zuwanderung[2], der Verkehr benötigt immer mehr Platz, die Belastungen vor allem durch Lärm nehmen exponenziell zu, der Kulturlandverschleiss und die Landschaftszerstörungen rufen nach Eindämmung der Siedlungsausbreitung, nach Verdichtung und Konzentration, nach Siedlungsentwicklung nach innen und das heisst auch: nach unten. Die Stadt muss die Räume, die der Untergrund anbietet, für ihre Entwicklung nutzen. Zu den bebaubaren Räumen des Untergrunds kommen nutzbares Gestein, geothermische Energie, Trinkwasser.

Die Politik macht sich für die Nutzung des Untergrunds nicht stark; die Stadtplaner kennen die Beschaffenheit des Untergrunds und sein Potenzial für die Stadtentwicklung nicht; mangelnde geologische Kenntnisse des Untergrunds können zu Schäden führen (s. Staufen im Breisgau, unten 5.4); die Raumplanung und das Raumplanungsrecht befassen sich kaum mit dem Untergrund. Seine Inanspruchnahme ist unkoodiniert. Dadurch entstehen Nutzungskonflikte, und die Gefahr wächst, dass das Potenzial des Untergrunds nicht ausgeschöpft wird. Der Untergrund muss auf allen „Ebenen" in die Raumplanung schlechthin und besonders in die Planung der Stadtentwicklung einbezogen werden.

Vielfach ist von der dreidimensionalen Stadtentwicklung die Rede. Es geht aber darum, die Methoden und Instrumente der (Raum)Planung über die flächige und auf den oberirdischen Raum beschränkte Anwendung hinaus auch fruchtbar zu machen für die unterirdische Dimension des Raums. Es ist zu prüfen, wieweit das Recht sich mit der städtischen Untergrundplanung befassen muss, wieweit bestehende Instrumente der Raumplanung für die spezifischen Belange der Nutzung des Untergrunds taugen, wieweit besondere Regelungen zum Untergrund auf den verschiedenen Planungsebenen notwendig sind, wie die Koordination der unterschiedlichen Nutzungsansprüche zustande gebracht werden kann, wieweit eine gesamtheitliche Sichtweise eine neue Methodik erfordert, wieweit das geltende Recht über den Umfang des Grundeigentums und die Abgrenzung der Zuständigkeiten und Interessenbereiche für die Nutzung des Untergrunds noch genügt, ob die 3D-Vermessung hinreichend Unterstützung bietet. Solche und ähnliche Fragen sollen im Folgenden zur Sprache kommen. Dabei soll das Schwergewicht auf den Verhältnissen in der Schweiz liegen.

Keywords: Geothermie, Grundwasser, Schweiz, Stadtentwicklung, Untergrund

2 EINLEITUNG

Auf die Nutzung des Untergrunds besteht eine immer grössere Nachfrage. Die Konkurrenzen sind vielfältig: In ein und demselben Gebiet will Einer Erdwärme nutzen, ein anderer eine Gasleitung verlegen, ein Dritter einen Bahntunnel bauen und jeder Grundeigentümer möchte Wärme aus dem Grundwasser beziehen. Bis anhin wurden die im Untergrund liegenden Ressourcen unkoordiniert genutzt mit der Folge von Nutzungskonflikten und der Gefährdung sinnvoller Ausschöpfung des unterirdischen Potenzials. Es kann aber kein Recht des Ersteren geben, sondern nur miteinander koordinierte Tätigkeiten, wie wir das an der Oberfläche gewohnt sind. Mit der unabdingbar gewordenen Raumplanung verbunden ist ein Planvorbehalt (keine raumwirksamen Tätigkeiten ohne Planung) und hiermit wiederum eine Planungspflicht der Behörden (RUCH, 2014, N. 18).

Im Folgenden werden zunächst verschiedene Arten von Nutzungen im Untergrund und die Zuständigkeit zu ihrer Regulierung präsentiert (Ziffer 3). Sodann werden einige rechtliche Aspekte erörtert (z.B. Eigentumsrechte, Zulassungen/Bewilligungen, Nutzungsregelungen) (Ziffer 4). Schliesslich wird die Planung der Nutzungen im Untergrund in Umrissen gezeichnet (Ziffer 5).

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[1] Die Siedlungsflächen nahmen in der Schweiz von 1985 bis 2009 doppelt so stark zu wie die Bevölkerung (23% gegenüber 11%, vgl. BFS, 2013, S. 8.

[2] Die Zuwanderung wird vor allem als positiver Faktor zur Stärkung der Wirtschaftskraft und der gesellschaftlichen Vielfalt wahrgenommen (SSV/IGGK, 2015, S. 28, 31.

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3 ARTEN VON NUTZUNGEN IM UNTERGRUND UND ZUSTÄNDIGKEITEN ZU IHRER REGULIERUNG

Nach schweizerischem Staatsrecht sind die Kantone – das sind die Gliedstaaten des Bundesstaates Schweiz – zur Gesetzgebung über alle Gegenstände zuständig, die nicht durch die Bundesverfassung dem Bund zur Gesetzgebung zugewiesen sind. Somit gibt es keine Bereiche, zu deren Legiferierung keine der beiden staatlichen Ebenen zuständig ist. Sollten dem Bund Zuständigkeiten verschafft werden, so braucht es für jeden einzelnen Gegenstand eine Änderung der Bundesverfassung.

In der Schweiz werden in Wesentlichen die folgenden Arten von Nutzungen im Untergrund unterschieden (vgl. PARRIAUX et al., 2010, S. 7 ff.; LAURENT, 2011, S. 31 ff.; HAAG, 2012, S. 11).

3.1 Untergrund als Baugrund

Der Untergrund dient der Verankerung der Hochbauten (ihre Fundamente übernehmen die Funktionen sowohl der Trag- und Befestigungskonstruktion als auch der Hülle für Siedlungstätigkeiten) und von Tiefbauten (Brücken, Tunnels für Strassen, U-Bahnen usw.) sowie der Einbettung von Leitungen aller Art. Der Vorteil von Untergeschossen ist die Isolation gegen klimatische Einflüsse, Lärm, Sicht, ihr Nachteil das fehlende natürliche Licht. Sie sind daher nicht geeignet für den längeren Aufenthalt von Menschen (zum Wohnen, Arbeiten). Allerdings gibt es auch in zahlreichen Gebäuden an der Oberfläche häufig kein natürliches Licht (namentlich in Verkaufslokalen). Den betroffenen Mitarbeitenden werden sogenannte Lichtpausen gewährt, damit sie im Interesse der Gesundheit für eine gewisse Zeit (aktuell 20 Minuten pro Halbtag) Tageslicht und Sicht ins Freie tanken können (Art. 15 der Wegleitung zur Verordnung 3 zum Arbeitsgesetz vom Februar 2016). Im Grunde können alle Nutzungen, die nicht dauernd auf Tageslicht angewiesen sind, in den Untergrund verlegt werden, damit der oberirdische Raum für die anderen Nutzungen – wie Wohnungen, Büros, Erholungsflächen, Stadträume – freigehalten werden kann.

In der Regel unterliegen Untergeschosse nicht Grenzabstandsvorschriften und bauzonenbedingten Höhen- bzw. Tiefenbegrenzungen, wie sie je für Hochbauten gelten. Grundsätzlich können daher Untergeschosse in der Horizontalen und in der Vertikalen ohne Begrenzung dimensioniert werden. Aus öffentlichrechtlicher Perspektive stehen dem allenfalls Rechtsregeln über den Baumschutz oder über Grundwasser entgegen. Gerade der Grundwasserschutz gebietet vielfältige Rücksichtnahme. So lenkt er z.B. die Ausdehnung der Untertagebauten in horizontaler und in vertikaler Richtung, begrenzt also die Anzahl unterirdischer Stockwerke und setzt Massstäbe für die Einrichtung von Dükern, d.h. von Druckleitungen, mit deren Hilfe das Grundwasser Hindernisse überwindet.

Weitere baugrundspezifische Grenzen sind zu beachten: Zunächst liegen im wenig tiefen Untergrund der Strassen Netze der Erschliessung und der Kommunikation. Sodann sind der städtische Kontext und die Charakteristiken der konkreten Lage zu berücksichtigen, in die die unterirdischen Bauten eingefügt werden, wie auch die Akzeptabilität unterirdischer städtischer Nutzungen. Diese sind ferner an die geologischen und hydrogeologischen Bedingungen an Ort gebunden. Von grosser Bedeutung sind dabei die Techniken, die für den Bau der unterirdischen Werke angewandt werden. Schliesslich sind die Kosten ein Kriterium für die Entscheidung darüber, ob unterirdisch gebaut wird.

Abb. 1: Parkhaus Balestra Lugano (Foto: A. Ruch)

In den Untergrund, was nicht unbedingt Tageslicht braucht? Das Parkhaus Balestra in Lugano nimmt mit seinen acht Parkgeschossen und seinem Gesamtvolumen sehr viel oberirdischen Raum in Anspruch, der sinnvoller für Wohnen und Arbeiten genutzt werden könnte. Andererseits können die geologischen und hydrogeologischen Verhältnisse einem derartigen Volumen im Untergrund zu wenig Raum lassen. Nicht ohne Bedeutung ist schliesslich, dass dem Stadtbild eine architektonisch gelungene Baute, auch wenn sie „nur“ ein Parkhaus ist, gut anstehen kann.

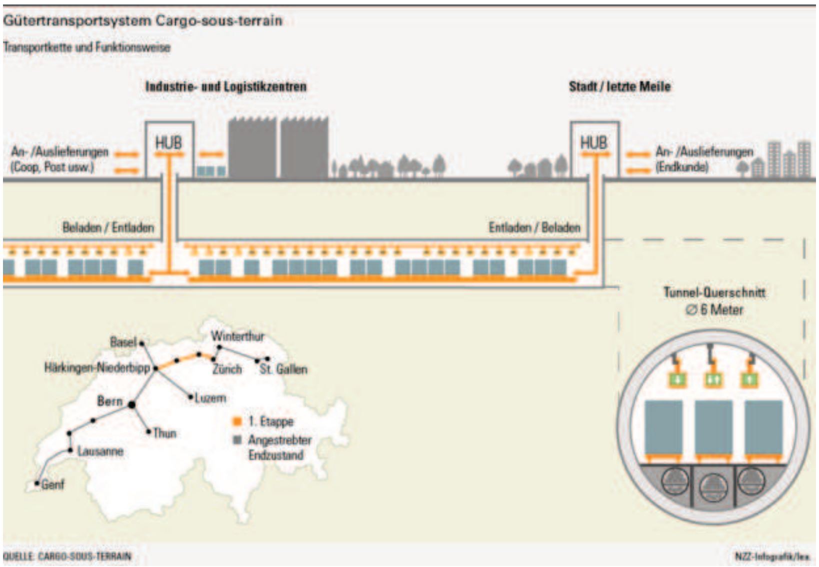

Abb. 2, Quelle: NZZ

Der Verkehr, namentlich der Güterverkehr, wird auch als geeignet empfunden, jedenfall teilweise in den Untergrund verlegt zu werden. Das jüngst vorgestellte Projekt Cargo sous-terrain dient als unterirdische Röhre mit permanent selbstfahrenden Fahrzeugen zum Transport von Gütern der Entlastung der Strassen und Eisenbahnadern.

Der Güterverkehr soll in den Boden verlegt werden. In dreispurigen Tunnels sollen unbemannte Wagen standardisierte Paletten im 24 Stundenbetrieb transportieren. Die Tunnelröhren werden in einer Tiefe von 20 bis 50 Metern liegen und einen Durchmesser von rund 6 Metern aufweisen. In die Röhren werden drei Fahrspuren gelegt, je eine Spur pro Richtung, in der Mitte eine Servicespur. Die Fahrzeuge sollen durch elektromagnetische Induktion angetrieben und gelenkt werden. Der Strom wird durch Leitungen im Tunnelboden geführt.

Die Regulierung der Nutzung des Untergrunds als Baugrund ist Sache des Baurechts und damit Aufgabe der Kantone. Der Bund hat aber einige sektorielle Kompetenzen im Bereich des Baurechts; so vor allem bei den klassischen Infrastrukturen wie den Eisenbahnen, Autobahnen, Flugplätzen, Anlagen der Energieversorgung und bei der Telekommunikation, wo jeweils der Bund die Bewilligungen erteilt. Es gibt sodann einige Gesetze des Bundes, die baurechtsrelevante Bestimmungen enthalten, die in allen baurechtlichen Entscheiden angewandt werden müssen. Dazu gehören insbesondere das Umweltrecht und das Gewässerschutzrecht.

3.2 Nutzung des Untergrunds für die Entsorgung

In städtischen Gebieten ist die Nutzung des Untergrunds für die Entsorgung weniger aktuell. Sie wird hier nur der Vollständigkeit halber erwähnt.

Zuständig für die Regulierung der Nutzung des Untergrunds für die Entsorgung sind je nach Gegenstand entweder der Bund oder die Kantone. Der Bund ist z.B. zuständig für die Gesetzgebung über die Abfallanlagen, so auch zur Lagerung von radioaktiven Abfällen, während die Gesetzgebung über die CO2-Lagerung Sache der Kantone ist. Zu beachten ist freilich, dass die rahmengebenden Gesetze über den Umweltschutz und den Gewässerschutz Erlasse des Bundes sind und somit in diesen Bereichen für die Schweiz einheitliche Bestimmungen gelten.

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3.3 Gewinnung von Rohstoffen

Im Unterschied zu den beiden vorstehend besprochenen Arten der Nutzung des Untergrunds verweist die Gewinnung von Rohstoffen auf die natürlichen Eigenschaften des Untergrunds. Es geht nicht mehr um einen Raum für die Entwicklung menschlicher Tätigkeiten, sondern um die Ausnützung der inneren Bestandteile des Untergrunds. Die Rohstoffe sind ohne Zutun des Menschen vorhanden. In diesem Beitrag sind solche Rohstoffe (Geomaterialien: Steine und Erden) anzusprechen, die in der Stadt gebraucht werden (z.T. werden sie auch in städtischem Gebiet abgebaut). Es handelt sich um mineralische Materialien, die als Granulate für die Herstellung von Beton und Asphalt verwendet werden, um Materialien für die Herstellung von Gips und Zement, um Natursteine für den Hochbau sowie um Aufschüttungsmaterialien für den Strassenbau. Für die Bautätigkeit werden immer mehr Geomaterialien verwendet, die von immer weiter her herantransportiert werden. Die qualitativ hochwertigen Hartgesteine kommen in einem schmalen Band zwischen Boden- und Genfersee vor und liegen häufig in geschützten Landschaften (JUD, 2012, S. 3). So besteht ein zunehmender Bedarf an der Erschliessung neuer Kiesvorräte und der Eröffnung neuer Steinbrüche. Der Konflikt mit anderen Nutzungen und Nutzungsansprüchen ist damit vorgezeichnet (HAAG, 2011, S. 6).

Die Regulierung der Gewinnung von Geomaterialien, insbesondere der Steinbrüche und Kiesgruben, liegt in der Kompetenz der Kantone (CARREL, N 481). Der Bund hat keine Kompetenz, verbindliche Vorschriften zu erlassen.

3.4 Lagerung und Nutzung von Grundwasser

Auch das Grundwasser ist ein Rohstoff, seine besondere Bedeutung und die vielfältigen Nutzungsmöglichkeiten verdienen aber eine separate Darstellung. Grundwassser ist in der Schweiz fast überall ausreichend und in guter Qualität vorhanden. In städtischen Gebieten kann es aber auch unerwünschte Fremdstoffe enthalten (z.B. VOC, v.a. Tri- und Tetrachlorethen/Lösungsmittel; PFC aus der Siedlungsentwässerung; Zusätze zum Benzin als Antiklopfmittel; Arzneimittel) (vgl. zu solchen Problemen BAFU, 3/09, S. 62 ff.). Zudem ist in städtischen Gebieten ein Defizit an Grundwasserschutz festzustellen (vgl. PARRIAUX et al., 2010, S. 10). Für die Qualität des Grundwassers spielt der Boden, dessen Schichten das Wasser schützen, eine wichtige Rolle.

Über 80% des Trinkwassers der Schweiz werden aus Grundwasser gewonnen. Grundwasser dient ausserdem als Lösch- und Industriewasser städtischen Funktionen. Zudem wird es zunehmend zur Energiegewinnung verwendet. Die Nutzung von Grundwasser dient ferner der Wärmegewinnung; im Unterschied zur Geothermie wird die Wärme direkt dem durch Grundwasserwärmepumpen geförderten Grundwasser entzogen (direkte thermische Nutzung).

Die Regulierung des Grundwassers ist alleine Sache des Bundes. Er verfügt über die Kompetenz zum Erlass der Gewässerschutzgesetzgebung seit Beginn der fünfziger Jahre des 20. Jahrhunderts; das geltende Gesetz mit seinen einlässlichen Verordnungen (sekundäre Rechtssetzung der Landesexekutive) ist bereits das dritte umfassende Gewässerschutzgesetz. Trinkwasser gilt als Lebensmittel; in diesem Bereich verfügt der Bund ebenfalls über die alleinige Gesetzgebungszuständigkeit. Für den planerischen Schutz des Grundwassers hat der Bund Rahmenbestimmungen erlassen; die Festsetzung der Pläne ist Aufgabe der Kantone.

3.5 Nutzung des Untergrunds für die Gewinnung von Geothermie

Genutzt wird die im Untergrund gespeicherte Erdwärme. Sie nimmt mit wachsender Tiefe zu. Nach der Tiefe der Gewinnungsstätten wird im allgemeinen (noch) unterschieden zwischen untiefer und tiefer Geothermie. Die Unterscheidung hängt mit den technischen Möglichkeiten zusammen. Für die hier vertretenen Anliegen sollte auf die Unterscheidung verzichtet werden (vgl. auch HOFMANN, 2014, S. 513). Die untiefe Geothermie erreicht Tiefen bis 400–500 Metern. Die Wärme wird dem Grundwasser mittels Erdweärmesonden, Erdregister, Wärmekörben, Energiepfählen und ähnlichen thermoaktiven Elementen entnommen (indirekte thermische Nutzung, vgl. BAFU, 10/09, S. 18; CHGEOL, 2012, S. 20). Die untiefe Geothermie ist in Städten von erheblicher Bedeutung, besonders für Einfamilienhäuser und kleinere Gebäude im periurbanen Raum (vgl. PARRIAUX et al., 2010, S. 12 f.).

Die Geothermie aus grösseren Tiefen eignet sich auch für die Wärmeversorgung von Gebäuden. Sie spielt bei der intelligenten Energieversorgung von Städten eine wichtige Rolle. Nach ersten Bohrungen 1988 wird in Riehen bei Basel seit 20 Jahren die Erdwärme aus einem Aquifer in ca. 1500 Metern Tiefe genutzt. Bei hoher Siedlungsdichte werden Gebäudegruppen aus umgrenzten Wärmefeldern mit je geschlossenen Netzen versorgt (GEODH; vgl. GeoDH-Report 2014, S. 12).

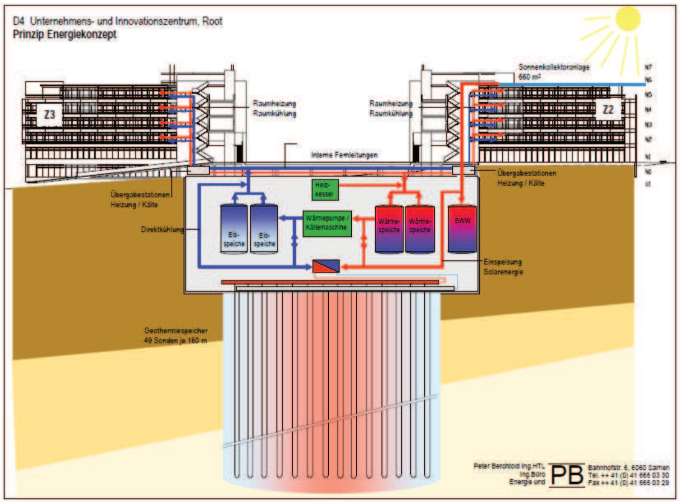

Abb. 3, aus: Florian Ruesch, Das Erdreich als Speicher für Solarthermie?, 3. Tagung Solarwärme Schweiz, 12.11.2014

Die Möglichkeit von Konflikten mit anderen Nutzungen im Untergrund ist in besonderem Mass gegeben und nimmt zu. Anders die tiefe Geothermie, die für Wärme- und Stromgewinnung eingesetzt werden kann. Sie spielt für die Stadt zwar auch eine Rolle (vgl. neben Basel auch das wieder eingestellte Projekt im Zürcher Triemli-Quartier), ihre Installationen sind aber zahlenmässig von untergeordneter Bedeutung.

Die Regulierung der Geothermie ist Sache der Kantone. Wiederum ist zu beachten, dass bei Entscheiden über Geothermieprojekte spezifisches Bundesrecht mit angewendet werden muss, namentlich das Gewässerschutz- und das Umweltschutzrecht.

4 RECHTLICHE ORDNUNG DER NUTZUNG DES UNTERGRUNDS

4.1 Eigentums- und Nutzungsrechte

Im Untergrund konkurrieren zwei Kategorien von Verfügungsberechtigten: Die Grundeigentümer, deren Verfügungsrecht auch in die Tiefe reicht, und die „öffentliche Hand“, die das Verfügungsrecht über die Bereiche hat, die nicht Grundeigentum sind. Zur Abgrenzung ist die Frage zu beantworten, wieweit das (private) Grundeigentum reicht und ab welcher Tiefe die Nutzung im Hoheitsbereich des Kantons liegt. Wird ein Eisenbahntunnel projektiert, der unter Bauzonengebiet führen soll, so interessiert es einerseits das Bahnunternehmen, ob durch den Tunnel privates Grundeigentum in Anspruch genommen wird und es zu einer Auseinandersetzung mit Eigentümern kommen wird, andererseits interessiert es den Grundeigentümer, ob er seine Erdwärmesonde jetzt ohne Weiteres bauen kann oder ob er auf die erwähnte Auseinandersetzung warten muss.

Die Grenzen des Grundstücks werden in der Horizontalen durch Zeichen und durch die mittels amtlicher Vermessung gewonnenen Eintragungen im Grundbuchplan festgelegt. Die Grenze gilt, bis sie in einem formellen Verfahren geändert wird. Anders in der Vertikalen: Das Grundeigentum reicht so weit in die Tiefe (und in die Höhe), wie ein Ausübungsinteresse des Eigentümers besteht; es reicht also nicht bis zum Erdmittelpunkt wie in anderen Ländern. Das ist geregelt in Art. 667 Abs. 1 ZGB (massgebend für die Frage der Ausdehnung des Grundeigentums ist also das bundesrechtliche Privatrecht). Was ausserhalb dieses Interessen- oder Beherrschungsbereichs liegt, fällt in die (Gesetzgebungs)Hoheit des Kantons. Das Besondere am Grundeigentum in der Tiefe besteht darin, dass die Begrenzung nicht grundstückbezogen erfolgt, sondern grundätzlich offen bleibt, und dass sich der Umfang des Eigentums mit dem Willen des jeweiligen Grundeigentümers ändert, somit dynamisch ist und nicht fest abgegrenzt werden kann (HUSER, 2013, S. 245 f.; ENDER, 2014, S. 449). Das massgebende konkrete Interesse des Eigentümers kann sich in einem Kellergeschoss beschränken, kann sich auf vier unterirdische Parkgeschosse ausdehnen, kann Wärmesonden unterschiedlicher horizontaler und vertikaler Ausdehnung umfassen.

Das Ausübungsinteresse hat zwei Seiten (vgl. LAURENT, 2011, S. 63; ENDER, 2014, S. 451): eine positive und eine negative. Die positive Seite verlangt vom Eigentümer, dass ihm die konkrete Nutzung tatsächlich

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möglich ist; er muss den Raum beherrschen und die aus dem Eigentum fliessenden Nutzungsbefugnisse, „ohne besondere Schwierigkeiten und ohne übermässigen Aufwand“ (BGE 93 II 170 S. 176 E. 5), ausüben können. Die negative Seite besagt, dass Dritte Nutzungsrechte nur soweit ausüben können, als sie Grundeigentum in seiner positiven Ausrichtung nicht schädigen. Diesem Konzept der Eigentumsdefinition kommt Grenzziehungsfunktion zu (BGE 119 Ia 390 S. 398 E. 5c/bb). So bestimmt Art. 664 Abs. 1 ZGB, dass die herrenlosen und die öffentlichen Sachen – denen auch der Untergrund zugeordnet wird – unter der Hoheit des Staates stehen, in dessen Gebiet sie sich befinden. Mit „Staat“ sind hier die Kantone gemeint. Die Kantone können demnach den Untergrund mit ihrer Verfügungshoheit belegen, soweit dadurch nicht Eigentum, wie es vom Zivilrecht definiert wird, betroffen ist. Ausserhalb der „Interessensphäre“ der Grundeigentümer gibt es kein privates Grundeigentum. Dem öffentlichen Bereich kommt Vorrang zu (Primat der Öffentlichkeit; BGE 119 Ia 390 S. 399 E. 5d). „Hoheit“ schliesst ein, dass die Kantone auch über die Nutzungsart bestimmen können. Es kommt ihnen in bezug auf die Ausübung wirtschaftlicher Tätigkeiten im soeben umschriebenen Untergrund eine Monopolstellung zu (s. auch unten 4.3 a.E.).

4.2 Eigentümliches zum rechtlichen Begriff des Untergrunds

Der Untergrund wird rechtlich im Bundesrecht nicht definiert. Die Suche in kantonalen Rechtssammlungen ergibt, dass z.B. das geltende Gesetz des Kantons Aargau über die Nutzung des tiefen Untergrunds und die Gewinnung von Bodenschätzen vom 19. Juni 2012 folgendes regelt: «Unter Nutzung des tiefen Untergrunds werden Nutzungen in der Erdtiefe ausserhalb des gemäss Privatrecht geschützten Eigentums verstanden» (§2 Abs. 2). Das Mustergesetz der Nordostschweizer Kantone über die Nutzung des Untergrundes vom 2. Dezember 2013 definiert: «Als Untergrund gilt jener Teil des Erdinnern, der nicht Gegenstand der Bundeszivilgesetzgebung bildet» (§2 Abs. 1). In kantonalen öffentlichrechtlichen Erlassen, wie es die beiden erwähnten sind, geht der Trend offenbar dahin, als Untergrund nur das zu verstehen, was unterhalb der Erdoberfläche ausserhalb des gemäss Privatrecht geschützten Eigentums liegt und öffentlichrechtlich geregelt werden kann (vgl. KNAPP, 1987, S. 31). «Untergrund» ist rechtlich nicht einheitlich definiert.

Im Baurecht ist mit «unterirdisch» nicht einfach "mit Erdreich überdeckt" gemeint, entscheidend ist, unter welchem Boden die unterirdische Baute zu liegen kommt. In der Regel ist dafür das gewachsene Terrain massgebend (Urteil B 2011/77 des Verwaltungsgerichts des Kantons St. Gallen vom 20. März 2012, E. 4.2, mit Hinweis auf vereinzelte kommunale Rechte, wo das gestaltete, aufgefüllte Terrain massgebend ist).

4.3 Zulassungen: Arten und Zuständigkeiten

Es geht an dieser Stelle um zwei Typen von Zulassungen: die Baubewilligung und die Konzession. Alle Bauten und Anlagen dürfen nach der einschlägigen Vorschrift des Bundesrechts in der ganzen Schweiz nur mit behördlicher Bewilligung errichtet oder geändert werden. Einerlei ist, ob ein Privater oder ein Gemeinwesen als Bauherrschaft auftritt. Behördlich bewilligt werden müssen nicht nur eigentliche Bauwerke im Untergrund, Leitungen, Anlagen für Wärmegewinnung, Grabungen, Bohrungen (auch Probebohrungen), seismische Untersuchungen. Zwischen dauernden und vorübergehenden Einrichtungen wird nicht unterschieden. Die Bewilligung wird in einem umfassenden Sinn als Baubewilligung bezeichnet. Sie bleibt das auch dann, wenn kantonale Rechte bestimmte Typen anders benennen, z.B. die Bewilligung für eine Erdwärmesonden-Wärmepumpenanlage oder die Bewilligung für Anlagen in Gebieten mit nutzbaren Grundwasservorkommen als gewässerschutzrechtliche Bewilligung (dies weil im Zentrum der materiellen Erwägungen das Gewässerschutzrecht steht; vgl. auch CONRAD, 2014, S. 498 f.). Die Baubewilligung gibt dem Inhaber keine neuen Rechte, sondern erlaubt ihm nur zu bauen und die Baute zu betreiben.

Die Nutzung von Rohstoffen und dergleichen braucht über die Baubewilligung der Anlagen hinaus, vorgeschaltet, eine sogenannte Konzession. Sie ist eine Rechtsverleihung, d.h. sie verschafft dem Empfänger das Recht zur Nutzung. Dieses steht unter dem Schutz der Eigentumsgarantie, kann also nur mittels Enteignung wieder entzogen oder geschmälert werden. Inhaber des Rechts, das verliehen wird, sind die Kantone (vgl. oben 4.1 letzter Satz); sie können es selbst ausüben oder eben an Dritte verleihen.

4.4 Untergrund als Baugrund

Massgebend sind verschiedene Rechtskomplexe. Vorweg das kantonale und kommunale Raumplanungs- und Baurecht, das grundsätzlich auf alle Bauten der eigentlichen Siedlungsfunktion anwendbar ist: z.B.

unterirdische Teile von Wohn-, Gewerbe-, Industriebauten, öffentlichen Bauten. Dazu gehören auch Erschliessungsanlagen wie Wasser-, Elektrizitäts-, Abwasserleitungen, aber auch Einzelbauten wie Parkhäuser. Besondere gesetzliche Regelungen über unterirdische Bauten und Anlagen existieren nicht. Es gelten auch für sie die allgemeinen Rechtsnormen, Fachnormen und Standards (vgl. für den Bereich Luft CONRAD, 2014, S. 495).

Die Baugesetze sprechen von Überbauung der Grundstücke, von Gebäudehöhe , von Gebäudetiefe (die ein Mass für eine bestimmte Fassadenlänge ist). Untergeschosse werden nicht in die Nutzungshöchstmasse eingerechnet, so dass mit unterirdischen Bauten und Gebäudeteilen Nutzungsraum gewonnen werden kann. Unterirdische Bauteile dürfen aus eigentumsrechtlichen Gründen die Parzellengrenze nicht verlassen. Doch die Tiefe der unterirdischen Bauteile ist im kommunalen Baurecht prinzipiell nicht begrenzt. Wie ausgeführt (oben 3.1), kennt das Gewässerschutzrecht des Bundes im Interesse des Grundwasserschutzes Tiefenbeschränkungen.

4.5 Gewinnung von Rohstoffen

Die Gewinnung von Rohstoffen fällt unter das sog. Bergregalrecht. Regalrechte sind kantonale Monopole, die schon vor Erlass der Bundesverfassung von 1874 bestanden haben. Sie ermöglichen den Kantonen Ausnahmen von der Wirtschaftsfreiheit, die ihnen sonst für die Abstützung ihrer Aktivitäten nicht zur Verfügung steht (nur der Bund kann Wirtschaftspolitik betreiben). Die Regalrechte haben ihre rechtliche Grundlage in den kantonalen Verfassungen und werden allenfalls in einem Spezialgesetz (Bergregalgesetz, «Untergrundgesetz» o.ä.) konkretisiert. Es handelt sich vor allem um die Bodenregale wie Berg- und Salzregale. Mit dem Monopol hat der Kanton das ausschliessliche Recht der Nutzung, das er mittels Rechtsverleihung (Konzession) an Andere, z.B. Private, weitergeben kann (vgl. oben 4.3).

5 KOORDINIERTE PLANUNG DER NUTZUNGEN IM UNTERGRUND

5.1 Planungssystem

Das System der schweizerischen Raumplanung umfasst mehrere Instrumente, die in einer Art Hierarchie zu einander stehen. Es besteht ein übergeordnetes strategisches und koordinatives Niveau mit dem Richtplan, zu dessen Erlass die Kantone zuständig sind. Mit den kantonsübergreifenden Abstimmungen soll sich so ein gesamtschweizerisches Ganzes ergeben. Die Richtpläne sind für die Behörden verbindlich, namentlich diejenigen, die nachfolgend die Nutzungspläne festlegen. Dieses zweite Niveau kann als das reglementarische Niveau bezeichnet werden (vgl. PARRIAUX et al., 2010, S. 63). Die Nutzungspläne sind für alle verbindlich und bestimmen parzellenscharf die Nutzungsmöglichkeiten. Zu ihrem Erlass sind i.d.R. die Gemeinden zuständig, die ihre Nutzungspläne vom Kanton genehmigen lassen müssen. Auf der dritten Stufe stehen die (Bau-)Bewilligungen, die für einzelne Projekte ausgestellt werden und die Vorgaben der Nutzungsplanung und aller rechtlicher Vorschriften, die auf sie anwendbar sind, einhalten müssen.

Der Untergrund ist als eine Ganzheit zu verstehen, in der die verschiedenen Nutzungen interagieren (PARRIAUX et al., 2010, S. 59). Wie grundsätzlich jede Baute oder Anlage ein System bildet, das nicht nur das Objekt umfasst (Gebäude, Strasse, Leitung), sondern auch seine Auswirkungen auf die Umgebung (Lärm, Erschütterungen, Luftbelastung), muss jedes Projekt weit verstanden werden. Im Untergrund ist die Erfassung der Objekte und der gegenseitigen Beeinflussungen besonders bedeutsam, weil die Höhenniveaus weniger begrenzt und die Verhältnisse viel unübersichtlicher sind als an der Oberfläche.

Die folgende Darstellung zeigt die verschiedenen Nutzungsarten im Untergrund und ihre gegenseitige Beeinflussung und Störung.

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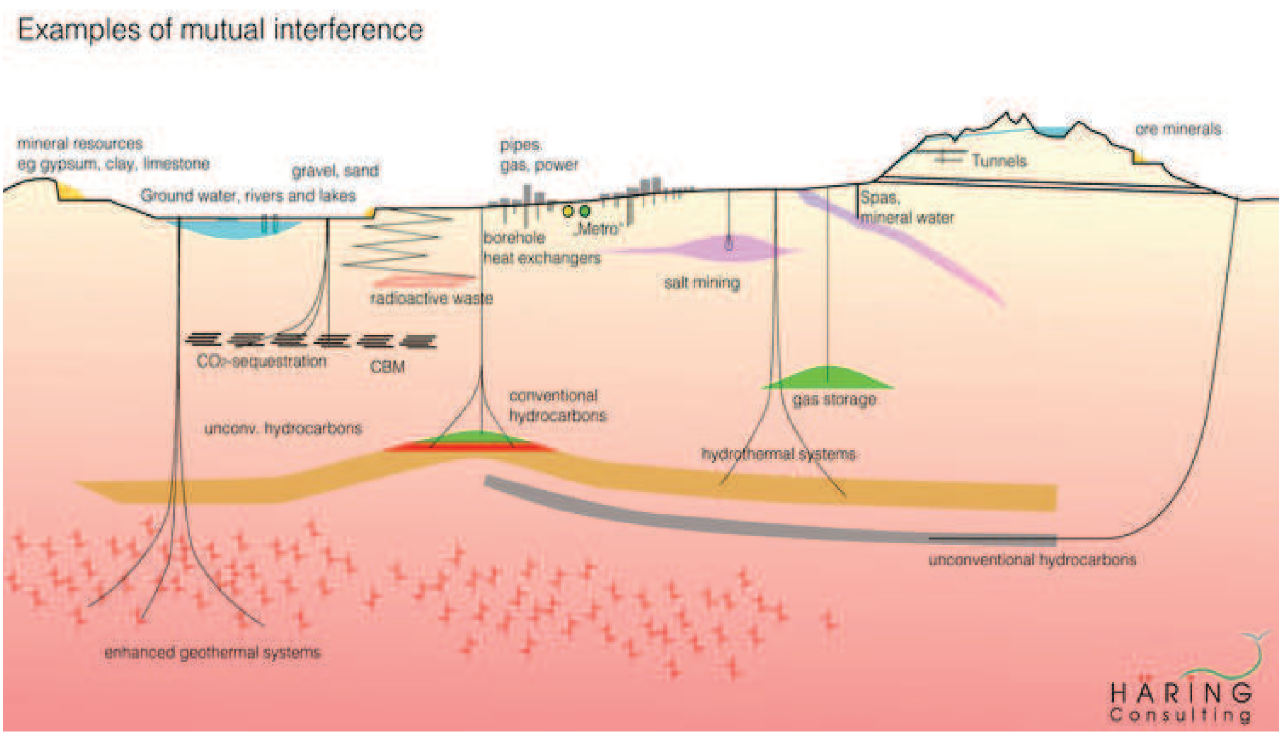

Abb. 4, Quelle: Dr. Markus Häring Consulting, 2015 (kein Massstab)

Aus der Darstellung lässt sich die Notwendigkeit der umfassenden Koordination heraus lesen. Sie verlangt, dass die massgebenden Daten zum Untergrund systematisch erfasst, die Möglichkeiten an Nutzungen, die der Untergrund bietet, bestimmt und die künftigen Nutzungen geplant werden. Die Koordination ist die zentrale und vordringliche Aufgabe der Raumplanung. Das gilt für die herkömmliche Raumplanung, wegen der besonderen örtlichen Verhältnisse aber in besonderem Mass für die Raumplanung im Untergrund.

5.2 Richtplanung

Das schweizweit anzuwendende Instrument der koordinativen Planung (der Abstimmung der verschiedenen raumwirksamen Tätigkeiten, der schon bestehenden und der noch geplanten), das für die Behörden verbindliche Vorgaben enthält, ist der kantonale Richtplan bzw. die Richtplanung: Richtplanung ist der fortwährende Prozess, Richtplan ist die bei der Planfestsetzung geltende Momentaufnahme. Behördenverbindlichkeit bedeutet, dass die Behörden, die die für jedermann verbindliche Planung der nächsten Stufe – die Nutzungsplanung (s. 5.1) – erlassen wird, an die Anordnungen des Richtplans gebunden sind. Alle Vorhaben mit gewichtigen Auswirkungen auf Raum und Umwelt brauchen eine Grundlage im Richtplan (Art. 8 Abs. 2 RPG); im Grunde sind es alle Vorhaben, die der Koordination mit anderen Vorhaben bedürfen. Der Richtplan besteht aus Karte und Text, beide in gleicher Weise verbindlich. Die Karte gibt die Orte der Aktivitäten wieder, während der Text die Anordnungen in Wortform enthält, also nicht bloss Erläuterung der Karte ist.

Richtplantext: Kantonales Interessengebiet für Grundwassernutzung
Vorrangiges Grundwassergebiet von kantonaler Bedeutung

Abb. 5: Richtplan Kanton Aargau (Ausschnitt: Brugg – Windisch – Turgi)

Spezifisch auf den Untergrund ausgerichtet ist noch kein kantonaler Richtplan. Die Verzeichnung der Grundwasservorkommen und darüber hinaus von kantonalen Interessengebieten für die Grundwassernutzung ist ein koordinativer Ansatz. Der Richtplan kann neben dem Aufzeigen von Abstimmungsbedarf auch Priorisierungen vorsehen (CARREL, 2015, N 486). Bestehende kantonale Richtpläne enthalten noch keine Aussagen etwa über Geothermiebohrungen, auch nicht in den Kantonen, in denen solche bereits vorgetrieben worden sind. Gelegentlich wird im Richtplan auf Übersichten verwiesen, in denen Gebiete ausgewiesen werden, in denen z.B. Erdwärmesonden zulässig sind (vgl. Richtplan Kanton Thurgau, Ziffer 4.2., S. 9, was natürlich noch keine planerische Leistung ist). Aber die normativen Vorgaben des Richtplans können durchaus auch für die Planung der Untergrundnutzungen gelten. Man wird allerdings eine Dreidimensionalität der Darstellung ins Auge fassen müssen. Die Besonderheit an der (Richt)Planung im Untergrund ist, dass die untergründigen Nutzungen an der Oberfläche Erwähnung finden (vgl. HOFMANN, 2014, S. 517). Denn eine rein unterirdische Planung gibt es nicht, alle Aktivitäten im Untergrund wirken auf die Oberfläche (vgl. CARREL, 2015, N 477: Le sous-sol est de façon générale au service du développement en surface). Unter planerischen Gesichtspunkten ist, eher als von der unterirdischen Stadt, von der umfassenden unterirdischen Dimension der Stadt zu sprechen.

5.3 Nutzungsplanung

Die Nutzungsplanung ist in der Planhierarchie die nächstfolgende Stufe. Die konkreten Nutzungsmöglichkeiten werden hoheitlich in einem Nutzungsplan – jetzt in der Regel auf der Stufe der Gemeinde und vom Gemeindegesetzgeber – festgelegt. Der Nutzungsplan ist für alle verbindlich, namentlich für die Grundeigentümer und die sonstwie an Grund und Boden Berechtigten und Verpflichteten. Die Anordnungen sind grundstücksgenau („parzellenscharf“) in Zonen gegliedert. Es gibt Grundnutzungen (z.B. Wohnzone 3-geschossig, Gewerbezone mässig störend, Industriezone) und es gibt sog. überlagernde Zonen (z.B. Gewässer- und Grundwasserschutzzonen, Denkmalschutz, Naturgefahren). Während in den Richtplan nur Vorhaben Aufnahme finden, die koordinationbedürftig sind, so hat der Nutzungsplan alle Festlegungen zu enthalten, die für die örtliche Bestimmung der zugelassenen Bodenverwendung notwendig sind. Auch der Nutzungsplan ist zweidimensional gezeichnet und dreidimensional zu verstehen; er beschränkt sich aber auf die Bodennutzung, wie sie in erster Linie oberirdisch zur Geltung kommt (vgl. CARREL, 2015, N 520). Auch der untergründige Nutzungsplan müsste wohl in einer dreidimensionalen Darstellungsart erlassen werden können. Für die Nutzungen im Untergrund vermöchte der Nutzungsplan, der wohl in erster Linie für die Planung des untiefen Untergrunds eingesetzt würde, den Grundeigentümern Sicherheit zu gewährleisten (vgl. HOFMANN, 2014, S. 517).

5.4 Dreidimensionale Modellierung und Aufbau von Katastern

In der Altstadt von Staufen/Breisgau (D) führte 2006 die Abteufung einiger Erdwärmesonden zu Wasserzutritten in trockene, aber quellfähige Gebirgsabschnitte. Die Folge war das sogenannte Gipskeuperquellen, ein durch Wasser bewirktes Anschwellen von Anhydrit zu Gips mit einer Volumenvergrösserung um bis zu 60%. Dadurch hob sich die Altstadt und hebt sich noch immer, was zu erheblichen Gebäudeschäden mit grossen finanziellen Folgen führt (vgl. RUCH/WIRSING, 2013; vgl. auch das Beispiel bei SCHENKER, 2014, S. 438). Solchen Schadensfällen soll durch die Kenntnis der Beschaffenheit und die physikalischen Eigenschaften des Untergrunds begegnet werden. Mittel hierzu ist das geologische 3D-Modell, das in Basel zunächst als projektbezogenes Modell zur Bearbeitung lokal begrenzter Fragestellungen, vor allem in den Bereichen Grundwasser- und Erdbebenschutz, aufgebaut worden ist, nunmehr aber zu einem 3D-Schichtenmodell entwickelt wird, mit dem verschiedene Nutzungsmöglichkeiten evaluiert werden können. Ziel ist indessen die Entwicklung eines dynamischen 3D-Modells als Werkzeug für die untergründige Raumplanung (DRESMANN/HUGGENBERGER, 2012, S. 17/19).

Die geometrische Dokumentation von Eigentum durch die Amtliche Vermessung (3D-Eigentum) ist heute eine Aufgabe, die sich bei der oberirdischen Nutzung und bei der Nutzung im Untergrund in gleicher Weise stellt. Hinzu kommt die Dokumentation und Verwaltung des Raums über und unter dem Boden. Technisch können 3D-Probleme juristisch korrekt dokumentiert und verwaltet werden. Ziel ist die Erstellung eines rechtsverbindlichen 3D-Katasters (vgl. REIMANN, 2013, S. 2; ÅSTRÖM BOSS, 2014, S. 614 f.). Wenigstens in städtischen Zentren soll der 3D-Kataster in naher Zukunft machbar sein (vgl. HOFMANN, 2014, S. 516).

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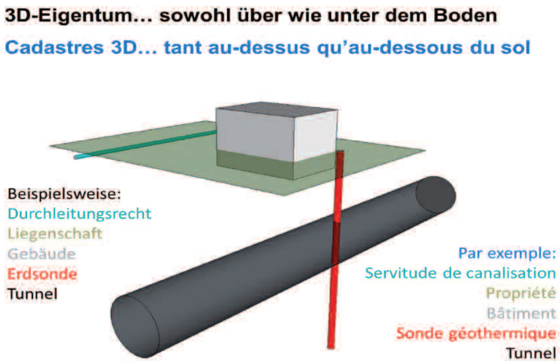

Abb. 6, aus: Åström Boss, 2014, S. 614

Die Nutzung von Grundstücken unterliegt zahlreichen öffentlichrechtlichen Eigentumsbeschränkungen (ÖREB), die für den Grundeigentümer bindend sind. Sie beruhen auf Erlassen gesetzgebender Behörden (Gesetze, Verordnungen, Pläne) oder Entscheidungen von Verwaltungsbehörden (Pläne, Verfügungen). Bis heute besteht keine zentrale Auskunftsstelle für ÖREB. Diese Lücke schliesst der ÖREB-Kataster, in dem Informationen aus unterschiedlichen Bereichen zusammengeführt sind (z.B. Nutzungspläne, Projektierungszonen, Baulinien, Grundwasser- und Hochwasserschutzzonen, Lärmempfindlichkeitsstufen, Höhenbegrenzungen, Sicherheitszonen), die nicht in das dem Zivilrecht unterstehende Grundbuch aufgenommen werden. Der gesetzliche Rahmen über den ÖREB-Kataster wird vom Bund gesetzt, die Kantone regeln die Organisation für die Führung des Katasters und bestimmen die verantwortlichen Organe (Geoinformationsgesetz vom 5. Oktober 2007, Art. 16; s. auch Verordnung über den Kataster der öffentlich-rechtlichen Eigentumsbeschränkungen, ÖREBKV, vom 2. September 2009).

6 SCHLUSSBETRACHTUNG

An diese Stelle sollen acht Stichwörter gesetzt werden, die für die Planung der unterirdischen Dimension der Stadt von Bedeutung sein können (vgl. RUCH/GRESCH/FLURY, 2013, S. 607):

- Betrachtung des ganzen Untergrunds, unabhängig von der Tiefe (keine Unterscheidung tiefer–untiefer Untergrund;
- Betrachtung aller Arten von Vorhaben und Nutzungen, unabhängig von der Grösse;
- Umfassende Beurteilung der Auswirkungen auf die Umwelt;
- Schaffung von hinreichenden gesetzlichen Grundlagen (im RPG, in kantonalen Rechten);
- Vitalisierung der Raumplanungsinstrumente, primär der Richtplanung und des Richtplans, Versuch dreidimensionaler Darstellung. Auch der Nutzungsplan sollte für die Festsetzung von Untergrundnutzungen herangezogen werden;
- Bessere «Vernetzung» der nach Sachgesetzen (z.B. Bergregalgesetzen, Kernenergie-, Eisenbahn-, Nationalstrassengesetz) abzuwickelnden Bewilligungsverfahren;
- «Veralltäglichung» der Koordination von Vorhaben;
- Harmonisierung der kantonalen und kommunalen Vorschriften.

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8 ABKÜRZUNGEN

a.E.: am Ende
ARE: Bundesamt für Raumentwicklung
BAFU: Bundesamt für Umwelt
BFS : Bundesamt für Statistik
BGE: Entscheidung des Schweizerischen Bundesgerichts
BR : Bundesrat
EGK: Eidgenössische Geologische Fachkommission
GEODH : Geothermal district heating
IDHEAP: Institut de hautes etudes en administration publique
PFC : Perfluorierte Chemikalien
PNR: Programme national de recherche
RPG: Bundesgesetz über die Raumplanung vom 22. Juni 1979 (mit gewichtigen Änderungen vom 15. Juni 2012)
SSV/IGGK: Schweizerischer Städteverband/Interessengemeinschaft Grosse Kernstädte
URP/DEP: Umweltrecht in der Praxis/Droit de l'environnement dans la pratique (Zeitschrift)
VOC: Flüchtige organische Verbindungen
ZBGR: Schweizerische Zeitschrift für Beurkundungs- und Grundbuchrecht (Zeitschrift)
ZGB: Schweizerisches Zivilgesetzbuch vom 10. Dezember 1907

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🏆 *reviewed paper*

Stand der Weiterentwicklung und Umsetzung des Standards XPlanung in Deutschland

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1 ABSTRACT

Das XPlanung Datenmodell zur verlustfreien Übertragung digitaler Bauleit-, Raumordnungs- und Landschaftspläne zwischen unterschiedlichen IT-Systemen wurde auf früheren CORP Konferenzen bereits mehrfach vorgestellt. Der vorliegende Beitrag beleuchtet den aktuellen Stand bei der Weiterentwicklung von XPlanung sowie bei der Umsetzung und Einführung des Standards in der öffentlichen Verwaltung in Deutschland. Dabei wird insbesondere auf die aktuell laufenden Bemühungen eingegangen, XPlanung und den verwandten XBau-Standard aus dem Bauwesen zu offiziellen, für bestimmte Anwendungsfälle verpflichtend zu benutzende Standards des IT-Planungsrates zu machen. Im Rahmen dieses Prozesses ist eine Bedarfsbeschreibung erstellt worden, die allgemein die Anforderungen an Austauschstandards im Planungs- und Bauwesen sowie die Anwendungsfälle, die von derartigen Standards profitieren würden, beleuchtet. Weiterhin geht der Beitrag auf die aktuelle Weiterentwicklung von XPlanung im Bereich der Raumordnungsplanung sowie auf die laufende Umsetzung und Einführung von XPlanung in der Freien und Hansestadt Hamburg ein.

Keywords: Stadtplanung, Bauleitplanung, INSPIRE, Regionalplanung, XPlanung

2 EINLEITUNG

Die Abwicklung von Verwaltungsvorgängen im Kontext von Bau- und Planungsprozessen findet heute nahezu ausnahmslos unter Einsatz entsprechender IT-Anwendungen und -Systeme statt. Trotz dieser Entwicklung wird bisher nur ein relativ geringer Teil des vorhandenen gewinnbringenden Potentials für die öffentliche Verwaltung im Bau- und Planungswesen genutzt. So werden benötigte Informationen im Laufe eines Planungsverfahrens bzw. im Rahmen eines Bauantragsverfahrens mehrfach manuell erfasst. Die Vorgänge in den Verwaltungen, die sich mit Planungs- und Bauvorhaben beschäftigen, sind in weiten Teilen von Medienbrüchen oder Transformationsverlusten durch Inkompatibilitäten geprägt.

Im Rahmen der E-Government Initiativen Deutschland-Online (2003-2009) und Media@Komm-Transfer (2004-2006) starteten die ersten Aktivitäten zur Definition eines Datenmodells und Datenformats zur Beschreibung der semantischen Inhalte von Planwerken der Raumordnung, Bauleit- und Landschaftsplanung (XPlanung) (Benner et al. 2005) bzw. der alphanumerischen Inhalte von Bauanträgen (XBau). Das „X“ steht dabei für XML (Extensible Markup Language) basierte Datenformate der öffentlichen Verwaltung (XÖV Standards). Die spezifizierten Datenmodelle XPlanung und XBau wurden zwar vom Präsidium des Deutschen Städtetages (XPlanung) im Jahr 2008 bzw. von der Bauministerkonferenz (XBau) im Jahr 2005 zur Einführung empfohlen, eine gesetzlich verbindliche Einführung unterblieb bislang jedoch. Mit dem Auslaufen der E-Government Initiativen war die Fortführung der Standardisierungsaktivitäten nicht gesichert. Dieses Ergebnis ist auch dem Umstand geschuldet, dass die Mitarbeit in den Arbeitsgruppen der E-Government Initiativen freiwillig und unverbindlich war. Für eine über einen Projektstatus hinaus regelmäßige Zusammenarbeit von Bund, Ländern und Kommunen bei der Spezifizierung von Vereinbarungen über IT-Standards fehlte bis zur Grundgesetzänderung im Zuge der Föderalismuskommission II die gesetzliche Grundlage.

Der neu eingeführte Artikel 91c GG (2009) ermöglicht nunmehr dem Bund und den Ländern eine Festlegung von Vereinbarungen der für die Kommunikation zwischen ihren informationstechnischen Systemen notwendigen Standards und Sicherheitsanforderungen. Der Bund und die Länder haben zur Ausführung des Artikel 91c GG einen Vertrag geschlossen, mit dem die Zusammenarbeit in diesem Bereich und die Einrichtung des IT-Planungsrates geregelt wurden. Dem IT-Planungsrat obliegt es, fachunabhängige und fachübergreifende IT-Interoperabiltäts- und IT-Sicherheitsstandards zu beschließen. Ein Instrument des IT-Planungsrats ist die Standardisierungsagenda, die den Zweck hat, im föderalen Kontext relevante IT-Standardisierungsbedarfe zu erfassen, zu klassifizieren und in transparenter und planmäßiger

Vorgehensweise einer Lösung zuzuführen. Ziel hierbei ist es, einzelne IT-Standards per Beschluss des IT-Planungsrats als Lösung zur Deckung zuvor definierter Standardisierungsbedarfe für Bund und Länder verpflichtend festzulegen. Der Arbeitskreis der E-Government-Staatssekretäre hat bereits im Jahr 2009 beschlossen, eine Koordinierungsstelle für IT-Standards (KoSIT) bei der Freien Hansestadt Bremen einzurichten, die basierend auf den Beschlüssen des IT-Planungsrates im Auftrag der Geschäftsstelle des IT-Planungsrates tätig wird. Die Standardisierungsagenda wird im Auftrag des IT-Planungsrats durch die KoSIT und den Beirat der KoSIT kontinuierlich fortgeschrieben.

Auf den ersten Blick ergibt sich nicht sofort eine Zuständigkeit des IT-Planungsrates für den Bereich Bau- und Planungswesen, da dieser doch eher fachlich begrenzt zu sein scheint. Der Charakter fachübergreifender Standards resultiert insbesondere aus der verfahrenssteuernden und koordinierenden Funktion von Baugenehmigungs- und Bauleitplanungsprozessen. Befasst sind zahlreiche Zuständigkeits- und Rechtsbereiche der öffentlichen Verwaltung einschließlich weiterer öffentlich-rechtlicher Aufgabenträger im privatisierten Sektor (z.B. Infrastrukturträger wie Wasserwerke oder Telekommunikationsdienstleister, Zweckverbände usw.). Vertikal sind sowohl die Kommunen und Landkreise als auch die Länder, der Bund und die Europäische Union in unterschiedlichen Rollen beteiligt. Die Beteiligung der genannten Ebenen beruht auf den jeweiligen unterschiedlichen Funktionen, zum Beispiel als Bauherr, als planende Stelle, als Genehmigungsstelle, als Antragsteller, als Träger öffentlicher Belange (etwa 50 Rechtsbereiche), als zuständige Baunebenrechtsdienststelle oder ähnliches.

Die Vielzahl der Akteure dokumentiert, dass die Standardisierung von Datenmodellen / Austauschformaten im Bau- und Planungswesen sich nicht eindeutig einer Organisationseinheit zuordnen lässt, da das Planungs- und Bauwesen viele Fachbereiche tangiert und somit querschnittsorientiert ist. Beispielsweise berührt der Standard XPlanung mindestens die Zuständigkeit von drei Fachministerkonferenzen (Ministerkonferenz für Raumordnung, Umweltministerkonferenz, Bauministerkonferenz), da mit einem Objektmodell die Inhalte von Planwerken der Raumordnung, Landschafts- und Bauleitplanung abgebildet werden können.

Schließlich fließen auch die Belange der Bürgerinnen und Bürger, z.B. als Bauherr, Bauvorlageberechtigter, Sachverständiger, Prüfingenieur, in die öffentlich-rechtlichen Verwaltungsverfahren ein. Sie sind eine notwendige und nicht wegdenkbare Verknüpfung, denn die Bürgerinnen und Bürger sind in öffentlich-rechtlichen Verwaltungsverfahren in unterschiedlichen Rollen betroffen, z.B. als Antragsteller, als Nachbar, als Bauunternehmer, als Bauleiter, als Bauproduktehersteller.

Im Herbst 2014 wurde durch den Beschluss des IT-Planungsrates auf Antrag des Bedarfsvertreters der Freien und Hansestadt Hamburg der Standardisierungsbedarf „Austauschstandards im Bau- und Planungsbereich" als fachübergreifenden Bedarf in die Standardisierungsagenda aufgenommen. Das Verfahren und Kriterien zur Aufnahme von Standardisierungsbedarfen auf die Standardisierungsagenda wurden von der KoSIT durch die Definition von zehn Meilensteinen definiert. In der Regel wird davon ausgegangen, dass der Standardisierungsprozess innerhalb von zwei Jahren abgeschlossen werden kann. Am Ende des Standardisierungsprozesses besteht das Ziel, dass der IT-Planungsrat zur Deckung des Standardisierungsbedarfs im Bereich Planen und Bauen einen Beschluss zur verbindlichen Nutzung der Standards XPlanung und XBau für den Datenaustausch innerhalb und mit der Verwaltung fassen soll.

3 ENTWICKLUNG FACHÜBERGREIFENDER AUSTAUSCHSTANDARDS IM PLANUNGS- UND BAUWESEN

In der Standardisierungsagenda werden die Austauschstandards im Planungs- und Bauwesen gemeinsam betrachtet. Der Weg, die vorhandenen Standards XPlanung und XBau zu verpflichtenden, fachübergreifenden Standards weiter zu entwickeln, kann deshalb nur gemeinsam beschritten werden. In diesem Abschnitt werden die allgemeine Vorgehensweise sowie der aktuelle Stand in diesem Prozess näher beleuchtet. Der Schwerpunkt der Darstellung liegt beim Standard im Planungswesen, es werden aber auch Gemeinsamkeiten und Unterscheide zum Standard im Bauwesen deutlich gemacht.

3.1 Allgemeine Vorgehensweise bei fachübergreifenden Standards

Am Anfang von Standardisierungsaktivitäten steht gemäß des Meilensteinkonzeptes der KoSIT (s. Tabelle 1) eine systematische Analyse von Anwendungsszenarien, in deren Kontext der Bedarf besteht, digitale Daten und digitale Planwerke verlustfrei zwischen unterschiedlichen Akteuren austauschen bzw. weiter in nachgelagerten Prozessen nutzen zu können. Diese Bedarfsbeschreibung wird durch ein Fachgremium erstellt und der Öffentlichkeit zur Stellungnahme vorlegt (Meilenstein M4). Erst auf dieser abgestimmten Basis werden potenzielle IT-Lösungen am Markt gesucht, bzw. wenn keine Lösungen am Markt für den entsprechenden Bedarf gefunden werden können, der Auftrag zur Modellierung einer Datenmodells und Austauschformats durch den Bedarfsvertreter in Auftrag gegeben (Meilensteine M5 und M6). Nachdem die Bedarfe formuliert und abgestimmt wurden (Meilenstein M7), muss analysiert werden, ob die vorliegenden Standards XBau und XPlanung die Anforderungen an verlustfreie Datenaustauschszenarien im Bereich Planen und Bauen erfüllen können. Falls sich durch die Bedarfsanalyse ergeben sollte, dass die Standards die Anwendungsfälle nicht abdecken können, werden diese Standards erweitert. Das Ergebnis wird der Öffentlichkeit erneut zur Stellungnahme vorgelegt (Meilenstein M8). Nach Dokumentation und Würdigung der eingegangenen Stellungnahmen wird ein abgestimmter Beschlussvorschlag für den IT-Planungsrat erarbeitet, und schließlich (Meilenstein M10) von diesem die verbindliche Nutzung der ermittelten Lösung beschlossen.

M1/M1	Der Standardisierungsbedarf wurde bei der KoSIT registriert (M1) und eine vorläufige Bedarfsbeschreibung wurde vorgelegt (M2).
M3	Auf Basis der vorläufigen Bedarfsbeschreibung wurde der Standardisierungsbedarf durch den IT-Planungsrat beschlossen und in die Standardisierungsagenda aufgenommen.
M4	Die Bedarfsbeschreibung wurde von einem Fachgremium vervollständigt und der Öffentlichkeit zur Stellungnahme vorgelegt.
M5/ M6/ M7	Die Stellungnahmen wurden dokumentiert und in die Beschreibung aufgenommen (M5). Auf der Basis erstellt ein Fachgremium eine Liste potenzieller Lösungen (M6) und bewertet sie an Hand der in der Beschreibung definierten Kriterien (M7).
M8	Das Bewertungsergebnis wird der Öffentlichkeit zur Stellungnahme vorgelegt. Eingehende Stellungnahmen werden dokumentiert und abgearbeitet.
M9/M10	Auf Basis eines abgestimmten Beschlussvorschlages (M9) beschließt der IT-Planungsrat die in seinem Zuständigkeitsbereich verbindliche Nutzung der ermittelten Lösung.

Tabelle 1: Meilensteine im Standardisierungsprozess der KoSIT

Die Festlegung verbindlicher Standard im Planungs- und Bauwesen auf Basis von XPlanung und XBau hat den Meilenstein M3 erreicht. Die für M4 notwendige überarbeitete Bedarfsbeschreibung ist erstellt und wurde zum Zeitpunkt der Erstellung dieses Beitrags noch von der Öffentlichkeit begutachtet.

3.2 Bedarfsbeschreibung der Austauschstandards im Planungs- und Bauwesen

Die beiden Austauschstandards haben einen wesentlichen technischen Unterschied, der in der Bedarfsbeschreibung herausgearbeitet wurde. Im Planungsbereich soll ein Datenformat für den interoperablen Austausch digitaler Planinformation entwickelt werden. Die Prozesse, mit denen diese Pläne aufgestellt, geändert, verbreitet oder genutzt werden sind nicht Gegenstand der Standardisierung. Für den Bereich des Bauwesens stehen dagegen gerade diese Prozesse im Vordergrund. Gegenstand der Standardisierung sind die verschiedenen mit dem Bauwesen verknüpften Fachverfahren, sowie die Daten, die innerhalb dieser Verfahren in Form von Nachrichten zwischen den beteiligten Akteuren ausgetauscht werden.

In vielen Fachverfahren spielen allerdings sowohl Planungsdaten als auch baubezogene Daten eine Rolle, was für eine enge Abstimmung zwischen beiden Standards spricht. Weiterhin gibt es eine Reihe allgemeiner, von beiden Standards zu erfüllender Anforderungen wie die Kompatibilität mit der Nationalen E-Government Strategie, der Nationalen Geoinformationsstrategie (NGIS), sowie den grundsätzlichen Vorgaben zur Spezifikation von Standards der öffentlichen Verwaltung (XÖV Standards).

3.2.1 Spezifische Anforderungen und Anwendungsfälle eines Austauschstandards im Planungswesens

Da es für den Planungsbereich mit XPlanung bereits einen etablierten und vielfach technisch erprobten Austauschstandard gibt (Benner 2008), orientierte sich die Bedarfsbeschreibung stark an der Funktionalität von XPlanung. Die folgenden zentralen technischen Anforderungen an ein standardisiertes Austauschformat für Planinformation wurden herausgearbeitet:

- Die Kompatibilität mit internationalen Normen und Standards (ISO 191xx, GML 3.2.1), mit europäischen Standards (INSPIRE), sowie mit relevanten nationalen Standards (ALKIS/NAS) im Bereich raumbezogener Daten.
- Eine vollständige Abbildung des nationalen Planungsrechts auf Bundesebene (ROG, BauGB, BauNVO, BNatSchG) und Landesebene (länderspezifische Raumordnungs- und Naturschutzgesetze), die es prinzipiell ermöglicht, das in einem bestimmten Gebiet gültige

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Planungsrecht automatisch abzuleiten, bereitzustellen, auszuwerten, und unter Einhaltung der gesetzlichen Vorgaben (z.B. der PlanZV) zu visualisieren.

- Die Unterstützung zweier verschiedener Varianten ("Profile") bei der Erfassung digitaler Planinformation:
  - Im Profil "Vollvektoriell" werden alle raumbezogenen Planinhalte als geographische Vektordaten (Referenz) erfasst, denen optional auch nicht-raumbezogene oder unstrukturierte Daten (z.B. textliche Festsetzungen, Dokumente oder Rasterbilder) zugeordnet werden können.
  - Im Profil "Teilvektoriell" muss lediglich der räumliche Geltungsbereich eines Plans vektoriell erfasst werden, dem alle nicht-raumbezogenen und unstrukturierten Planinhalte zugeordnet sind. Der eigentliche Planinhalt wird nur durch georeferenzierte, digitale Rasterdaten abgebildet. Optional können einzelne raumbezogene Planelemente zusätzlich noch vektoriell repräsentiert werden.
- Die Unterstützung der gängigen Planungspraxis, Planänderungen durch separate Änderungspläne zu erfassen und diese mit den geänderten Basisplänen zu verknüpfen.
- Die Unterstützung einer automatischen Transformation digitaler Planungsdaten in das INSPIRE Datenformat "Geplante Bodennutzung" (INSPIRE PLU) (Benner et al. 2013).

Zentraler Bestandteil der Bedarfsbeschreibung sind die Anwendungsfälle, bei denen die Nutzung der Standards zukünftig verpflichtend vorgeschrieben werden soll. Für den Planungsbereich hat sich ergeben, dass zwischen "generischen Anwendungsfällen" und "Anwendungsfällen in der Praxis" unterschieden werden muss. Die relevanten generischen Anwendungsfälle, die durch ein standardisiertes Austauschformat erheblich unterstützt würden, sind:

- Die Erstellung von teil- oder vollvektoriellen Plänen;
- Der Austausch von teil- oder vollvektorieller Planinformation;
- Die Speicherung von teil- oder vollvektoriellen Plänen;
- Die Bereitstellung von teil- oder vollvektorieller Planinformation.

Diese generischen Anwendungsfälle stellen keine eigenständigen Geschäftsprozesse in der Verwaltung dar. Sie finden sich allerdings als Bausteine in vielen Anwendungsfällen in der Verwaltungspraxis wieder. Die Bedarfsbeschreibung listet dafür beispielshaft folgende Anwendungsfälle auf:

- Planaufstellung;
- Planänderung (in zwei Varianten mit bzw. ohne einen vollvektoriell vorliegenden Basisplan);
- Planauskunft;
- Unterstützung von INSPIRE-Berichtspflichten.

In der Bedarfsbeschreibung werden sowohl generische als auch reale Anwendungsfälle informell beschrieben und als UML Anwendungsfalldiagramme dokumentiert.

3.2.2 Spezifische Anforderungen und Anwendungsfälle eines Austauschstandards im Bauwesen

Während der Austauschstandard im Planungswesen auf die Darstellung von Daten fokussiert (raumbezogene und georeferenzierte Inhalte von Planwerken), legt der Standard für das Bauwesen seinen Schwerpunkt auf Prozesse und Nachrichten. Weiterhin wird für diesen Standard eine XÖV Zertifizierung angestrebt, was die Einhaltung der im XÖV-Handbuch spezifizierten Konformitätskriterien und Regelungen beinhaltet.

Inhaltlich werden in der Bedarfsbeschreibung 11 Verfahren und Prozesse im Bereich der Verwaltungsverfahren der Bauaufsichtsbehörden identifiziert, wobei sich die rechtlichen Rahmenbedingungen an den Vorgaben der Musterbauordnung (MBO) orientieren. Es handelt sich um bauaufsichtliche Prozesse und um Nachrichten zwischen den an diesen bauaufsichtlichen Prozessen Beteiligten. Ein zentraler Fokus liegt dabei auf dem Baugenehmigungsverfahren, zu dessen Verfahrenshandlungen die Antragstellung, die Antragsprüfung und die Bescheid Erteilung gehören. Einzelne Verfahrenshandlungen der Bauaufsichtsbehörden im Baugenehmigungsverfahren (zum Beispiel die

Durchführung der Beteiligung von Behörden und Stellen, Benachrichtigung von Informationsempfänger oder Prüfung bautechnischer Nachweise) werden als eigene Verfahren differenziert, da sie auch in sonstigen Verwaltungsverfahren der Bauaufsichtsbehörde vorkommen. Weiterhin werden Verwaltungsverfahren beschrieben, die - wie das Baugenehmigungsverfahren - die Struktur eines Antragsverfahrens aufweisen, die aber nicht die Erteilung einer Baugenehmigung zum Gegenstand haben (z.B. Vorbescheidsverfahren, Abweichungsverfahren). Schließlich werden auch noch weitere relevante Verwaltungsverfahren im Aufgabenbereich der Bauaufsichtsbehörde wie z.B.: das Genehmigungsfreistellungsverfahren, das Verfahren zur Eintragung von Baulasten, Unterstützung der Betreiberpflichten beim Betrieb von Gebäuden, Anzeige des Baubeginns bzw. der Nutzungsaufnahme sowie Anzeige von Bauzuständen beschrieben.

4 STAND DER MODELLIERUNG DER STANDARDS PLANUNG UND BAU

Dieses Kapitel geht auf die nach derzeitigem Kenntnisstand notwendigen Weiterentwicklungen der aktuellen Versionen von XPlanung und XBau ein, damit die in der Bedarfsbeschreibung formulierten Kriterien erfüllt werden.

4.1 Auf dem Weg zum Standard XBau 2.0

Die erste Version des Standards XBau wurde zu einem Zeitpunkt modelliert, zu dem die aktuell durch die KoSIT definierten Vorgaben zur Modellierung eines XÖV Vorhabens noch nicht vorlagen. In einem ersten Iterationsschritt wurde das Datenmodell XBau 1.0 an die XÖV Modellierungsvorgaben und an die XÖV Werkzeuge hin zu einer Version XBau 1.1. angepasst. Ein Modellierungsgrundsatz bei XÖV Standards besteht u.a. darin, sogenannte XÖV Kernkomponenten zu definieren, die in einer Vielzahl von Standards wiederholt vorkommen (z.B. Anschrift). Für den Fall, dass in der ursprünglichen Version von XBau Objekte definiert wurden, die sich aktuell durch XÖV Kernkomponenten ersetzen ließen, wurden diese in einem weiteren Iterationsschritt durch diese Kernkomponenten ersetzt. Der vorliegende XBau 1.1 Standard muss auch inhaltlich noch an die sich in den vergangenen Jahren geänderten gesetzlichen Grundlagen der Musterbauordnung angepasst werden. Die aktuellen XÖV Modellierungsvorgaben eröffnen mittlerweile auch die Möglichkeit, raumbezogene GML codierte Geometrien zu referenzieren. Es besteht die Zielsetzung, diese Möglichkeit in einer Version XBau 2.0 zu nutzen, um z.B. Geometrien eines Lageplans für ein Bauvorhaben (z.B. geometrische Repräsentanz der äußeren Begrenzungen eines Vorhabens) digital in GML abbilden zu können. Zukünftig gilt es noch zu prüfen, welche Informationen ggf. aus einem XBau Dokument genutzt werden können, um Informationen generieren zu können, die helfen, ein Bauwerk ganzheitlich als digitales Bauwerksmodell (Building Information Modeling, BIM) beschreiben und verwalten zu können. Ein digitaler Bauantrag sollte in der Regel am Anfang des Lebenszyklus eines Gebäudes stehen und somit Bestandteil eines BIM Projektes sein. Eine weitere zukünftige Zielsetzung im Anschluss an die Veröffentlichung einer Version XBau 2.0 könnte darin bestehen, neben den alphanumerischen Informationen eines Bauantrages ebenso digitale Antragsgeometrien in einem noch zu spezifizierenden IFC Profil über einen XBau basierten digitalen Antrag an Baugenehmigungsbehörden zur Prüfung übermitteln zu können.

4.2 Auf dem Weg zum Standard XPlanung 5.0

Version 4.1 des Datenmodells XPlanung sowie des daraus abgeleiteten Austauschformats XPlanGML sind seit September 2013 freigegeben und durch Umsetzungen in verschiedenen Bundesländern und Kommunen, insbesondere in der Freien und Hansestadt Hamburg (FHH) praktisch erprobt (siehe Kap. 5). Zumindest für den Bereich der kommunalen Bauleitplanung ist damit erwiesen, das XPlanung die spezifizierten Anforderungen an einen "Austauschstandard Planung" erfüllt. Unter der Voraussetzung, dass im Rahmen der laufenden Öffentlichkeitsbeteiligung keine Forderungen nach einem erheblich erweiterten Funktionsumfang kommen, wird sich im Bereich der Fachschemata für Bebauungs- und Flächennutzungspläne die Version 5.0 des Standards nur unwesentlich von der aktuellen Version unterscheiden.

Ein offener Punkt ist dabei noch, ob es in der nächsten Version des Standards mehr Pflichtattribute gibt. Eine eindeutige Abbildung von XPlanung konformen Plänen auf das INSPIRE PLU Datenformat ist nur möglich, wenn bestimmte, vom XPlanGML Datenformat her optionale Attribute auch tatsächlich vorhanden sind. Es ist zu diskutieren, ob diese Verschärfung der Schemaregeln in die nächste Version fest integriert wird, oder nur als optionales "INSPIRE-Profil" definiert wird.

Im Bereich der Raumordnungsplanung ist der Weg zur Version 5.0 des Standards weiter. Aktuell werden nur die Regelungen des ROG abgebildet sowie, mit Hilfe von Schema-Erweiterungen (Benner et al. 2010) einige Raumordnungsgesetzte auf Länderebene. Das aktuell laufende Modellprojekt, alle länderspezifischen Raumordnungsgesetze XPlanung-konform zu modellieren, wird im folgenden Abschnitt beschrieben. Nach Abschluss des Projektes soll das Resultat ein integraler Bestandteil von XPlanung 5.0 werden.

4.3 Modellprojekt der Raumordnung (MORO) "Entwicklung und Implementierung eines Standards für den Datenaustausch in der Raumordnungsplanung"

Das vom Bundesministerium für Verkehr und digitale Infrastruktur (BMVI) geförderte und vom Bundesinstitut für Bau-, Stadt- und Raumforschung (BBSR) geleitete Modellvorhaben der Raumordnung (MORO) "Entwicklung und Implementierung eines Standards für den Datenaustausch in der Raumordnungsplanung" fokussiert sich auf die Weiterentwicklung des XPlanung 4.1 Kernmodells Regionalplan zu einem einheitlichen Fachschema der Raumordnungsplanung und dessen praktikabler, softwaretechnischer Nutzung. Hierbei sollen die Anforderungen der rechtsverbindlichen zeichnerischen Festlegungen aller Bundesländer berücksichtigt werden. Ein im Projekt zu entwickelnder webbasierter und quelloffener Konverter soll Transformationen von Shapefiles nach XPlanGML und mit geringem Aufwand von XPlanGML in das europäische INSPIRE PLU Schema ermöglichen. Weiterhin soll ein Thesaurus der Raumordnung erstellt werden, der Definitionen verschiedener Modellelemente darstellt und wahlweise semantische Unterschiede zwischen Planungsträgern für einzelne Modellelemente enthalten kann. Letztlich soll auch ein Konzept zur Bereitstellung der Raumordnungsdaten in einem Geodienst erarbeitet und die mögliche Visualisierung anhand von Styled Layer Descriptors (SLDs) vorbereitet werden.

Das existierende Kernmodell Regionalplanung als Spezialisierung des XPlanGML Basisschemas leitet seine Klassen aus den gesetzlichen Rahmenbedingungen des Raumordnungsgesetzes und Teilen der Landesplanungsgesetze ab (IT-Planungsrat 2012). Da das Kernmodell die in Deutschland verwendeten verbindlichen zeichnerischen Planelemente jedoch weder erschöpfend noch in ihrer Präzision für die Planträger zufriedenstellend abdeckt, ist eine Weiterentwicklung um sinngerechte Elemente aus der Praxis notwendig.

In XPlanung wurden auf Basis des Kernmodells Regionalplanung bereits länderspezifische Erweiterungen für Rheinland-Pfalz (RLP-Schema), Nordrhein-Westfalen (NRW-Schema) und Niedersachsen-Schleswig-Holstein-Mecklenburg-Vorpommern (NSM-Schema) entwickelt. Diese konnten durch den Application Domain Extension (ADE) Mechanismus, welcher seit XPlanGML 4.0 existiert, wahlweise an das Kernmodell angegliedert werden. Für eine erweiterte ganzheitliche Struktur der Raumordnung wurden die Ländermodelle nun direkt in das Modell integriert und harmonisiert. So wurden etwa Redundanzen von gleichen Werten aus verschiedenen Ländermodellen entfernt und Auflistungswerte angeglichen.

Für die weitere Modellierung bildete insbesondere der Raumordnungsplanmonitor (ROPLAMO) des BBSR eine Datenbasis. Dieser enthält eine Auflistung aller rechtsverbindlichen zeichnerischen Festlegungen der Raumordnung Deutschlands inklusive verschiedener Metadaten, etwa den spezifischen Rechtscharakter oder Gebietstyp einzelner Werte (Zaspel & Einig 2012). Durch den Versuch der Zuordnung aller verbindlichen zeichnerischen Planelemente zu XPlanGML-Klassen und -Enumerationen des erweiterten Modells konnten Lücken identifiziert werden, auf deren Grundlage Erweiterungen konzipiert wurden. In iterativer Folge konnten die ROPLAMO-Daten so erneut dem Modell zugeordnet werden und, falls nötig, weitere Modelländerungen vorgenommen werden.

Während das so nach mehreren Anpassungsdurchgängen erweiterte Modell konzeptionell alle verbindlichen zeichnerischen Planelemente des ROPLAMO abdecken konnte, war es gleichwohl notwendig, das Modell in wesentlichen Punkten mit den Planträgern zu besprechen und gegebenenfalls den Expertenwünschen anzupassen. Dies geschah einerseits in Absprache mit der Arbeitsgruppe E-Government des Ausschusses für Struktur und Umwelt der Ministerkonferenz der Länder, die das Projekt betreut und aus Planungsexperten einzelner Länder besteht, und andererseits durch Gespräche mit den Planträgern in den Ländern selbst. Hierbei wurde in jedem Flächenland ein Termin zur Vorstellung und Absprache des Modells angesetzt, um das Projekt den Planungsträgern näher zu bringen und einzelne Modellierungsfragen zu klären.

Auf Basis des so erhaltenen Modells konnten nun weitere Projektschritte angegangen werden. Falls jedoch durch Praxistests und späterer Nutzung Elemente auftauchen werden, die das derzeitige Modell nicht abdeckt, was etwa bei Neuplänen mit neu erstellten zeichnerischen Festlegungen auftreten kann, lassen sich diese durch bereits in XPlanGML eingebaute Mechanismen wie offene Codelisten, generische Objekte oder ADE-Schnittstellen abbilden und gegebenenfalls in eine spätere Version des Standards übernehmen.

Für die Praxistests während des Projektzeitraums und zur Unterstützung bei der Erstellung von XPlanGML und INSPIRE PLU wird im Projektzeitraum der zu entwickelnde quelloffene Konverter verwendet. Für die Umwandlung nach INSPIRE sind hierfür auf Basis von Benner (2013) Transformationsregeln erstellt worden, die in XPlanGML vorhandene Elemente zum Beispiel durch Extensible Stylesheet Language Transformations (XSLT) nach INSPIRE umwandeln können. Weiterhin wurde auch eine Nationale Codeliste für die INSPIRE-Klasse SupplementaryRegulation erstellt, die sich stark an den Elementen und Enumerationen von XPlanGML orientiert. Die Klasse SupplementaryRegulation modelliert in INSPIRE PLU Planelemente ohne Flächenschluss, welche unter Berücksichtigung von Ausnahmen generell die zeichnerischen Elemente der Raumordnung wiedergeben. Die durch das Attribut specificSupplementaryRegulationValue referenzierte Nationale Codeliste orientiert sich in ihrem Aufbau streng an XPlanGML, soll bei jeder Transformation mit dem Projektkonverter übermittelt werden und erlaubt eine genauere Interpretation von deutschen Raumordnungsplänen in INSPIRE, da sie neben der relativ offenen INSPIRE Klassierung spezifischere nationale Werte mitgibt.

Das generelle Problem von klassierten Austauschmodellen mit definitorischen und semantischen Unterschieden innerhalb von Klassen und Werten trifft neben der relativ offenen Klassierung von INSPIRE auch im geringeren Maße im Raumordnungsmodell von XPlanung auf. Als Austauschstandard sind diese Definitionen zur Interpretation und Weiterverwendung der Daten notwendig (Würriehausen et al. 2014). Sie könnten dabei theoretisch durch Textfelder oder Listen im Modell übermittelt werden. Unter anderem aus Handhabbarkeits-, Vergleichbarkeits- und Zugangsgründen ist es allerdings sinnvoll, diese Definitionen extern zu führen, wofür im Projektrahmen mit der Software iQvoc (IqVoc 2016) ein Thesaurus der Raumordnung aufgesetzt wurde. Dieser erlaubt die Aufnahme von spezifischen Definitionen durch die einzelnen Planungsträger als Referenz, welche durch verschiedene Beziehungen mit anderen Elementen im internen Thesaurus oder auch mit externen Thesauri in Verbindung gesetzt werden können. Ein Thesaurus ist in diesem Zusammenhang ein kontrolliertes Vokabular, welches strikter als eine einfache Taxonomie zu sehen ist, die oft nur nach Hierarchien gliedert. Er wird jedoch offener als eine Ontologie gehandelt. Ontologien enthalten neben verschiedenen Beziehungen auch Axiome und Restriktionen, sind wegen ihrer komplexen Struktur jedoch schwer zu handhaben und pflegen. Der auf Projektebene entwickelte Thesaurus enthält dabei vorerst primär Einträge zu XPlanung, INSPIRE und Definitionen der einzelnen Bundesländer. Grund hierfür ist die aus Projektsicht gewünschte primäre Nutzung als Referenz statt als allgemeinen kompletten Thesaurus der Raumordnung. Ein solcher könnte jedoch in Zukunft aus der gegebenen Struktur entwickelt werden, wenn derzeit notwendige Duplizitäten entnommen werden und eine einheitliche Strukturierung einzelner Begrifflichkeiten jenseits von XPlanung herausgearbeitet werden kann.

Die Strukturierung von XPlanGML in ein Basisschema und davon abgeleitete Fachschemata erlaubt eine konfliktarme Übernahme von dem im Projekt entwickelten Raumordnungsmodell in eine zukünftige Version des Standards, da Modelländerungen von Projektseite nur auf Fachschemaebene stattfanden. Nichtsdestotrotz könnten wichtige Projektschritte wie die an XPlanung angelehnte Nationale INSPIRE-Codeliste und die Ergänzung und Sammlung von Definitionen durch einen Thesaurus gleichfalls für andere Fachschemata erstellt werden.

Falls die Ergebnisse des Projekts in den zukünftigen Standard XPlanung 5.0 Eingang finden, kann dieser somit als verlustfreies Datenaustauschformat in der Raumordnungsplanung Deutschlands verwendet werden, eine erleichterte Transformation für Raumordnungsdaten nach INSPIRE PLU ermöglichen und die Datenhaltung im Datenaustausch entscheidend verbessern.

5 DIE EINFÜHRUNG VON XPLANUNG IN DER FREIEN UND HANSESTADT HAMBURG

Die FHH hat das Ziel, den Standard XPlanung sowohl aus Stadt- als auch auf Bezirksebene einzuführen. Welche Schritte dazu bereits durchgeführt wurden bzw. sich derzeit in der Umsetzung befinden wird im weiteren beleuchtet.

5.1 XPlanungs-konforme Erfassung des bestehenden Planungsrechtes

In der FHH werden im Zeitraum 2013-2017 alle geltenden Planwerke der verbindlichen Bauleitplanung (ca. 1.800 Bebauungspläne, ca. 80 Baustufenplänen, ca. 300 Durchführungspläne und ca. 550

Teilbebauungspläne) der verbindlichen Bauleitplanung gemäß dem Objektmodell XPlanung neu digitalisiert und als XPlanGML Dateien über OGC-konforme Darstellung- und Downloaddienste bereitgestellt. Neu erstellte Planwerke, die von der Verwaltung bzw. von externen privaten Planungsbüros erarbeitet werden, müssen gemäß der „Fachanweisung Bauleitplanung – Verfahren“ der Senatskommission für Stadtentwicklung und Wohnungsbau der FHH vom 08.11.2012 ebenfalls im Format XPlanGML bereitgestellt werden. Auf Basis dieses Datenbestandes können sowohl die Bereitstellungspflichten im Rahmen der Umsetzung der INSPIRE Richtlinie zum Thema des Annex III „Bodennutzung“ als auch die Bereitstellungspflichten des Hamburger Transparenzgesetzes (HmbTG) erfüllt werden. Das HmbTG verpflichtet die Verwaltung ab dem 06.10.2014 u.a. zur Bereitstellung von öffentlichen Planwerken im Informationsregister (Transparenzportal: http://suche.transparenz.hamburg.de) in einem offenen, herstellerunabhängigen und maschinenlesbaren Datenformat. Das Format XPlanGML erfüllt diese Voraussetzungen. Neben diesen gesetzlichen Bereitstellungspflichten ist die Bereitstellung von standardisierten Daten der Bauleitplanung eine Voraussetzung für die Etablierung von E-Government Prozessen im Bau- und Planungsbereich (z.B. digital gestützte Baugenehmigungsprozesse, Beteiligungsprozesse, Monitoring, usw.).

Das geltende Planrecht wird mit Hilfe der AutoCAD-Applikationen WS-LANDCAD bzw. mit der ArcGIS Erweiterung AED-SYNERGIS GeoOffice durch den LGV digital neu erfasst. Bebauungspläne werden, soweit diese von der öffentlichen Verwaltung eigenständig in den Bezirken der FHH erstellt werden, generell mit WS-LANDCAD konstruiert, währenddessen Planwerke der vorbereitenden Bauleitplanung zukünftig auf Basis des geografisches Informationssystems der Firma ESRI „ArcGIS“ erstellt werden. Die Digitalisierung und Übertragung der in den Planwerken der verbindlichen Bauleitplanung dokumentierten Festsetzungen, Kennzeichnungen und Hinweise orientiert sich an der Lage der aktuellen Örtlichkeit der Liegenschaftskarte (ALKIS). So werden Festsetzungen, die sich auf eindeutig in der Liegenschaftskarte identifizierbare Örtlichkeiten beziehen, geometrisch an diese Örtlichkeiten angepasst (z.B. Baukörperausweisungen). Die Planwerke können aus den jeweiligen Erfassungssystemen in der Version XPlanGML 4.1 jeweils verlustfrei im- bzw. exportiert werden.

Alle Bauleitpläne sowie die entsprechenden Darstellungs- und Downloaddienste werden im Hamburger Metadatenkatalog (HMDK) mit Metadaten beschrieben. Als Downloadressource wird für jeden Plan der Verordnungstext eines Bebauungsplans (B-Plans), inkl. der Plangrafik und den textlichen Festsetzungen als PDF Datei angeboten. Weiterhin werden die Begründung des Planwerkes als PDF Datei und als OGC konformer WFS 2.0 Aufruf „stored query“ in dem komplexen XPlanungs Schema bereitgestellt. Allgemein ermöglicht ein WFS den Web basierten Zugriff auf geographische Features in Datenbanken und gibt das Ergebnis mindestens als unabhängiges Dateiformat Geography Markup Language (GML) zurück. In einer „stored query“ werden serverseitig Filterdefinitionen gespeichert, die in einer Anfrage referenziert werden können. So kann z.B. ein Filter definiert werden, der alle Geometrien eines Bauleitplans als auch die textlichen Festsetzungen über die Angabe des entsprechenden B-Plan Namens in der WFS Abfrage im Format XPlanGML bereitstellt. Informationen über Bauleitpläne sowie Downloadressourcen zu den Inhalten von Bauleitplänen sind über die initiale Beschreibung im HMDK ebenso in anderen Metadatenkatalogen auf nationaler bzw. europäischer Ebene recherchierbar. Neben einer Veröffentlichung in „klassischen“ GDI Metadatenkatalogen können Bauleitpläne auch in Metadatenkatalogen im Open Data Kontext recherchiert werden.

5.2 Aufbau des zentralen Planungsinformationssystems PLIS

Ab dem Jahr 2011 wird kontinuierlich im Rahmen des Aufbaus der Geodateninfrastruktur der FHH ein zentrales Planungsinformationssystem (PLIS) entwickelt. Ziel des Vorhabens ist die Einrichtung einer zentralen Infrastruktur zur Pflege und Speicherung von Planungsdaten in einer einheitlichen semantischen Struktur auf Basis des E-Government Standards XPlanung, sowie der Aufbau einer Verfahrensdatenbank zur Dokumentation von Bauleitplanverfahren. Bedingt durch die Vorgabe, die Planwerke konform dem Standard XPlanung über aktuelle OGC-konforme Web Services (WMS 1.3 / WFS 2.0) bereitzustellen und somit auch die INSPIRE Anforderungen an Darstellungs- und Downloaddienste erfüllen zu können, werden die Planwerke auf technischer Basis des GDI-HH OpenSource Fachdatenserver (basierend auf dem Open Source Framework deegree, http://www.deegree.org/) bereitgestellt. Der auf Basis von deegree bereitgestellte WFS 2.0 XPlanGML Dienst ist in der Lage, die Planwerke sowohl in einem vereinfachten (synthetisierten)

XPlanung GML Anwendungsschema (XPlanSynGML) als auch in dem komplexen XPlanGML Anwendungsschema bereitzustellen. Die Bereitstellung in einem vereinfachten Schema bietet den Vorteil, dass dieser WFS Dienst von gebräuchlichen WFS Clients genutzt werden kann, währenddessen die Nutzung des WFS Dienstes, der die Daten im originären komplexen Anwendungsschema bereitstellt, vielen Anwendungen, die eine WFS Importschnittstelle anbieten, noch technische Schwierigkeiten bereitet.

Die Bauleitpläne werden je nach Planstatus über einen der bislang implementierten drei Endpoints bereitgestellt. Je nachdem ob es sich bei den bereitgestellten Planwerken um festgesetzte (geltende) Planwerke, um Planwerke, die sich in einem Aufstellungsverfahren befinden oder um Planwerke, die bereits untergegangen sind und somit aktuell kein geltendes Planrecht mehr dokumentierten, handelt, werden diese Planwerke über den jeweiligen Endpoint sowohl als Darstellungs- und als Downloaddienste bereitgestellt. Die Vorgabe des Hamburger Transparenzgesetzes, dass öffentliche Daten, die einmal veröffentlich wurden, mindestens für zehn Jahre der Allgemeinheit zur Nachnutzung bereitzustellen sind, bedingt die Bereitstellung von untergegangenen öffentlichen Plänen auch noch zu einem Zeitpunkt, zu dem aus dem Planwerk kein Planungsrecht mehr abgeleitet werden kann. Aktuell ergibt sich aus Rückmeldungen aus der Planungspraxis die Notwendigkeit, Planwerke, die sich im Aufstellungsverfahren befinden und die bislang zentral über einen Endpoint bereitgestellt werden, je nach Verfahrensstand zu differenzieren. Bei den Verfahrensständen soll zwischen Planwerken, die sich intern in der Behörden- und Träger öffentlicher Belange Abstimmung befinden und zwischen Planwerken, die für die Öffentlichkeit bereitgestellt werden, unterschieden werden. Für diese zwei Fallgruppen soll zukünftig je ein Endpoint bereitgestellt werden, so dass Planwerke gezielt für einen Adressatenkreis bereitgestellt werden können. Die Planwerke können sowohl transparent (der Geltungsbereich eines Planwerkes wird jederzeit angezeigt) als auch vollflächig als WMS bereitgestellt werden.

Im Kartenclient der Beteiligungsplattform wird der XPlanGML WMS-Dienst transparent über der originären Rasterplangrafik bereitgestellt. Damit ist es möglich, die Festsetzungen (inkl. textlicher Festsetzungen) im Portal über eine „GetFeatureInfo“ Anfrage an den deegree-basierten XPlanGML WMS abzufragen. Eine GetFeatureInfo Anfrage stellt Sachinformationen zu einer Position im dargestellten Kartenausschnitt bereit, z.B. die Art und das Maß der baulichen Nutzung in einem Baufenster.

Um zu gewährleisten, dass nur syntaktisch, geometrisch und semantisch korrekte XPlanGML Dateien im Open Source Fachdatenserver gespeichert werden, erfolgt eine Validierung der Daten in der Open Source Anwendung „XPlanManager“. Nur wenn die Planwerke erfolgreich validiert wurden, können diese in die Datenhaltung importiert werden. Die Anwendung XPlanManager dient auch weiterhin als Verwaltungs- und Recherchetool für digitale Bauleitpläne. Über diese Anwendung können auch die XPlanGML-Dateien mit der entsprechenden Dokumentation des Verfahrens in der Verfahrensdatenbank verknüpft werden. Das Objektmodell XPlanung sieht vor, dass externe Datensätze über das Attribut „internalId“ mit einem XPlanGML Datensatz verknüpft werden können. Mit Hilfe dieses Attributes kann eine Kennung (id) eines Datensatzes, in dem weitergehende Informationen zu einem Planwerk in einem externen Informationssystem gespeichert werden, referenziert werden. Aus den Verfahrensangaben, der Geometrie des minimal umgebenden Rechteckes („Bounding Box“) eines Planwerkes, und aus dem WFS 2.0 „stored query“ Aufruf werden mit Hilfe eines Transformationsprozesses synthetisch Metadatensätze generiert, die danach in den HMDK importiert werden können. Der XPlanManager ermöglicht es ebenso, Metaangaben (Attribute des Objektes BP_Plan) zu einem Planwerk zu editieren. Somit können Browser basiert Angaben oder Inhalte, die sich auf den Geltungsbereich eines Planwerkes beziehen, geändert werden.

6 ZUSAMMENFASSUNG UND AUSBLICK

Das Datenmodell XPlanung sowie das daraus abgeleitete Austauschformat XPlanGML werden seit mehr als 10 Jahren entwickelt. Obwohl sich viele Stellen auf kommunaler Ebene, Kreis- und Landesebene seit längerer Zeit mit XPlanung beschäftigen, steht eine flächendeckende Einführung des Standards in den Regelbetrieb der öffentlichen Verwaltung, mit Ausnahme der Freien und Hansestadt Hamburg, noch aus. Die im Beitrag geschilderten Aktivitäten, XPlanung zusammen mit dem Standard XBau aus dem Bauwesen zu fachübergreifenden, für bestimmte Anwendungsfälle verpflichtend einzusetzende Austauschstandards der öffentlichen Verwaltung zu erklären, sollten die Umsetzung und Einführung von XPlanung im Bereich der kommunalen Bauleitplanung unterstützen und beschleunigen. Nach heutigem Stand ist im Jahr 2017 mit einem entsprechenden Beschluss des IT-Planungsrates zu rechnen.

Im Bereich der Raumordnungsplanung ist der Beschluss, die entsprechenden Pläne zukünftig XPlanung konform zu erfassen und auszutauschen sowie bestehende Pläne in den Standard zu überführen, bereits getroffen. Die aktuell noch bestehenden technischen Probleme, alle länderspezifischen Planinhalte im Datenmodell abzubilden, werden gerade im Rahmen eines Modellprojektes des Bundesinstitutes für Bau-, Stadt- und Raumforschung (BBSR) beseitigt. Nach Abschluss dieses Projektes und Freigabe durch die zuständigen Gremien der Ministerkonferenz für Raumordnung werden die Ergebnisse in die nächste Version 5.0 des XPlanung Standards einfließen.

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Stresstest städtischer Infrastrukturen – ein Experiment zur Wahrnehmung des Alters im öffentlichen Raum

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1 ABSTRACT

Im Zuge des demographischen Wandels ist ein deutlicher Anstieg des Bevölkerungsanteils an Seniorinnen und Senioren (Personen ab 65 Jahren) in Deutschland abzusehen. Dadurch wächst auch die Anzahl der mobilitätseingeschränkten und behinderten Menschen. Insbesondere für die Gruppe der über 80-Jährigen spielen barrierearme Wege eine große Rolle, sie stellen dementsprechend eine zunehmend wichtiger werdende Herausforderung für die räumliche Planung dar.

In einer Pilotstudie wurde hierfür im Bochumer Stadtteil Querenburg versucht, Barrieren (nach DIN 18040-3 etc.) in einem „barrierefreien Stadtplan" zu erfassen. Es stellt sich jedoch die Frage, ob es tatsächlich diese Barrieren sind, die den mobilitätseingeschränkten Verkehrsteilnehmerinnen und -teilnehmern Stress verursachen. Um diese Problematik zu klären, wurde die Technik des „EmoMapping" (dt. Emotionskartierung) verwendet. Dieses Verfahren dient dazu, Emotionen von einzelnen Personen mit einer Georeferenz zu erfassen. Zu diesem Zweck wurden Testpersonen mit einem Alterssimulationsanzug, einem GPS-Logger zur Erfassung der geographischen Position sowie einem Sensorband, welches die Hautleitfähigkeit und die Hauttemperatur misst, ausgestattet. In Testläufen wurden durch Erkennung von Mustern besondere Situationen, in denen die Probanden Stress verspürten, positionsgenau erfasst.

Anschließend wurden die Messdaten des GPS-Loggers und des Sensorbands ausgewertet und kombiniert. Die daraus resultierenden Ergebnisse wurden als Dichtekarten (Heatmaps) in einem Geoinformationssystem dargestellt. Aus diesen wurde ersichtlich, an welchen Stellen im Straßennetz die Probanden Stress empfunden haben. Im Anschluss daran wurden die Daten des barrierefreien Stadtplans mit den Ergebnissen des EmoMappings validiert und die einzelnen Barrierearten hinsichtlich ihrer Relevanz für eine barriere- und stressfreie Navigation eingeschätzt.

Da die Auswertung der Daten aus dem EmoMapping bislang nicht automatisiert und über verschiedene Software durchgeführt wurde, konnten die Daten nicht sehr zeitnah ausgewertet werden. Auch der Arbeitsaufwand war als relativ hoch einzustufen. Deshalb wurde im Rahmen einer Bachelorarbeit ein Werkzeug entwickelt, mit welchem sich die einzelnen Arbeitsschritte der Auswertung automatisiert durchführen lassen. Das Tool wurde in der frei verfügbaren Programmiersprache „R" entwickelt und erleichtert den bisherigen Arbeitsablauf der Auswertung deutlich. Das lässt in Zukunft eine erhöhte Nutzung der EmoMapping-Methode zu.

Keywords: Barrierefreier Stadtplan, Demographischer Wandel, EmoMapping, Emotionskartierung, Smart planning

2 DEMOGRAPHISCHER WANDEL

Der demographische Wandel beschreibt die Veränderung der Zusammensetzung der Bevölkerungsstruktur und wird im Wesentlichen durch die Summe der drei folgenden Faktoren beeinflusst (vgl. Hoßmann & Münz 2009):

- Geburtenrate
- Lebenserwartung
- Wanderungssaldo

In Deutschland liegt die Geburtenrate mit derzeit 1,4 Kindern je Frau auf einem niedrigen Niveau und wird laut Prognosen in den nächsten Jahren auf maximal 1,6 Kindern je Frau ansteigen. Dies wäre allerdings immer noch weit unter dem Bestandshaltungsniveau von 2,1 Kindern je Frau. Im Gegensatz dazu soll die

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durchschnittliche Lebenserwartung um 6 bis 9 Jahre ansteigen, sodass Männer im Durchschnitt 84,8 bis 86,7 Jahre und Frauen 88,8 bis 90,4 Jahre zu leben haben. Das Wanderungssaldo beschreibt die Differenz zwischen Zu- und Fortzügen. Eine Vorhersage hierfür beschreibt ein Absinken von derzeit ca. 500.000 Personen in den nächsten Jahren bis 2021 auf zwischen 100.000 und 200.000 Personen (vgl. Statistisches Bundesamt 2015).

Dies bedeutet, dass zukünftig der Anteil an Seniorinnen und Senioren in Deutschland steigt und der Anteil der unter 20-Jährigen sinkt. Daraus folgt ein Anstieg der Anzahl altersbedingter Krankheiten und damit auch das Risiko für gesundheitsbedingte Beeinträchtigungen, wie Mobilitätseinschränkungen oder Behinderungen (vgl. Grünheid & Fielder 2013). Trotz der aktuell hohen Zuwanderungen kann der Alterungsprozess in Deutschland nicht umgekehrt werden. Es wird lediglich ein kurzfristiger Anstieg der Bevölkerung verzeichnet (Statistisches Bundesamt 2016).

3 BARRIEREFREIER STADTPLAN

Unter den Gesichtspunkten des demographischen Wandels und der damit einhergehenden Alterung der Bevölkerung in Deutschland, wird derzeit in einem Pilotprojekt ein barrierefreier Stadtplan für die Stadt Bochum erstellt. Zu diesem Zweck sind Barrieren, in Anlehnung an die DIN 18040-3, in einem Testgebiet (im Stadtteil Querenburg) erfasst worden.

Durch die Entwicklung eines Datenmodells wurden die aufzunehmenden Barrieren festgelegt. Wie in Tabelle 1 zu sehen, beinhaltet das entstandene Modell acht Kategorien, die in ihren Attributen weiter spezifiziert und mit verschiedenen Geometrien dargestellt werden.

Objektart	**Geometrie**
Hindernisse (Schlagloch, Laterne, Baum u.a.)	Punkt
ÖPNV-Haltestellen	Punkt
Treppen und Rampen	Punkt
Übergänge (Zebrastreifen, Ampeln)	Punkt
Öffentliche WC-Anlagen	Punkt
Straßen und Wege	Linie
Steigungen	Linie
Parkplätze	Fläche

Tabelle 1: Arten der erfassten Barrieren mit Geometrie

Nachdem das Datenmodell festgelegt war, sind die Barrieren des Testgebietes erfasst worden. Diese wurden mittels der Smartphone App „Collector for ArcGIS“ (der Firma ESRI) während einer Ortsbegehung erfasst. Es wurden die Positionen einzelner Barrieren über GPS bestimmt und beschreibende Informationen (Sachdaten) eingefügt. Die Genauigkeit der Datenaufnahme beläuft sich auf weniger als zehn Meter, dies entspricht der üblichen GPS-Genauigkeit (Witte & Sparla 2015). Zusätzlich konnte mit Hilfe von Hintergrundkarten von OpenStreetMap und hochauflösenden Orthophotos der Stadt Bochum die Position manuell angepasst und verbessert werden. Die aufgenommenen Objekte sind anschließend in ein Geoinformationssystem übertragen und auf deren Grundlage ein „Barrierefreie Stadtplan“ des Aufnahmegebietes erstellt worden. Dieser steht als Grundlage für weitere Projekte zur Verfügung. (siehe Abbildung 1).

4 EMOMAPPING

Unser Alltag wird durch Emotionen erheblich beeinflusst. Deshalb nehmen sie bei Planungsprozessen einen zunehmenden Platz ein. Die EmoMapping-Methode ist ein Forschungsfeld aus dem Bereich der Humansensorik, die den Menschen als Sensor nutzt und Vitaldaten über ihn liefert siehe dazu Wilhelm et al. (2015). Pionier dieser Messmethodik ist Christian Nold, der mit seinen Experimenten zum Thema „Biomapping“ und „Emotional Carthography“ den Grundstein für die Verortung von humansensorischen Messungen gelegt hat (Nold 2009). In der räumlichen Planung wurden diese Verfahren experimentell erstmals von Höffken et al. (2008) und Zeile et al. (2009) in Mannheim angewendet. Bei dieser Methodik werden biostatische Signale gemessen und als Emotionen interpretiert. Eindeutig messbar sind dabei negative Erregungen, die als „Stress“ interpretierbar sind (vgl. Kreibig 2010, Exner et al 2012). Durch die relativ einfache Identifikation von „Stresspunkten“ wurde die Methode des psychophysiologischen Mappings (Monitoring) für das Projekt in Bochum gewählt, die im Folgenden erläutert ist.

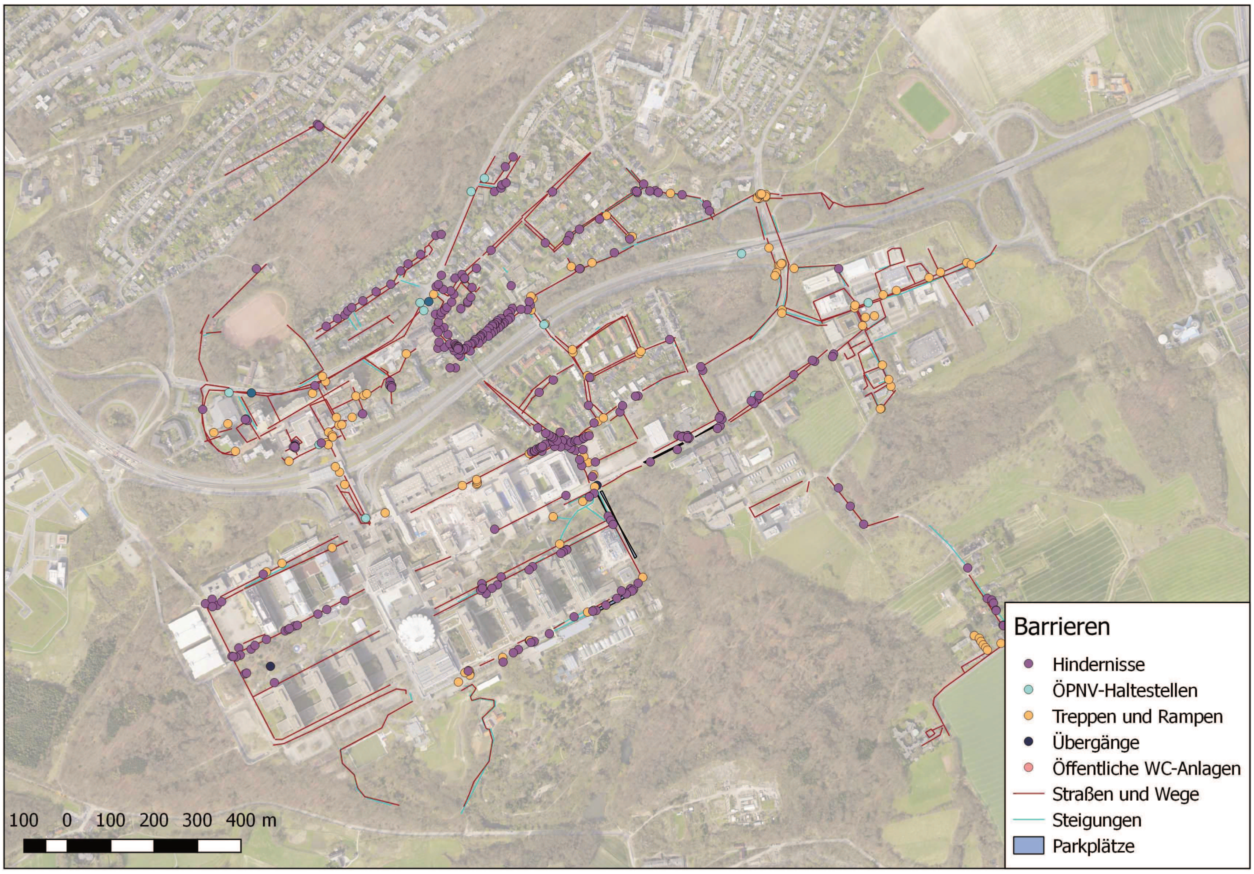

Abbildung 1: Barrierefreier Stadtplan im Testgebiet "Stadtteil Querenburg" (Hintergrundkarte: WMS Luftbild Bochum 2015)

4.1 Psychophysiologisches Monitoring

“Innerhalb der Emotionsforschung bietet das psychophysiologisches Monitoring die optimale Methode zur Messung stadträumlicher Barrieren durch Feststellen von georeferenzierten Stressreaktionen” (Bergner et al. 2011: 43). Bei diesem Verfahren werden die Leitfähigkeit und Temperatur der Haut (Vitaldaten) einer Person, unter Berücksichtigung von Ort und Zeit, aufgenommen. Probanden werden dazu mit einem Sensorarmband (BMS Smartband von bodymonitor.de) einem GPS-Logger (alternativ mit einem GPS-fähigen Smartphone) ausgestattet. Durch die zeitlich synchrone GPS-Messung sind diese physiologischen Daten lokalisierbar (vgl. Zeile et al. 2013).

Das Ziel ist es, mit diesen Daten Stressmomente zu identifizieren. Dies geschieht durch Erkennung von Mustern, die sich an den Stellen herausbilden, bei denen Probanden negative Emotionen (z. B. Angst oder Ärger) verspüren. Es entsteht der sogenannte „kalte Angstschweiß“, durch den die Hautleitfähigkeit ansteigt und kurz darauf die Hauttemperatur abfällt. Bei diesem auftretenden Phänomen ist von sog. „Stressmomenten“ die Rede (vgl. Groß et al. 2015).

4.2 Durchführung des EmoMappings im Testgebiet Querenburg

Zur Einschätzung der Vollständigkeit des barrierefreien Stadtplans wurde im Testgebiet Querenburg ein psychophysiologisches Mapping mit 13 Probanden durchgeführt. Diese waren mit der Standardausrüstung (Sensorarmband und GPS-Logger), die um einen Alterssimulationsanzug erweitert wurde, ausgestattet.

Der Alterssimulationsanzug GERT (Gerontologischer Anzug) der Firma „Produkt + Projekt“ lässt seinen Träger einige körperliche Probleme des hohen Alters nachempfinden. So werden vor allem für jüngere Personen die Schwierigkeiten des Alters nachvollziehbarer. Der Anzug besteht aus einzelnen Komponenten (siehe Abbildung 2), die verschiedene altersbedingte Einschränkungen (z. B. Eintrübung der Augenlinse oder Kraftverlust) simulieren (vgl. Website Produktundprojekt).

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Abbildung 2: Alterssimulationsanzug GERT

Die 13 Probanden liefen eine zuvor definierte Testroute zweimal ab. Ein zweiter Durchgang war notwendig, da sich die Testpersonen bei dem ersten Testlauf an die neue Situation gewöhnen mussten. Aus diesem Grund wurden nur die Ergebnisse der zweiten Messung zur Auswertung verwendet. Die Testläufe der einzelnen Personen fanden zeitversetzt statt, da so zeitabhängige Stresssituationen nur bei einzelnen Personen auftraten. Zusätzlich wurden Videos und Fotos aufgenommen, um eine retrospektive Verifizierung der Stressmomente durchführen zu können.

5 STAND DER DATENVERARBEITUNG

Die Auswertung der gemessenen Daten, des Sensorarmbandes und des GPS-Loggers wurde bisher in mehreren Arbeitsschritten mit diverser Software durchgeführt. Vorwiegend wurden die Programme „STATA“ (www.stata.com) und „Excel“ (aus dem Microsoft-Office Paket) eingesetzt. Als Ergebnis ist eine CSV-Datei erzeugt und im Anschluss daran in einem Geoinformationssystem georeferenziert worden, sodass die Daten im Shape-Format vorlagen. Hierfür fand das Open-Source Produkt „QGIS“ (www.qgis.org) Verwendung. Aus der CSV-Datei ist eine sogenannte Heatmap (dt. Dichtekarte) erzeugt worden, welche die Häufung von Stressmomenten wiederspiegelt.

Bisher waren viele manuelle Zwischenschritte notwendig, sodass der Arbeitsaufwand des Anwenders sehr hoch war. Aus diesem Grund sollten sämtliche Arbeitsschritte in einem einzigen Tool zusammengeführt werden. Zur Umsetzung wurde die freie Programmiersprache „R“ (cran.r-project.org) eingesetzt. Ziel war es, die vorliegenden Rohdaten des Sensorarmbandes und des GPS-Logger automatisiert durch eine Anwendung auswerten und verbinden zu können. Als Ergebnis sollte das Tool eine georeferenzierte Datei im Shape-Format liefern, in der alle erfassten Daten enthalten sind. Das Konzept des Tools wird im folgenden Kapitel genauer beschrieben.

6 KONZEPTION DES TOOLS

Bei der Entwicklung des Tools wurde darauf geachtet, dass es möglichst viele Arbeitsschritte beinhaltet und so die Bearbeitung deutlich vereinfacht. Dazu musste überlegt werden, welche Leistungen das Tool erbringen soll bzw. welche Arbeitsschritte vom Tool durchgeführt werden sollen. Erste Überlegungen zur automatisierten Auswertung der EmoMapping-Daten stellte bereits Wilhelm (2014) an. Der Grundgedanke ist in Abbildung 3 in Form eines Aktivitätsdiagramms zu sehen. Dieses stellt den realisierten Ablauf in einzelnen Schritten dar. Es wurde eine Funktion definiert, die Rohdaten importiert und eine Shape-Datei, mit den ausgewerteten Geodaten, erzeugt. Außerdem besteht die Möglichkeit durch Eingabe von Parametern die

Auswertung anzupassen. Dadurch wurden gezielt einzelne Arbeitsschritte, die bisher manuell durchgeführt wurden, automatisiert. Nach den abschließenden Programmierarbeiten, wurden die erstellten R-Skripte in die Toolbox von QGIS integriert.

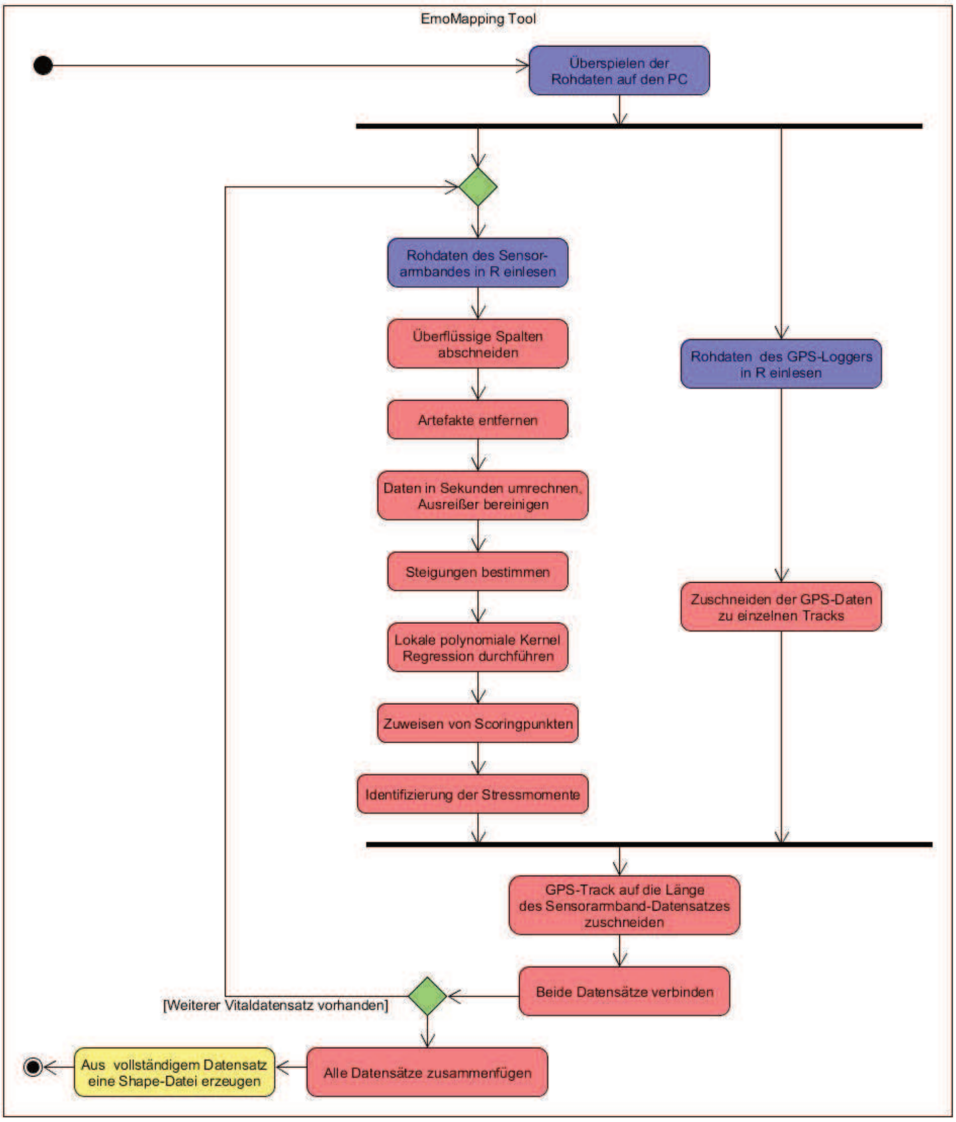

Abbildung 3: Aktivitätsdiagramm des Tools

6.1 Arbeitsweise des Tools

Im Anschluss an eine Messung werden die Rohdaten des Sensorarmbandes und des GPS-Loggers auf einen PC übertragen. Daraufhin verarbeitet das Tool die GPS- und Vitaldaten getrennt voneinander. Prinzipiell kann dies parallel durchgeführt werden, da die Daten erst nach erfolgreicher Bearbeitung beider Datensätze zusammengefügt werden.

Zu Beginn werden die Rohdaten in R importiert. Das Tool erkennt anhand von Markern, die während der Messung gesetzt werden können, automatisch, ob die Daten mehrere Tracks beinhalten. Diese werden zugeschnitten und stehen zur Verbindung mit den passenden Datensätzen des Sensorarmbandes bereit.

Das Tool erwartet die Eingangsdaten des GPS-Loggers mit Informationen zur Position und Zeit der Aufnahme. Diese sind mit sekündlichen gemessenen Positionen, im geographischen Koordinatensystem WGS84 angegeben. Die Daten des Sensorarmbandes müssen je eine Spalte mit Messwerten zur Hautleitfähigkeit und -temperatur enthalten.

Gegensätzlich dazu ist die Auswertung der Daten des Sensorarmbandes (siehe Tabelle 2) deutlich umfangreicher. Die für das EmoMapping wichtigen Parameter bilden die ersten beiden Spalten, mit den entsprechenden Werten:

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- scl Hautleitfähigkeit (skin conductance level)
- temp Hauttemperatur

Die übrigen Werte enthalten Daten zur Elektroden-Andruckkraft, zur Außentemperatur, zur triaxialen Beschleunigung (Beschleunigung in drei Achsenrichtungen – x, y, z) und einen Zeitstempel. Da sie jedoch in diesem Projekt keine Verwendung finden, wird darauf nicht näher eingegangen.

scl	temp	force1	force2	x	y	z	na	außentemp	Zeitstempel
706	595	149	1022	590	603	366	416	691	1526499598
705	595	148	1021	590	608	364	409	691	1526499598
705	595	148	1022	592	607	366	407	692	1526499598
705	595	148	1022	581	612	372	404	692	1526499598

Tabelle 2: Ausschnitt der Daten einer Messung des Sensorarmbandes

Nach einem erfolgreichen Import der Daten wird durch einen Schwellenwert, der die minimale Differenz zwischen dem kleinsten und größten Messwert darstellt, geprüft, ob die Datensätze zur Auswertung geeignet sind. Im Anschluss werden nach erfolgreichem Import der Daten nicht benötigte Spalten entfernt und Artefakte aus den Messungen der Hautleitfähigkeit und -temperatur entfernt. Dies wird durchgeführt, indem jeder Messwert mit dem arithmetischen Mittel der nächstgelegenen 250 Messwerte (je 125 Zeitschritte vor und nach dem zu prüfenden Wert) verglichen wird. Falls die Differenz größer als der zuvor definierte Schwellenwert (Hautleitfähigkeit = 25, Hauttemperatur = 15) ist, wird der geprüfte Wert durch den Mittelwert ersetzt. Danach wird die Taktung von 10 Hertz (alternativ 50 Hertz), dies bedeutet zehn Messungen pro Sekunde, durch Bildung des arithmetischen Mittels in Sekunden umgerechnet. Anschließend wird die Steigung zwischen den einzelnen Punkten bestimmt und daraufhin mit den resultierenden Werten eine lokale polynomiale Kernel Regression durchgeführt. Diese führt, unter Angabe des Grads und Bandweite, eine Glättung mittels Kerndichteschätzer (Gaußkern) der Messwerte durch, sodass Anstiege und Abfälle der Daten besser erkennbar sind. Auf dieser Grundlage werden Scoringpunkte vergeben. Diese beschreiben eine Zunahme, Abnahme oder ein gleich bleiben eines Wertes gegenüber dem vorherigen Wert.

„Bilden eines Scorings:

- elektrische Hautleitfähigkeit nimmt zu = Wert+1;
- elektrische Hautleitfähigkeit nimmt ab = Wert-1;
- elektrische Hautleitfähigkeit bleibt gleich = Wert0;
- Hauttemperatur nimmt zu = Wert-1;
- Hauttemperatur nimmt ab = Wert+1;
- Hauttemperatur bleibt gleich = Wert0;“ (Bergner 2010: 184).

Durch dieses Scoring werden Stressmomente identifiziert und deklariert. Alle in diesem Abschnitt angegebenen Werte sind durch Tests als Standardwerte definiert worden.

Nachdem beide Datensätze (Vitalparameter und GPS-Positionen) ausgewertet sind, werden sie auf dieselbe Länge (Zeilenanzahl) gebracht, indem der längere Datensatz abgeschnitten wird. Die Unterschiede in der Länge entstehen durch vernachlässigbare Messungenauigkeiten. Anschließend werden die Datensätze miteinander verbunden. Diese Schritte werden für alle zur GPS-Datei zugehörigen Daten des Sensorarmbandes wiederholt. Zum Schluss werden alle Ergebnisse zu einem georeferenzierten Datensatz im Shape-Format zusammengefügt. Die Georeferenzierung erfolgt hierbei über die Angaben der geographischen Koordinaten (Länge und Breite).

6.2 Integration in die Toolbox von QGIS

Zur Integration selbst erstellter R-Skripte steht eine Schnittstelle zur Toolbox von QGIS bereit. Das Tool wurde zur nutzerfreundlichen Anwendung in die Toolbox eingebunden. Von dieser werden einfache GUI-Komponenten (Grafische Benutzeroberfläche) bereitgestellt. So findet die Auswertung der Rohdaten und Darstellung der Ergebnisse in einem Programm statt.

Die Anwendung des Tools in QGIS ist in Abbildung 4 dargestellt. Als Eingangsdaten werden ein Datensatz des GPS-Loggers und ein Ordner mit den dazugehörigen Daten des Sensorarmbandes erwartet. Es kann sich für eine Auswertung mit und ohne einer Anpassung der Artefakte entschieden werden. Außerdem können die bereits erwähnten Parameter angegeben werden. Die in der Abbildung zu erkennenden Werte sind als Standardeinstellung hinterlegt, die sich durch Tests ergeben haben. Als Ergebnis wird eine Shape-Datei und eine Datei mit Grafiken zur Auswertung im angegebenen Pfad erzeugt und geöffnet.

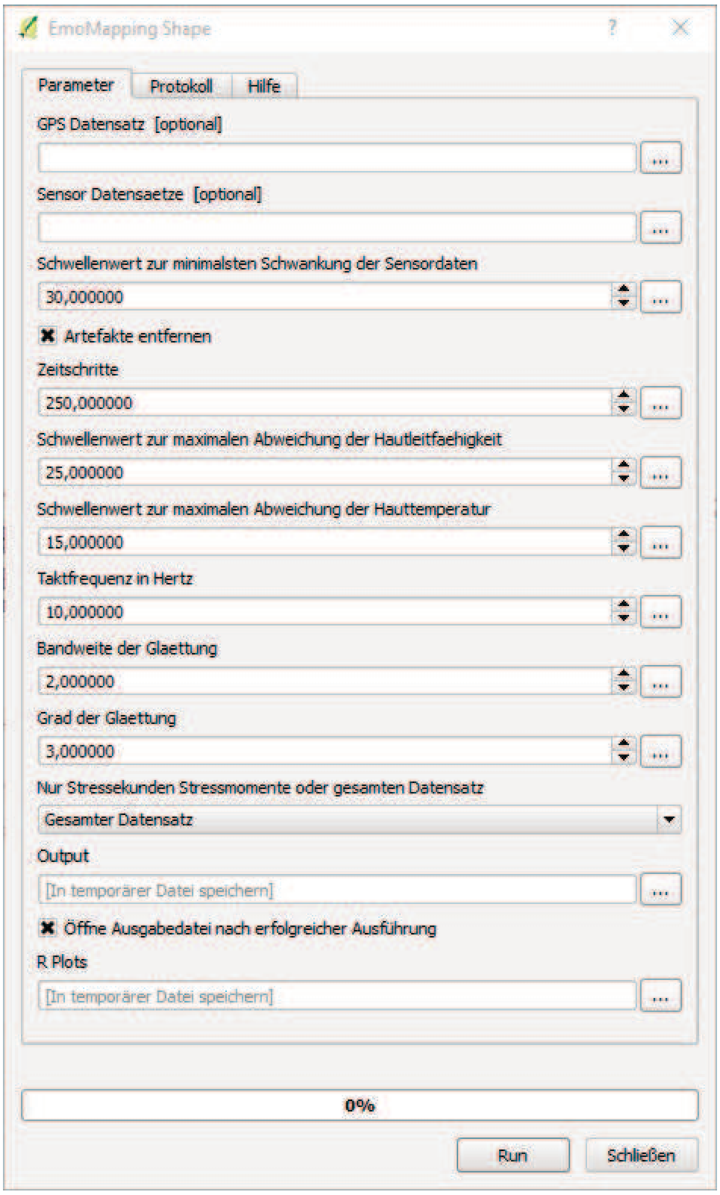

Abbildung 4: Tool zur Auswertung von EmoMapping-Daten in QGIS

7 ERGEBNISSE

Von den insgesamt 13 durchgeführten Messungen im Testgebiet Querenburg, sind acht mit dem Tool ausgewertet und verbunden worden. Die übrigen fünf Messungen waren wegen defekter Geräte nicht zur Auswertung geeignet. Im Anschluss ist die erzeugte Shape-Datei in das freie Geoinformationssystem QGIS eingelesen und drei verschiedene Versionen (siehe Abbildung 5-8) einer Heatmap erzeugt worden. Diese wurden mit verschiedenen Ausgangsdaten und einem Radius von 10 Meter erzeugt. Die höchste Ansammlung von Stresspunkten ist in rot dargestellt.

In Abbildung 5 sind alle Stresssekunden der acht Probanden überlagert zu sehen. Durch diese Darstellung lässt sich die Länge der Stressmomente erkennen. Auf Abbildung 6 sind nur die auslösenden Punkte, also die Momente in denen der Stress eingetreten ist dargestellt. In Abbildung 7 sind die gleichen Punkte wie in Abbildung 6 zu sehen, mit dem Unterschied, dass diese durch die Länge der einzelnen Stressmomente gewichtet wurden. Punkte, an denen länger andauernde Stressmomente ausgelöst wurden, werden durch die farblichen Unterschiede betont dargestellt.

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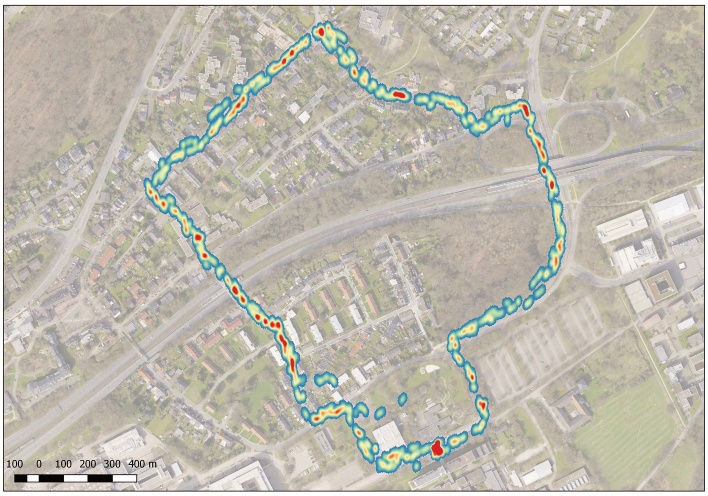

Abbildung 5: Alle Stresssekunden (Hintergrundkarte: WMS Luftbild Bochum 2015)

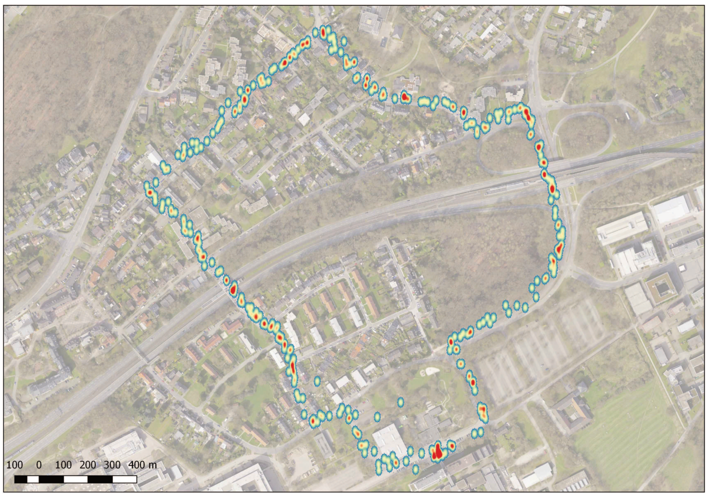

Abbildung 6: Startsekunden des Stresses (Hintergrundkarte: WMS Luftbild Bochum 2015)

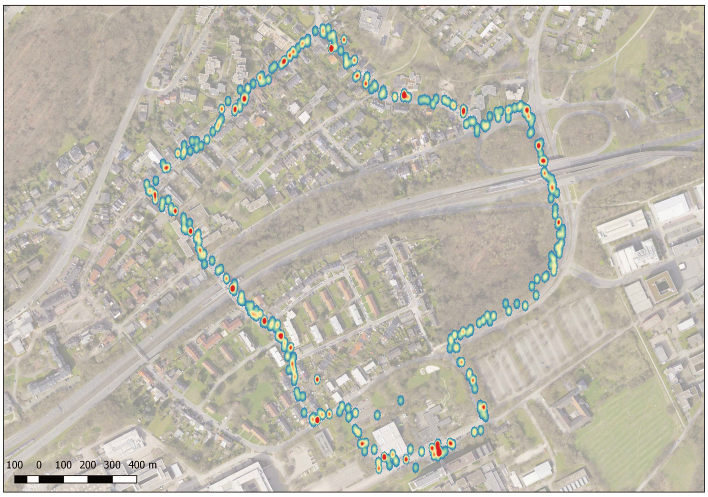

Abbildung 7: Startsekunden des Stresses mit Gewichtung durch Länge der Stressmomente (Hintergrundkarte: WMS Luftbild

8 DISKUSSION

In dieser Fallstudie ist zur Überprüfung der Barrieren die in Abbildung 5 zu sehende Variante am besten geeignet. Diese soll Aufschluss über die Vollständigkeit der Barrieren im Testgebiet geben. Dazu ist es notwendig einzelne Punkte näher zu betrachten. In diesem Zusammenhang sind alle Momente in denen der Stress eintrat zusammen mit den Barrieren des barrierefreien Stadtplans in Abbildung 8 dargestellt.

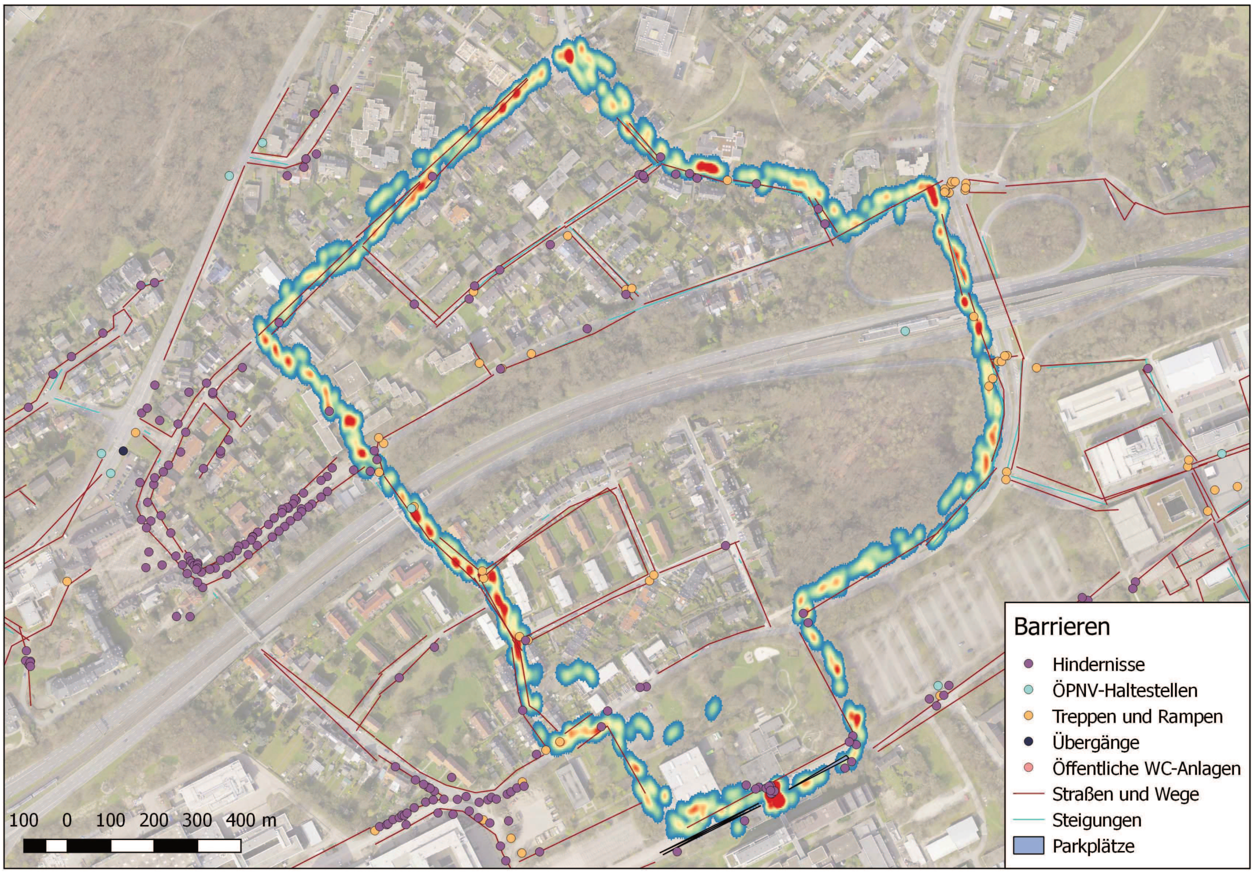

Abbildung 8: Alle Stresssekunden und Barrieren (Hintergrundkarte: WMS Luftbild Bochum 2015)

Wie in Abbildung 8 zu sehen ist, stimmen an einigen Stellen die zuvor aufgenommenen Barrieren mit den Stressmomenten überein. Der Startpunkt der Testläufe liegt im Süden und die Laufrichtung ist entgegengesetzt zum Uhrzeigersinn. An einigen Stellen lassen sich die Stressmomente sehr gut interpretieren. So wird im Osten der Stress durch die Unterführung des Zubringers und Überquerung gefährlicher Zebrastreifen ausgelöst (blaue Markierung). Anschließend folgt bis zum nördlichsten Punkt eine starke Steigung, wobei sich auf dem Weg einige Hindernisse befinden (gelbe Markierung). Im weiteren Verlauf wurde eine Baustelle (rote Markierung) und kurz vor der U-Bahn-Haltestelle im Westen eine Treppe bzw. eine Rampe (lila Markierung) passiert. An der U-Bahn Station und bei der Überquerung der Brücke trat viel Lärm auf (grüne Markierung) und danach waren nur sehr schmale Bürgersteige begehbar. Besonders hoch sind die Werte am Start- bzw. Endpunkt des Testlaufes (braune Markierung). Dies ist üblich, da die Testpersonen am Startpunkt länger verweilen und sich an die Situation gewöhnen müssen.

Es lässt sich auch erkennen, dass an einigen Positionen bereits aufgenommener Barrieren (wie die bereits erwähnten U-Bahn-Haltestellen oder Hindernisse) zu erwartender Stress verzeichnet wurde. Darüber hinaus trat Stress an Stellen auf, bei denen bisher keine Barrieren erfasst wurden (schwarze Markierungen). An diesen Stellen bedarf es einer genaueren Untersuchung, um noch nicht erfasste Barrieren zu identifizieren.

9 AUSBLICK

Die Anforderungen an das Tool wurden zufriedenstellend erfüllt. Durch die vorgestellte automatisierte Aufbereitung der EmoMapping-Daten wird viel Zeit und Arbeit eingespart. Dies lässt in Zukunft eine erhöhte Stichprobengröße und Anwendung in größeren Testgebieten zu. Dennoch bestehen einige Möglichkeiten zur Ergänzung bzw. Verbesserung. Außerdem könnte das Tool zur Auswertung von Messdaten anderer Sensoren leicht erweitert werden.

Die Daten des EmoMappings könnten im Nachgang mit den aufgenommen Videos und Fotos verifiziert werden, um Aufschluss über die tatsächlichen Auslöser der Stresssituationen zu erhalten. Im Anschluss daran wäre es denkbar die Parameter im Tool anzupassen, um genauere Ergebnisse zu erhalten.

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Darüber hinaus werden zukünftig die fehlenden Stressverursachenden Barrieren kartiert und in den Barrierefreien Stadtplan mit aufgenommen.

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Success Factors of Participatory Processes in Urban Development

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1 ABSTRACT

More than half of the world's population now lives in urban areas. In 2050, it will be even two thirds. Global problems such as climate change and scarcity of resources constitute new challenges especially for cities.

The City of Vienna is meeting these challenges with the Smart City Wien Framework Strategy (SCWR) – a long-term umbrella strategy for the period up to 2050 with objectives regarding three dimensions: resources – quality of life – innovation.

The City of Vienna considers participation crucial for implementing the SCWR. The requirements for this are still very general and need to be put into concrete terms. The realisation of participation within the SCWR is closely linked to the development and implementation of relevant programmes and projects of urban planning.

This paper addresses the question of what the key success factors are in drawing up participatory processes within the context of these programmes and projects.

The methodological approach was to combine available results of research and data analyses with analyses of case studies. The method of evaluation chosen is a summary analysis of the criteria deduced.

The major findings of this thesis are the following: in order to achieve high-quality municipal programmes and projects, essential success factors need to be considered:

- division of the process into separate phases
- paying special attention to the initial phase
- involvement of relevant stakeholders
- openness to ideas
- simultaneity of product and process
- attractiveness of process design
- external communication
- conducive attitude and values.

High-quality participatory processes entail particular benefits for the implementation of the SCWR. For instance, they can help to activate the innovation potential more efficiently and contribute to getting closer to the citizens.

Keywords: participation, participatory processes, Smart City, Smart City Wien Framework Strategy, urban development

2 PROBLEM AT HAND

According to information provided by the United Nations, the world's population is increasingly concentrated in urban areas. For 2050, forecasts predict that around 70% of the global population will live in cities (UN Habitat, 2012, p. 25).

At the moment, already more than half of humankind lives in urban spaces; according to estimates, this population consumes between 60% and 80% of the energy volume produced worldwide and causes 75% of all greenhouse gas emissions. As a result, concepts to resolve many global problems such as climate change or resource scarcity are focusing on compact urban agglomerations. A key challenge lies in preserving the future liveability of these areas with high population density and to design them as economically, ecologically and socially attractive spaces.

The Smart City Wien Framework Strategy (SCWR) is Vienna's answer to a number of topical global challenges and defines the city's policies for the coming decades. In 2011, an ongoing process was initiated by Mayor Michael Häupl and ultimately resulted in the Smart City Wien Framework Strategy, which was adopted by the Vienna City Council on 25 June 2014. The Smart City Wien Framework Strategy is a long-term umbrella strategy that extends until 2050. It is implemented on the basis of phased, concrete objectives subject to continuous checks and controls (City of Vienna, 2014 b). Specifically, the individual objectives are to be attained by implementing a great number of subordinate, mutually co-ordinated thematic concepts and masterplans, but also by means of practical project clusters as well as individual projects (e.g. at the local level).

The core element of the SCWR initiative is a long-term stakeholder process in whose context all groups concerned – both inside and outside the Vienna City Administration – formed general-interest as well as specialised-thematic advisory groups.

The six thematic areas of this platform were: demographic development, environment, administration, economy, energy and mobility. Special stakeholder forums allowed for the exchange of ideas regarding successes, current developments and future challenges, thereby providing input for further project developments and participation activities. This mainly involves potential links between theoretical and practical projects and their shared characteristics as Smart City projects.

According to the mission statement of the SCWR, integrative urban development is to be fostered by continuing the participatory process conducted so far and intensifying the codetermination possibilities of citizens.

The general statements of the Framework Strategy need to be concretised in greater detail:

- what should the future, broad-based implementation process be like?
- what form can the codetermination of, as well as active contributions to, urban development take?
- and above all: how can participation in the formulation of future thematic concepts, masterplans or projects be realised?

Successful implementation is important primarily for social, economic and political reasons. Against the backdrop of the expected dynamic population development, growing innovation pressure and increasingly scarce resources, the Austrian capital is confronted with specific questions: how can Vienna tap the opportunities inherent in growth dynamics and change? How does it position itself as an innovation hub?

Moreover, the City of Vienna is committed to the EU climate goals for 2030 and 2050 and wants to play a leading role in their implementation. With the SCWR, Vienna aims to defend and further strengthen its top position regarding energy and climate protection – combined with a smoothly functioning economic and social basis – in the European context.

3 THE SMART CITY WIEN FRAMEWORK STRATEGY

3.1 Key elements

From the perspective of the City of Vienna, the SCWR is a meta strategy defining the policies pursued by the Austrian capital in the coming decades against the backdrop of current challenges such as population growth and economic dynamics.

This means that the objectives are long-term and provide for maximum leeway and flexibility to foster their attainment. They should be understood as closely interwoven with the targets of various thematic strategies of the City of Vienna. The Framework Strategy does not replace the targets of these thematic strategies but is to act as a superordinate thematic framework. In this way, it offers an orientative structure for subordinate thematic strategies in such areas as climate protection, urban planning, mobility, etc. (City of Vienna, 2014 a, p. 30 f).

In the interplay of the three dimensions – resources, quality of life and innovation –, the SCWR specifies the following premises:

- radical resource conservation
- development and productive use of innovations/new technologies
- high, socially balanced quality of life

3.2 The SCWR implementation process

The implementation of the Framework Strategy embodies particular challenges for the City of Vienna, since many of the cross-cutting objectives call for overarching and networked management of the issues at hand.

In this, the Smart City approach is characterised by two principal implementation levels:

(1) the political level with special emphasis on the setting of political priorities and policy design.

(2) the operative level with special emphasis on the handling of tasks across individual organisational units.

One of the most important tasks of the SCWR lies in providing additional impulses for a variety of thematic strategies, programmes or projects. It creates the basis and framework for these downstream initiatives. Due to the special importance of the Framework Strategy at the political level, operative initiatives are given additional momentum to foster the attainment of their respective sectoral targets. Conversely, activities and projects at the operative level contribute to attaining the strategic objectives of the SCWR.

3.3 Participation from the perspective of the SCWR

It is the declared goal of the SCWR to involve a greater number of persons in the development of their city. This is to be achieved by means of a broad-based communication strategy and intensive exchange with the population as well as other partners (City of Vienna, 2015, p. 125).

What concept of a "participatory approach" is thus sketched in the Smart City Wien Framework Strategy?

With regard to participation, the SCWR provides that …

- codetermination and active contributions shape the development of the city. This means creating space for locally fine-tuned solutions and self-initiatives (City of Vienna, 2014 a, p. 15).
- the necessary processes of change should enjoy wide support (ibid.).
- citizens can participate and share actively and in myriad ways in the further development of the city (ibid., p. 19).
- codetermination and modern management work together both in direct interpersonal contact and via the Internet (ibid., p. 89).

So far, a number of participatory processes were launched within the scope of the Smart City Wien initiative. Current best practices include:

CLUE – Climate Neutral Urban Districts in Europe: further information at http://www.clue-project.eu/

Digital Agenda Vienna: further information at https://www.digitaleagenda.wien/de

4 BEST PRACTICES: ANALYSIS OF PARTICIPATORY PROCESSES

The following section presents and analyses best practices of urban and neighbourhood development.

The case studies selected comprise

- efforts or approaches embodying particularly innovative participatory processes, and
- particular references to the specific challenges of the SCWR, since they address the three dimensions of resources, innovation and quality of life.

The projects HafenCity Hamburg (D) and Zurich-West (CH) are examined as European case studies while the Viennese case studies analysed include the projects Vienna-Liesing Mitte and Kabelwerk Vienna-Meidling.

4.1 HafenCity Hamburg

HafenCity Hamburg is situated centrally in the immediate environs of the historic city core. Covering an area of 157 hectares, it is one of the biggest urban development sites in Europe and emerged as a result of changes in Hamburg's port industry and port logistics as well as due to the re-orientation of urban development towards the city centre and the waterfront (Walter, 2009).

HafenCity Hamburg – summary of special qualities:

- involvement of a great number of experts and planners

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- numerous architectural and urban design competitions
- highly flexible and updatable development process
- comprehensive PR work and marketing

Citizen involvement was limited to the informative format of a “citizens’s dialogue”.

4.2 Zurich-West

Zurich-West is one of the big development areas of the City of Zurich and an example of how urban development structures can be re-organised in the existing built context. Due to economic restructuring, a former industrial area became a brownfield site that had to be converted and put to new forms of use.

A defining trait of this project was the model of a “co-operative planning procedure”, which transformed the ongoing dialogue with all stakeholders into a methodological element.

Zurich-West – summary of special qualities:

- the organisation of the co-operative procedure is viewed as a “municipal service” by the city administration
- involvement of land owners, experts, planning teams and authorities
- open and public discussions
- test designs, pilot projects
- open “game rules”
- planning is understood as a dynamic process

As a result of prevailing individual interests, the involvement of land owners did not prove successful during certain phases.

4.3 Vienna-Liesing Mitte

As a dynamic municipal district of Vienna, Liesing is composed of highly diverse urban structures. Small-scale village-type structures and zones with single-family homes (Atzgersdorf) exist alongside large-scale industrial areas (Liesing industrial zone) and extensive agricultural spaces (In der Wiesen).

Each of these urban structures entails different challenges for urban planners. Problems at hand e.g. include urban renewal tasks in an existing, already built context, the conversion of areas to different forms of use, the involvement of the surrounding neighbourhood or the improvement of frame conditions for existing local enterprises.

Vienna-Liesing Mitte – summary of special qualities:

- planning with process character
- comprehensive involvement of both general and professional public
- working “on the ground”
- diverse and varied participation formats
- opportunities for open discussions
- process is understood as a dynamic process
- process is understood as a learning process (“laboratory situation”)

4.4 Kabelwerk Vienna-Meidling

The co-operative planning process for the Kabelwerk Vienna-Meidling urban development project was in many ways exemplary and constituted a milestone of a new planning culture (Tschirk, 2012).

Kabelwerk Vienna-Meidling is situated in the 12th municipal district of Vienna close to the “Kabelwerk” U6 Underground station. For a century, it housed one of the world’s biggest cable factories (hence the name). After production was shut down in 1997, temporary intermediate use for cultural events was followed by the construction of a new urban quarter (City of Vienna, 2004).

Kabelwerk Vienna-Meidling – summary of special qualities:

- planning with process character
- early involvement of all stakeholder groups
- open and communicative character
- location marketing, image cultivation
- "chaos as strategy"
- leeway left for decisions to be taken at a later date
- use for temporary cultural events
- flexibility and enthusiasm of persons involved

4.5 Summary of "special qualities"

The table below lists the elements and aspects identified in the analysis of the four case studies and arranges them in thematic groups.

This grouping reflects the "criteria and principles of process design" as formulated by Werner Tschirk (Tschirk, 2012, p. 221 f). The criteria identified embody special qualities that characterise the participatory processes examined.

Table 1 presents an overview of the elements identified in the analysis of the case studies and allocates them to the thematically structured criteria.

Criterion	HafenCity Hamburg	Zurich-West	Vienna-Liesing Mitte	Kabelwerk Vienna-Meidling
Division of process into separate phases			Planning with process character; several planning phases	Planning with process character; several planning phases
Involvement of relevant stakeholders	Involvement of a great number of experts and planners	Involvement of land owners, experts, planning teams and authorities	Comprehensive involvement of both general and professional public	Early involvement of all stakeholder groups
Openness to ideas	Numerous architectural and urban design competitions	Test designs, open "game rules"; open and public discussions	Diverse and varied participation formats; opportunities for open discussions	Leeway left for decisions to be taken at a later date; open and communicative character; "chaos as strategy"
Simultaneity of product and process	Highly flexible and updatable development process; high adaptability	Planning understood as dynamic process	Planning understood as dynamic process; process understood as learning process ("laboratory situation")	Planning understood as evolutionary, flexible process
Attractiveness of process design			Working "on the ground"	Use of temporary cultural events
External communication	PR work; marketing			Location marketing; image cultivation
Conducive attitude and values		Organisation of co-operative procedure viewed as "municipal service" by city administration		Flexibility and enthusiasm of persons involved

Table 1: Summary of "special qualities" derived from the best practice analyses and allocation by criteria.

5 RESULTS

5.1 Success factors of participatory processes

Based on the findings from the case studies analysed and the criteria deduced, the following key success factors can be generated to answer the question "What are the success factors for the design of participatory processes to accompany the development and implementation of municipal programmes and projects?":

- division of the process into separate phases
- paying special attention to the initial phase
- involvement of relevant stakeholders

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- openess to ideas
- simultaneity of product and process
- attractiveness of process design
- external communication
- conducive attitude and values

These success factors mainly aim at the design of process sequences and harbour the potential of generating particular quality to enhance the design of participatory processes.

Due to the methodology employed, the above list of success factors obviously cannot lay any claims to exhaustiveness or completeness.

5.1.1 Why divide the process into separate phases?

According to the Commission for Architecture and the Built Environment, structuring processes into manageable phases offers the possibility of reducing complexity, of setting focuses and, as a result, of acting in a more structured and target-oriented manner (CABE, 2008).

Consequently, subdividing phases into development stages seems useful, as this allows for splitting up the participatory process while setting different focuses. In this, important process sequences and milestones must be made transparent for all parties involved.

Defining "milestones" or "fixed points" between the stages that make up the individual phases moreover engenders the possibility of instituting quality checks and efficient control.

For this purpose, the interim results of the respective milestones should be fed back to juxtapose them with the general objectives as part of an iterative loop; where appropriate, necessary adjustments should be introduced. These reflections foster further development and improve overall process quality ("lessons learned").

The quality of the process thus determines the quality of the results.

5.1.2 Why pay special attention to the initial phase?

Mistakes have particularly grave and deterimental effects during the initial phase. For this reason, special attention must be paid to the initial phase (Maurer, 2010).

At the outset, it is important to discuss fundamental objectives and values and to delimit a scope for decisions as well as the fixed points of the participatory process (process design). In the long term, this initially greater effort is more than offset by more robust decisions and related optimised resource use.

Citizen participation should begin at a very early date in order to ensure that the planning process will be as open-ended as possible. It is easiest to stimulate interest among the population if participatory processes are launched as soon as feasible (Vetter, Klages, & Ulmer, 2013).

The more a project progresses, the more the citizens' power to influence it as well as their scope of action will decrease. Thus it should be the aim of all efforts to generate an interested general public with a common understanding of the problems at hand right from the outset ("concerted action").

For example, facilitation is one tried and tested method to engender such a common understanding of the problems at hand. According to the "PIMEV© principle", this safeguards possibilities of codetermination and active contribution.

5.1.3 Why involve relevant stakeholders?

The involvement of stakeholders must be preceded by the important question of whether and to what degree they are relevant for the specific project. For this purpose, it is essential to identify those groups that are affected by, or might have an interest in, the respective plans. Target group analysis can help to differentiate the various stakeholder groups and to plan specifically designed activities on this basis.

When selecting the circle of persons to be involved, what counts is less the number of participants than the requirement that the interests of all groups concerned be represented and correspondingly taken aboard. Frequently used selection methods e.g. include self-selection, the selection of representatives or random selection. Compared to the other methods, random selection in general embodies a qualitative leap, as this format makes for a more heterogeneous composition of the group and improved coverage of a highly diverse population.

Normally, citizens or citizen groups engage in participatory processes in keeping with the clout of their resources and the ability to articulate their interests. As a result, some groups will act more self-assertively than others. To specifically promote the participation of groups that find it difficult to express their interests, it is above all hard-to-reach population groups that should be primarily motivated to engage in participation when selecting stakeholders. Suitable procedures for this purpose should be considered and developed.

Potential critics and opponents should be included in the participation procedure right from the outset. In this way, they can be encouraged to approach the problems at hand in an objective manner. Generally speaking, truly disruptive conflicts only tend to emerge if key stakeholders are ignored.

5.1.4 Why openness to ideas?

Openness to ideas generates innovation, dynamism and further development.

This inter alia presupposes an open culture on the part of the organisations involved, inspired by a willingness to innovate and evolve (Ritter & Gemünden, 1998), as well as openness on the part of the decision-makers in charge, motivated by a willingness to try out something new (Moberg, 1999, p. 250).

Thus a sort of “field” or “network” able to productively blend the task-related knowledge of stakeholders beyond institutional and organisational boundaries of competence should be created. The aim therefore lies in the co-operative generation of knowledge, and not in maintaining institutional or spatial boundaries (Tschirk, 2012).

An interesting participation format is the “Art of Hosting” (AoH), for which above all large group methods are employed. In an AoH setting, a great variety of communication methods are used to develop innovative joint solutions that meet with broad support. AoH serves to highlight that what is new and innovative often can only be generated through a tightrope walk between chaos and order. In this context, resilience to chaos is particularly important (cf. the Kabelwerk Vienna-Meidling case study). It should be conceded that this method is time-consuming.

The keyword “Open Innovation” follows the principles of “being open to the knowledge of others” and “generating knowledge jointly” with the objective of e.g. tapping the collective knowledge base outside one’s own organisational structure. Here, the Internet acts as a central driver in the development of open, interactive systems.

As Web 2.0 has shown, a large number of “amateurs” can thus replace a small number of “professionals” within a short timespan (e.g. Wikipedia). Hence the collective knowledge may be superior to the know-how of experts in a given field (e.g. because of the topicality of information or special local knowledge).

Already successful, currently used models taken from market economy could be adapted for the municipal sector and also used in participatory processes.

In crowdsourcing projects, an initially undeterminable number of persons (with the “crowd” equalling the sum of Internet users) e.g. collaborates to resolve a defined task, leading to a process of mutual inspiration. The contribution of the creative mass allows for the attainment of high-quality and innovative results that an enterprise might be unable to produce with the same quality level.

5.1.5 Why simultaneity of product and process?

In complex systems such as municipal urban development, the product of planning (i.e. the “plan”) and the planning process per se (the thinking and learning process) cannot be viewed as isolated from each other. Therefore the product must be developed on an ongoing basis together with the process; it must not be regarded as static or completed (Tschirk, 2012).

At the end of the planning and participation process, the expected outcome is not just the “perfect” plan. Rather, continuous discourses, confrontations and reflections also trigger a learning process. As a sort of by-product of the plan, this learning process causes important changes in the awareness and behaviour of citizens.

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These simultaneous processes should also be accompanied by the feedback of results that are significant for further developments to the general public. The setup should provide feedback possibilities for all stakeholders, and the feedback submitted should be taken account of in the further course of events.

This not only involves the population more closely, but also harbours an opportunity for politicians to obtain a more clearcut idea of the needs and expectations of citizens. In its turn, this contributes significantly to ensuring a representative overview of opinions ("planning certainty" for administrators and politicians).

5.1.6 Why attractiveness of process design?

A well-designed process is characterised by a clearcut structure and definite rhythm of process sequences. Phases of individual work alternate with dialogue-based co-operative exchange. Offline phases (direct and interpersonal contact) are followed by online phases (Internet use). Jointly experienced elements such as shared city walks or collective gardening contribute to embedding participatory processes also on an emotional level.

By celebrating successes together and creating opportunities for the open exchange of information, trust is stimulated and co-operation is improved. This results in shared positive stories and a shared body of experience, which ultimately also helps to forge a common identity.

5.1.7 Why external communication?

Open communication is a key factor of participatory processes. It rarely develops spontaneously; normally, clear specifications and rules for its design are called for. For this reason, a communication concept must be formulated as a preliminary requirement.

Central issues are: who is informed – when – with what sort of information – via what information channels – with what means of information?

In accordance with the level of participation intensity (informative, consultative or co-operative) chosen, it must be clarified which communicative methods of participation are best suited for the respective participatory process (depending on the number of stakeholders, target groups, tasks at hand, etc.).

Informative communication formats can help to improve the recognition value and image of programmes and projects.

In the course of consultative formats, citizens can contribute and discuss their ideas. Conversely, experts benefit from the fresh perspectives added by "outsiders".

In case of co-operative formats, citizens perceive how they are actually able to codetermine planning processes. As a result, they identify more strongly with the project.

5.1.8 Why a conducive attitude and values?

"Participation is honest curiosity about the needs of not automatically involved parties." (City of Vienna, Municipal Department 18, 2014, p. 15)

The attitude towards participation contributes decisively to the success of a participatory process. In this context, a conducive attitude to participation among both citizens and politicians or administrators is called for. It is characterised by a dialogue conducted on equal terms, the willingness to change perspective, mutual respect and readiness to take the other side's opinions seriously. Values such as honesty, reliability, transparency and clarity must accompany the entire participatory process.

Table 2 presents a summary of the success factors identified together with a brief description.

5.2 Contributions and benefits of participatory processes

High-quality participatory processes can entail above all the following contributions and benefits for the implementation of the SCWR:

- getting close to the citizens: attractive process design and the choice of suitable methods can help the administration to forge direct contacts with citizens. This makes it possible to render the somewhat abstract concept of Smart City Wien more comprehensible and tangible ("join-in project").

- improving the image: targeted external communication by means of appropriate channels and means of communication can contribute to overcoming prejudices on the part of the population and strengthen the level of identification with the Smart City Wien Framework Strategy.
- establishing, using and strengthening interconnectedness: Smart City Wien thrives on networking. By finding implementation partners or networking representatives with citizens through participatory processes, new ideas and projects will emerge.
- tapping innovation potentials: Smart City Wien thrives on innovation. Openness to ideas and a conducive attitude towards participation can engender valuable impulses from business, science and the “local expertise” of the population at large.

Success factor	Brief description
Division of process into separate phases	Structuring of process into development stages to provide some orientation and deliberately reduce complexity; possibility of quality control, reflection and further development; process quality determines outcome quality
Paying special attention to initial phase	Avoiding mistakes especially at the outset; defining process design; allowing for leeways of action; involving citizens at the earliest possible moment; using e.g. facilitation as a method to generate a common understanding of the problems at hand
Involvement of relevant stakeholders	Generating an interested general public; identifying the groups concerned (e.g. target group analysis); capturing and taking account of the interests of all groups concerned; using e.g. randon selection as a suitable method; making the effort to actively engage the interest of hard-to-reach population groups; involving potential opponents from the start
Openness to ideas	Entails innovation, dynamism and further development but requires willingness; creating a “field” or “network” for pooling knowledge; “Art of Hosting“ (AoH) method; “Open Innovation” as a method to tap a collective knowledge base; using the Internet as a central driver; collective knowledge may be superior to the know-how of experts; adapting models derived from market economy and using them for participatory processes, e.g. crowdsourcing
Simultaneity of product and process	Evolving the product (the plan) simultaneously with the process; dynamic process; causes changes in the awareness and behaviour of citizens; loops must allow for feedback from and to the general public; taking account of this feedback; involging the population more intensively; representative overview of opinions
Attractiveness of process design	Clearcut and rhythmic process structuring; phases of individual work alternate with dialogue-based co-operative exchange; creating shared emotional elements, positive stories and joint experiences to forge a common identity; celebrating successes together; stimulating trust
External communication	Key factor of participatory processes; developing a communication concept; who is informed – when – with what sort of information – via what information channels – with what means of information?; which methods are suitable?; informative, consultative, co-operative formats result in different benefits
Conducive attitude and values	“Honest curiosity about the needs of not automatically involved parties”; dialogue on equal terms – e.g. “roundtable” method; willingness to change perspective – e.g. Dyrade method; mutual respect and readiness to take the other side seriously – e.g. non-violent communication method; “the Big Five”: honesty – reliability – transparency – clarity – a light touch. Values accompany the entire participatory process.

Table 2: Success factors for the design of participatory processes.

- emergence of networks and “comprehensive knowledge”: extending across boundaries of organisations or institutions, the creation of a “field” or “network” in the course of participatory processes contributes to generating collective knowledge.
- This (non-exhaustive) list illustrates that participation assumes special importance for the thematic areas of networking and innovation. This is especially interesting because these aspects are central elements of the Smart City Wien Framework Strategy.
- Alongside these insights into the advantages and benefits of participatory processes in connection with the SCWR, however, it is also possible to derive some understanding of the challenges involved:
- Smart City Wien is too abstract for many citizens of Vienna. One challenge lies in creating shared emotional elements through attractively designed participatory processes, in this way offering possibilities of actively experiencing and testing the strategy. For this purpose, individual projects rooted in local conditions should be explicitly developed to reach people in their everyday life contexts and thus render the Smart City Wien experience more concrete for citizens.
- Smart City Wien entails complex tasks. These on the one hand call for knowledge about planning processes on the part of experts; on the other hand, an interested general public with a common understanding of the problems at hand should be generated right from the outset. One challenge lies in encouraging the willingness of individuals to assume responsibility. It should be assessed which participation methods could be employed usefully and effectively towards this purpose (e.g. facilitation).

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6 CONCLUSION

The contributions and benefits of high-quality participatory processes for the successful implementation of the SCWR are evident in manifold ways. Professionally assisted participation can bring projects closer to the citizens (Smart City Wien as a "join-in project"), improve the image of the SCWR, help to better exploit innovation potentials or generate networks and "comprehensive knowledge".

One challenge lies in the abstract image that the Smart City Wien Framework Strategy conjures up in the minds of people. The generation of an interested general public with a common understanding of the problems at hand constitutes another challenge. Individual projects rooted in local conditions should therefore create possibilities of actively experiencing and testing the SCWR.

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reviewed paper

Technology-supported Citizens Participation in Taiwan

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1 ABSTRACT

The use of Internet technology and smart mobile devices had inspired and changed the public awareness and attitudes of urban planning and architecture.

One of the big changes is that people no longer gather their information through a single source. Instead, information is published and shared by different organizations and people who have access to the Internet. People not only share information, but also amend the data provided by each other. Through the various functions of smartphones, people can provide and edit the received information. By continuously editing, publishing, and revising the information online, more people could understand the topics.

The same concept applies to data collection, analysis, establishing theory and collective realization. As the process undergo constant discussion, urban planning and architectural problems can be properly recognizing and to uncover appropriate solutions. This also led to people willing to actively participate in planning.

In recent years, people in Taiwan influence the status of the political, economic and society through the internet. With some cases, such as student movement and emergency relief, will shown how people use the internet and smart mobile device. At the same time investigate in which kind of information can be effectively, properly communicated to the public and influence public participation.

Keywords: Sustainable Development, smart city, urban planning, participation, smart mobile devices

2 INTRODUCTION

The use of internet technology and smart mobile devices had inspired and changed the public awareness and attitudes of urban planning and architecture.

One of the big changes is that people no longer gather their information through a single source. Instead, information is published and shared by different organizations and people who have access to the internet. That do not only share information but also amend the data provided by each other. Through the various functions of smartphones, people can provide and edit the received information. By continuously editing, publishing, and revising the information on networks, users could understand the topics. Information, ideas, messages and discussions spread like viruses (Gladwell 2000). The Internet and smart devices are not only a tool but a platform of organizational operation, cultural expression and political autonomy.

In recent years, networked social movements have become fairly frequent in the world. In Taiwan, the first citizen protests caused by network was in 2013. A draftee suspected of improper corporal punishment, was dead in the last few days during his military service, but the Ministry of National Defense of Taiwan didn’t provide a reason why and how he died, his family refused government and military just paid consolation money but hidden the truth. With social media and network, Bulletin Board System (BBS) and Facebook, that protests inspired around a hundred thousand people to take part. More and more network media and social community such as “g0v” and “Watch out!”, began to focus on many social issues and information presented to the public. Stimulated by networked social movements, planners and governments are trying to get more support and recognition by Facebook and/or blogs. Government start to create homepage and Facebook pages for urban development project.

In this paper, I would like to give some examples about the Taiwan’s civic movement initiated by network. I will also try to study how people who join those movements are using the social network and media, and may help and change during citizen participation.

3 DIGITAL-ENVIRONMENT STATUS AND NETWORKED SOCIAL MOVEMENT IN TAIWAN

3.1 Taiwan's Internet development status

Network development in Taiwan can be dated back to April 1985, with the establishment of academic networks. Under the sponsorship of IBM, the Ministry of Education set up computer terminal workstations in

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eight public universities, connected with the IBM 4341 host of the Ministry of Education Computing Center when the very beginning of the academic network prototype appears. In 1994, HiNet, the first commercial network started operations. In 1997, the mobile communications business started. And to this day, according to the Taiwan Network Information Center's latest poll in 2015, the Taiwanese internet penetration rate is 80.3%. About 1,883 millions people use the web, whereas for 18-30 year old people is 100%.[1] 89.2% of respondents have a network at home, about 7,498,712 families. Most people access by desktop computers (72.8%), secondly by mobile phone with an internet connection (57.4%). 68.6% households can access internet use through optical network and/or Asymmetric Digital Subscriber Line (ADSL). After the 4G network started, 4.1% families use 4G wifi sharing device, and 26.8% have other internet access methods, such us optical network and ADSL. In addition, in Taiwan 67.9% people have used mobile network, whereas 55% are smartphones and 4G. 61.0% people have access to internet by wireless LAN.

According the report in 2014 by Market Intelligence & Consulting Institute (MIC), 96.2% internet user had recently used community websites such us Facebook (95.8%) and Google+ (24.7 %), 54.7 % of the users like to use multimedia to share information. 39.6% of Taiwanese users often use network forums, the top five in order, is Mobile01 (51.4%), PTT (51.2%), Yahoo! Answers (46.2%), eyny.com (35.5%) and ck101.com (23.4%). Among them, PTT is one of the earliest Bulletin Board System (BBS) in Taiwan.

PTT was founded by Yi-Chin Tu and other students from the National Taiwan University in 1995, and it is currently administrated by the Electronic BBS Research Society as a non-commercial and open-source BBS. It has more than 1.5 million registered users, with over 150,000 users online during peak hours. The BBS has over 20,000 boards covering a multitude of topics, and more than 20,000 articles and 500,000 comments are posted per day.[2] The operating mode is outdated, you can only use keyboard but mouse, new users have to provide a non-free e-mail to apply for an account. They have very complete and constantly edited “board rules”, each board have moderator(s) elected by the users to maintain order. Apart from inappropriate remarks which will be removed, moderators themselves will be supervised by other users. Users who have too many inappropriate comments or topics may be prevented from speaking, or in some cases their account will be deleted. They don’t want to establish an authoritarian discussion place, on the contrary, they form a very interesting utopia. PTT welcome to speak freely, promote freedom of expression and though. The rules, the concept of non-commercial and political presence is to ensure that freedom. According to the developer's description, they encourage everyone sccording with their abilities to help others. The atmosphere is one of true reflection from the users not put of business interests but to help others, and this slowly affected non-users in the real society.

Current Facebook users and other network communities always reference the topics from PTT, and share it with non-PTT users. Compared to the new network communication, PTT it is not easy to assess, but it accumulated a large number of users until it became an important cornerstone of the network discussed.

3.2 Networked social movement in Taiwan

In the evening of March 19, 2014, more than two hundred students in Taipei, broke through the police’s blockade into the Legislative Yuan and occupied the parliament chamber, in order to protest against the government examined the “Cross-Strait Service Trade Agreement (CSSTA)” on March 17. This treaty would be devastating small and medium-sized businesses, publishing industries, and could probably let democracy and freedom in Taiwan get controlled by China. They conveyed this movement right away on Facebook and other communication software by smartphone, internet and social media to stimulate more people to participate in this activity. On March 30, the influx about forty millions of protesters (the police estimated them at 110,000)[3] surrounded the Legislative Yuan and the Taipei Po Ai district. Just like for other moments of revolution over the past few years in other countries which were initiated by the network, people confronted and joined together during the occupation because governments were perceived not just as corrupt but unjust (Castells, 2012). Compared with earlier civic movements, there was a huge difference in the number of participants and also the fact that people took control of authority over information and media,

[1] Taiwan Internet chronological history research project, 2005

[2] https://en.wikipedia.org/wiki/PTT_Bulletin_Board_System

[3] Taiwan police is use “Herbert Jacobs Method” to calculate the number of protests. But there is a person named “weijidai” on internet use Geographic Information System with AutoCAD, calculate the road area and three people per square meter, draw about 45 million people participate at that day.

which inspired the willingness of young people to care about politics, social justice and urban issues in Taiwan.

It started by sharing information on network. Before March 17th, around 8,500 topics about CSSTA could be found on google search per month, but after the first day of movement, it raised to 52,600 topics. This is not yet included in the number of information which are shared on Facebook. In the first moment, people shared information by texts, but after a few hours, a student used iPad through the internet live webcasts platform “Ustream”, shared his live video on internet, and successfully grab the attention of web users in the middle of the night.

At the beginning, when the information about CSSTA were start passed on the web, only some text data attempted to explain the incomprehensible agreements to the public, but then, many text-based information was transferred into diagrams and infographics which are easier to share on smart devices. Under the condition of live events of the movement, background information continued to be spread, more and more people identified with this protest and tried to provided their assistance. With smartphones, the presence of protesters attracted more people to participate. In the first instance, participants just want to take advantage of numbers of people from outside to stop the police storming into the parliament chamber, after spread the information more and more people started to identify with this struggle and began to join this movement. These participants were not only in Taiwan but also overseas.

Some people began to give speeches, musical performances and some other activities. While more and more people got involved, people started a variety of divisions to maintain operations on the active site and order. In addition to allocation of supplies and streets kept clean (there was no garbage left behind in the field), various professionals began to stand up and help people at the event: for example, an advisory group composed of lawyers protected participants in social movement and helped students to understand their legal and criminal responsibilities; doctors in the medical team helped participants, the police during the movement and the picketing troops to prevent persistent individuals who took the opportunity to attack the students. After the movement, architects and building professionals tried to repair the slightly damaged Conclave after the student occupation, but were stopped by the government because of concerns about legal issues (because all public space projects have to follow a set of bureaucratic procedures). They changed to damage assessment and valuation, and put evaluation results on the internet to counter the price which was claimed by government or certain media.

Date	The Name of movement	Movement process	The number of participants	Initiated by the network
Mar. 19, 1990	Wild Lily student movement	The demonstrators sought direct elections of Taiwan's president and vice president and new popular elections for all representative in the National Assembly.	6,000+	No
Nov. 2008 - Jan. 2009	The Wild Strawberries Movement	Police actions on protests aimed at Chen suppressed the display of Taiwan's national flag and the playing of Taiwanese songs. This prompted a group of 400 students in Taipei, Taiwan to begin a sit-in in front of the Executive Yuan in protest of Taiwan's Parade and Assembly Law.	400	Yes
Jul. 20, 2013 & Aug. 08. 2013	White Shirt Counter-protest	Two protests for Death of Hung Chung-chiu, initiated by group “Citizen 1985”. In response to these protests Legislative Yuan approved major reforms to Taiwan's military justice system, which included the abolition of court martial during peacetime and transfer of military prisoners to civilian prisons.	30,000+ protesters at Jul. 20, 100,000+ protesters at Aug. 08	Yes
Mar. 18, 2014 – April 10, 2014 (23 days)	Sunflower student movement	It is associated with a protest movement driven by a coalition of students and civic groups that came to a head in the Legislative Yuan and, later, also the Executive Yuan of Taiwan. The activists protested the passing of the CSSTA by the ruling party Kuomintang (KMT) at the legislature without clause-by-clause review.	400+ protesters in the chamber 10,000+ protesters surrounding the Yuan	Yes

Table 1: Taiwan citizen movements.

Not only discussions but also broadcasts help more people acquire knowledge about this event, but they also corrected false information spread on the internet. Such incorrect information from the government and the media was refuted at different discussions and with evidence people had collected in real-time and in their presence. This was the way to continue collecting information, interpreting it, and keeping collect data, for re-interpretation through the online community network, spreading as the virus does (Gladwell, 2000).

On April 6, the Legislative Speaker Wang Jin-Pyng visited the occupied parliament chamber and promised to postpone review of the trade pact until legislation monitoring all cross agreements had been passed. In response to the April 6th concessions from Speaker Wang, the protesters held a press conference on April 7 stating they would vacate the Legislative Yuan on April 10 at 6 p.m. which they eventually did, and also to continue the movement in the broader Taiwan society. President Ma supported the students' decision to leave the legislature. The legislative chamber was fully cleaned by students before they left.

Manuel Castells examines the recent networked social movement in the world and provided several characteristics: 1) they are networked in multiple forms, 2) they become a movement by occupying the urban space, 3) movements are local and global at the same time, 4) spontaneous in their origin, they are usually triggered by a spark of indignation, 5) these are usually leaderless movements and 6) these movements are rarely programmatic movements (Castells 2012 & 2015). With the help of his investigation and the observations of the movement in Taiwan, urban planning participation was seen in a different view.

Although the Sunflower Movement was triggered by a spark of indignation, the reason why it achieved such a scale was due to the increase of users of network communities, digitized knowledge and the experience of many civic movement participants.

4 PARTICIPATION IN URBAN PLANNING IN TAIWAN

Basically, citizens have two ways of participating in urban planning: within the system and/or outside the system. The last chapter was about movements outside the system, and here we will provide some protests within the system of law.

	8. Citizen control	Degrees of citizen power
	7. Delegated power	
Public develop their own plans. Urban Planning Law § 24.	6. Partnership	
Public hearing. Urban Planning Law § 19. Urban Planning Law Enforcement Rules in Taiwan Province § 5, 6.	5. Placation	Degrees of tokenism
Opinion poll. Urban Planning Law § 25.	4. Consultation	
Explanatory meetings. Urban Planning Law § 19. Urban Planning Law Enforcement Rules in Taiwan Province § 5, 6. Land Acquisition Act § 10	3. Informing	
Public exhibition. Urban Planning Law § 19. Urban Planning Law Enforcement Rules in Taiwan Province § 5, 6. Urban Renewal Act § 19	2. Therapy	Non participation
	1. Manipulation	

Table 2: Arnstein's ladder of citizen participation and the Urban planning related laws of Taiwan. (Arnstein, 1969)

4.1 Laws related to participation in urban planning in Taiwan

Some urban planning related laws are referring to public participation: Urban Planning Law, Urban Planning Law Enforcement Rules in Taiwan Province, Urban Renewal Act, Land Acquisition Act, etc.

When comparing the public participation in Taiwan with Arnstein's ladder of citizen participation, it's situated between 6) Partnership and 5) Placation. (Huang, 2005) But in fact, the situation of particapation in Taiwan were not so optimistic.

In those laws and acts, holding certain meetings, such as explanatory meetings, public hearing, holding of hearings could make the public confused. There is no difference between explanatory meetings and public hearing as all meetings include only government's unilateral statements. No law can force government to take the opinions of the people in board. Holding of hearings takes place according to a programm having the force of law that allows governments and stakeholders to present their evidence and debate with each other. But holding of hearings takes a lot of legal and government resources, and high barrier conditions to participate in the meeting.

4.2 The issues of public participation in urban planning

So far, the public is a passive part in urban planning participation. Here are some summarized results from other studies. (Ou, J. Y. & Cai, T. B., 1996. Liao, Y. D., 1998) to give reasons for lack of public participation:

- The overall review process of planning and cannot cause public attention.
- People do not understand the overall review process.
- The comments made by the public, considered mostly out of selfishness, cannot be adopted by the Planning Commission. But most people think that this defies public opinion.
- The method of participation is weak; people only have a chance to express their opinions until the general considerations of plans. The public has no opportunity to communicate on the most important substantive planning program.
- Explanatory meetings are ineffective, and most of the meetings are during working time.
- Reconsideration for second interventions could become the way to raise land prices by some representatives and consortiums.
- Announcements in newspapers is often a formality.
- There is information asymmetry between the public and the government.

5 CHANGING THE PARTICIPATION BY NETWORK SOCIETY AND SMART DEVICES

Urban planning is a complex task and many different professions take part in the process. However, people in Taiwan can only be part of it at exhibitions (30 days), public hearings and/or briefings to understand the contents of planning and they are unable to exchange objections and ideas with government and planners. The big difference with the Sunflower Movement is that participants incorporated themselves in the whole process via the Internet. Not only did they show images and videos but people also asked and answered many questions immediately on the web. This process allows them to refute incorrect information and can also fix it immediately if they make mistakes. When the police tried to tackle people in the building, people showed that they did not have any weapons and were reluctant to use violence. Their peaceful reaction had broken the rumors which some TV news called "The riot!". When some students looked up and interfered with the Legislators' personal belongings they were immediately discovered and the leaders of the movement had stopped them and asked everyone not to break any objects in the room. People who participated were watched, but sharing information could also attract more participation and help. During the movement, people provided batteries, food and even some professional knowledge of computer technology, medical treatment or legal assistance. Below are some network social movement modes of operation which could apply to urban planning.

- The whole process of planning should be networked in multiple networks on the Internet. An urban planning project is a long turn work and a lot of different professions need to take part, but citizens in Taiwan can only join into some project procedures. The planning project will be strictly monitored by people once they agree with it. Several studies concluded that citizens should be allowed to participate in the planning process, but it should be the other way round. Planning should take part in people's wants and needs which can be achieved most easily through the social network at present. The planning team should get into the networks of groups of participants instead of doing deals with individuals. This would avoid a bureaucratic system's communication gap and the problem of covert negotiations.

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- The right to get information and open data. Information is one of the basic foundations of participation. With enough information, people can understand the context of planning and then provide informed advice. The Taiwan governments has started to open data slowly but still many problems persist. First, there is the definition of open data and secondly the accessibility is this data, be it human-readable or machine-readable. When the Taipei city government shared data of buses, a person produced an application "Speed Bus" for smartphones which showed user where the buses were and when they would arrive at the stopr, but after some days the application suddenly no longer worked. The application developer said that this was because the data provided by the city government was changed and he was working on these changes. However, a news reporter found that the developer had interfaced government data and information illegally. According to the department of transportation of Taipei the city government said that they had permitted users to use all the open data but that the software developer was not entitled to sell the data, while the chief of Taipei transportation police said that users did not apply to the government for information interfacing. Conversely, the information which was produced by scholars for all the participants of the movement allowed all kinds of uses and they took videos, photos and all kinds of "views". People started to ask the government to do the same thing for their own activities. For example, during government meetings, there should be live recording and permission for reporters and citizens take videos. The public can make judgments more easily it has access to many sources of information. Many people took the initiative to conduct activities in the internet, interpreting and re-interpreting data and debates. In 2011, the government required that all real estate transaction prices had to be uploaded online in order to curb speculation in housing prices. People can also access and check the rates. In addition to the official website, there is also a website which combines pollution information and other environmental deficiencies. Since the student movement, more and more young people in Taiwan have become interested in politics, and they reacted to issues raised by the legislature in video recordings. In the past, questions of the Legislative Yuan only passed on TV news according to its views. But now members of the political board of PTT are posting the full videos and sorting out the transcripts. Since the last movement a website hosted by Watchout, Co. (沃草) continues posting videos from questions.

Fig. 1: The website of Housing Prices. (http://www.foundi.info/)

- Constant interpretation and re-interpretation. Open data is the basic foundation, but information will be shared more easily by some people who interpret it. The information on Internet will be edited, trimmed, supplemented, altered or changed into different form, and the entire context will be preserved as long as it •does not get deleted. During the sunflower movement in Taiwan, the topic had been noticed because of information on new network media, as well as alternative interpretations by the internet users, bringing about more re-interpretations. At the beginning, a professor of economics from National Taiwan University tried to explain the CSSTA and how it can affect business in Taiwan.[4] During the movement, that document became an important theoretical basis for

[4] http://homepage.ntu.edu.tw/~ntuperc/conference-1-files/20130725_3_1.pdf

opposition agreement. People began adding more supplements and creating a lot of graphic explanations and infographics so called “For Dummies”. Even if the content of such style of information was extremely simplified it had attracted more people's attention who began to study the provisions of the original agreement.

Information has power only when used and applied effectively (Boon 1992; Martin 1984; Paez-Urdaneta 1989). A report with a map which showed the land liquefaction of Taipei as a jpeg file (Fig. 2) was hidden in a corner of the government’s website. When it was reported on the news, people suspected that the government did not want to publish it because it might be affect the price of land.[5] However, the japes files could not be analyzed by GIS and other mapping programs. Until 2016, after an earthquake struck with a magnitude of 6.4 28 km (17 mi) northeast of Pingtung City in southern Taiwan[6], the safety of building construction had become a public concern again, the Central Geological Survey finally provided an online query system to provide the general public or professionals with relevant information (Fig. 3).

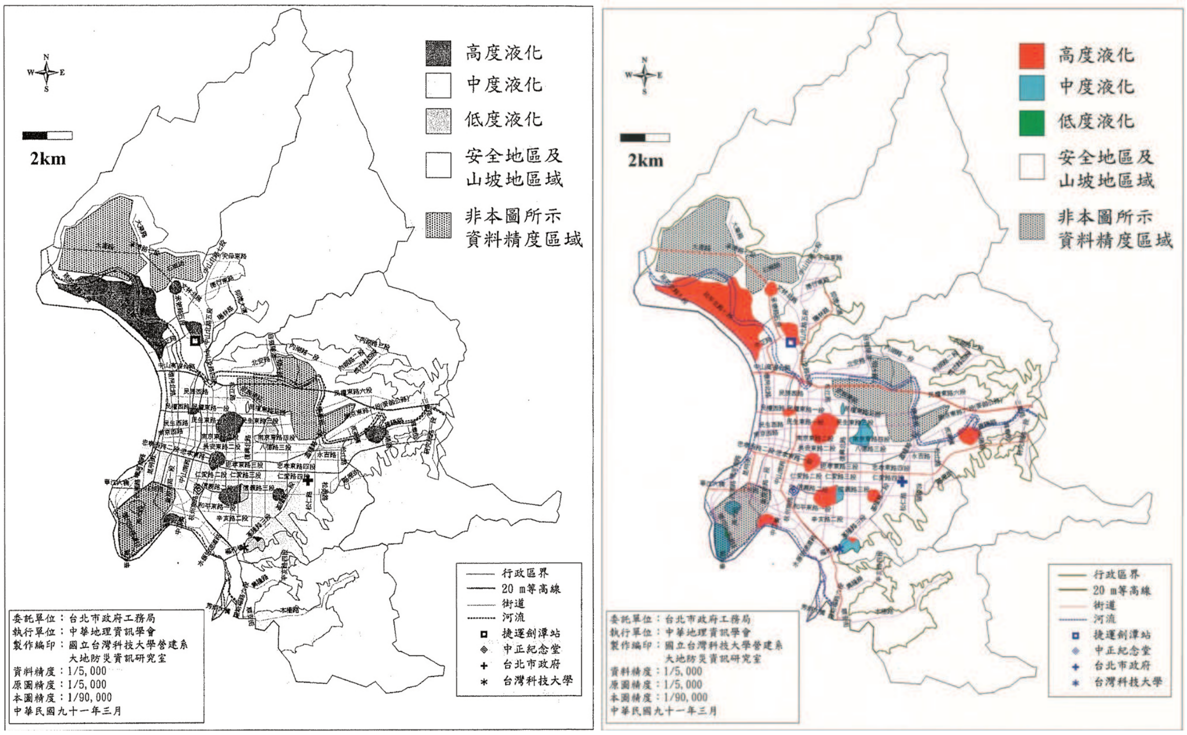

Fig. 2: The liquefaction map of Taipei. (Lee, S.H. 2002)

- Participation should not be limited by borders. Diversity of participants for urban planning is very important (Irvin & Stansbury 2004). During the movement and protests, participants may not have a direct link with issues but with identity. The demands and debates of the participants brought different perspectives to strengthen the depth and breadth of the discussions which requires a large numbers of people. In the past, participation in urban planning was always limited by space and time, and the number of people and the running time were reduced to a certain scale. The Internet had extended the the boundary of time and space (Castells 1996). It created a new platform to carry all kinds of information and a huge number of discussions and communications, one of the reasons why networks can accumulate a lot of power. In addition, planning even at a small scale will also affect the surrounding areas, environment and society. Reducing or restricting participation will only limit the possibility of rational conversations. The “Smart London Plan” – a project to support London’s growth and look to what new approaches to innovation in digital technology can bring – mentioned: We will…ask Londoners, businesses and other stakeholders what ‘Smart London’ should look like… As a city London tried to use technology and networks to communicate with citizens about the future, and had invited not only the people in the city but also other stakeholders.

[5] 姜毅宏、陳乃瑜 (2016, Feb. 16) 怕房價跌？北市土壤液化嚴重 馬英九14年前早知道. SET News. Retrieved Mar. 29, 2016http://www.setn.com/News.aspx?NewsID=124487

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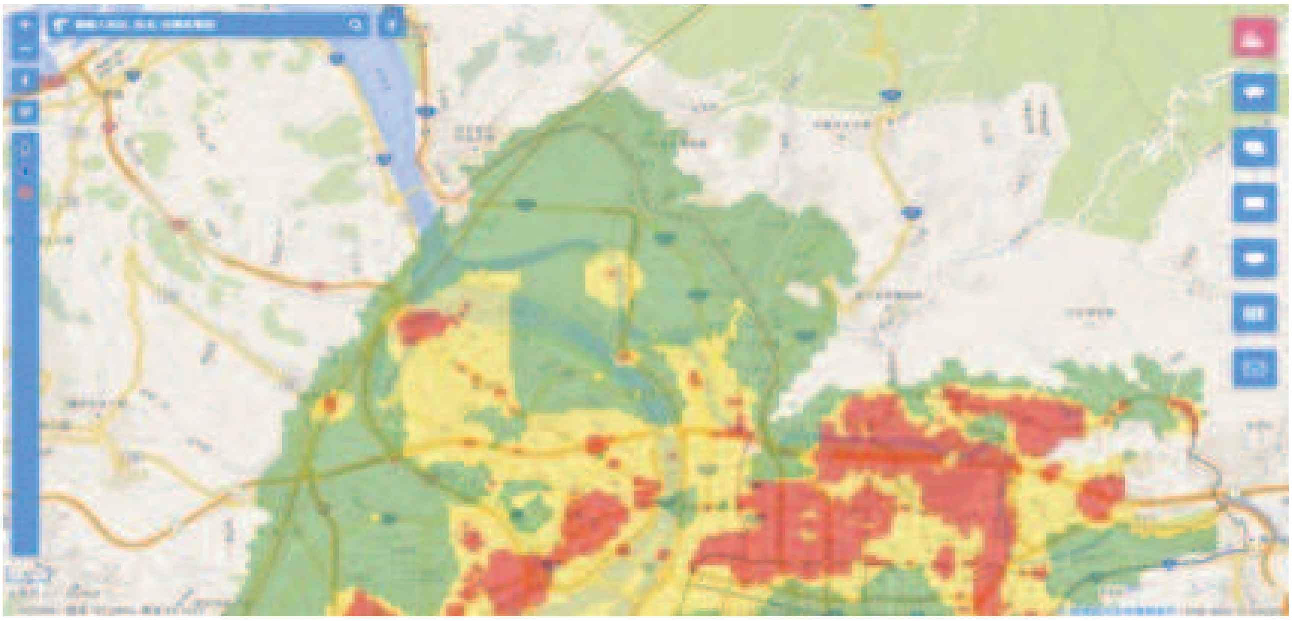

Fig. 3: The website of liquefaction map. (http://www.geologycloud.tw/map/liquefaction/zh-tw)

- Multiple participation which have legal effect. Action requires power to be able to do things. In addition to social movements, we need politics, which is the ability to decide what needs to be done,[7] through the legal mechanism which was stablished by the democratic system, one of the effective methods. Yet in Taiwan, the participants can hardly ask the government to respond to their comments and concerns at public hearing.

6 CONCLUSION

After a long protest, and through the popularity of the network which enabled the cumulative building up of online digital information and knowledge, and the development of various networks, forums and digital communities, the Taiwanese people began to have dee and broad communications on the internet. The next issue is to turn these communication models into a workable system and extend it to more communities. It is difficult and very disappointing to let the public communicate with government by social movement and protest in a very short, explosive time. Instead, we should construct a legislation system of participation and ensure that the public has the right to use technology and network to participate in and control urban planning. We also have to establish a framework of discussion on the social network and take it forward to non-network communities.

Planners and designers have to know that the most important subject of cities are its people. In addition to relying on the government to improve the legislative system, they could transfer knowledge of the urban planning issues by providing information and involving people in communication and discussion. The knowledge produced by planners and scholars needs to be opened up, digitized and translated into information which is easy to understand and can be transferred to all kinds of carriers. This process could also be undertaken by other network users, without being limited, misunderstood or misused, because according to the present experience, they would summarise the conclusions accepted by the general public if the number of participants is large.

In the end, we shouldn't underestimate the strong and active from a powerful identity. The urban space created by the public has a lot of energy, probably better than that created by the planners and it is a process rather than an end in itself, as has been presented by Jan Jacob and proven by our old neighborhoods in Taiwan.

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The Concept of Situation Centers for Smart Cities

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1 ABSTRACT

"Smart city" is a very popular trend for modern Europe. Nearly every large city aspires to become more technologically advanced in order to raise quality of life and security of its citizens.

Thus, various city departments and services, such as traffic services, police and fire departments, have constant need for receiving complete up-to-date heterogeneous information from various sources and for analyzing it in real-time scale.

The concept of situation centre for management and control of city life, described in this paper, is one of the ways of reaching that goal. Situation centre for monitoring and intelligent decision making support is intended for surveillance (observation) of objects of different nature and associated situations. Situation centre supports monitoring, prediction and modelling of development of various situation of local and global scale in real time operation mode with cartographic representation. In this paper we demonstrate the functionality of situation centre on the example of prototype installed in the Bonch-Bruevich Saint-Petersburg State University of Telecommunications.

Keywords: smart city, smart planning, decision support, monitoring situations, situation centers

2 INTRODUCTION

In recent years city management tasks have been characterized by high dynamic, complexity, multidimensionality and access to number of heterogeneous intersecting information sources. Moreover, the level of uncertainty in management decision making has risen greatly. It is primarily related to rapid development of modern digital and technological means of accessing data, growing number of heterogeneous data sources, and also to social factors, such as: "speed" of live in cities, constantly growing population size, improving quality of life and etc. Hence, at current moment, every city faces a problem of informational support and creation of city management structures – situation centers.

City's informational support implies aggregation of all information sources, their processing and analysis, provision of access to them on different management levels. Commonly, three levels of city management are distinguished:

- global level: provides centralized monitoring and management of city as a whole, and interaction with upper federal departments;
- local level: provides monitoring and management of specific city sector (district or region);
- object level: provides monitoring and management of specific city's entity (buildings and department units);

City's informational support ought to be executed sequentially: from information dissociation to centralized data and creation of unified information space, from unstructured resources to information portals, from custom engineering to standard application systems, and finally, from hard-copy paperwork to "electronic government".

Development and implementation of city management situation center will allow:

- to expand possibilities of strategic decision making;
- to improve efficiency of data representation;
- to improve productivity and quality of decision making;
- to increase city safety;
- to optimise communications and resources management.

Experience of developed countries shows that there are two major obstacles on the way of creating informationally supported city:

(1) Complexity of creation of large-scale information system. The more complex the system and its tasks, the more complex its architecture and engineering solutions become. Currently, there are no standard city level solutions.

(2) Low integration level of city information resources. Dissociation of data bases, various protocols and program solutions not only complicate data search and systematisation, but also increase the expanses of forming a unified city information space. Development of data representation model and of means of data aggregation is needed. Problem of data duplication in different city information systems is evident.

(3) Large amount of out-of-date systems. Process of development and integration of new systems is costly enough and is time-consuming.

(4) Number of properly-functioning systems that should be integrated into a unified city information system. System development, as a rule, is conducted with use of various technologies and standards. To provide opportunity of integration of existing systems, following issues should be solved:

- development of means of integration;
- provision of resources centralization;
- development of means of data aggregation.

(5) Absence of sufficient technical infrastructure. Currently, technical infrastructure is not fully formed. There exists a large number of various networks that differ from each other in their characteristics, scale and purpose. Those networks usually duplicate each other in many ways.

(6) Complexity of creation of a unified data access portal. Unified portal integrates whole range of services, provided by city's authorities, and allows access to them at any point in time. Aggregation of city's authorities resources has several of advantages:

- allows to provide objective and complete information to citizens, concerning social services and support;
- supports "transparent", constant and operational interaction of government agents with economic entities, along with sufficient economy of time and budget resources;
- provides optimization of government agents interaction among themselves.

(7) Absence of systematised list of city's business processes. In a city, as well as in any organisation, there exists a large variety of processes, that can be easily formalized and adjusted to fit existing concepts. Only with clear description of business processes it is possible to build information system on city level.

(8) Absence of worked out data processing and decision making support mechanisms on different levels of city management. Specifics of data processing lie in necessity of simultaneous analysis of large amounts of heterogeneous information. At that, processing should be executed in real-time mode in order to provide actual informations to users.

The issues of creating city information system stated above at large extent can be solved with integration of unified situation center for city management. Such centers will allow to execute comparison of data, acquired from various divisions and departments, in real time scale, detect dangerous and emergency situation in city life, and to operatively make effective management decisions.

3 GLOBAL EXPERIENCE OF SITUATION CENTER ORGANISATION

Concept of situation center creation in Siemens Company departments in Belgium and Luxembourg involves combining neurophysiology and ergonomics approaches with modern administration principles and information technologies (Cockpit).

Key advantages of this concept lie in expansion of opportunities for strategic decisions, rising of their quality, communication management and rising of management team productivity.

Concept of French Tableau de Bord (Daum, 2005) has been actively applied for many years in France for creation of situation centers. Information structure and representation are usually based on perception peculiarities of human brain. Walls in situation center room are usually without windows, and painted in four different colours (black, blue, red and white), that are associated with four basic steps of decision making process.

On each wall, data is displayed on six screens, along with aggregated geographical and detailed information, which represent six most actual questions.

The choice of six alternatives is determined by perception peculiarities of human brain as well, which is capable of processing no more than seven blocks of information under one decision making problem.

The Boeing Company (Boeing) has implemented the situation center concept for a department, responsible for maintenance and exploitation of aircrafts. In this context, situation center helps to improve interaction between different functional teams in given department. As a result of implementation of this project, the Company has saved about 3,5 million dollars per year and has significantly improver department productivity.

Currently, management situation centers efficiently operate in cities like New York and Miami. Situation centers allow to promptly coordinate functioning of various city services like police, medical, fire departments and others. This project is executed by IBM company. Instruments for integration and visualization of data were created on cartographic base as well. This instrument is called Crime Data Warehousing. Before, data used to be collected from bottom to top, which could take months. Data was in different formats, cluttered with errors and inconsistencies, and it had to be added manually.

4 SITUATION CENTER CONCEPT

Situation center, from technical point of view, represents hardware and software complex, equipped with communication and interactive data representation means, intended for monitoring, forecasting and modelling of development of various situations and objects in real-time scale. From the point of view of city management, situation center is an element of operative decision making system on strategic management level with application of earlier acquired data bases and expert technologies.

Situation centers allow to perform effective informational and organisational decision making and to train personal that takes part in city management.

Among strategic city management tasks, situation center solves the following:

- social and economic factors dynamic forecasting
- analysis of balance and accessibility of different city resources (electricity, water, gas and etc.);
- estimation and planning of city infrastructure state and its development;
- citizens' safety estimation;
- social tension analysis;
- provision and optimal resource allocation.

Situation center functioning is based on the following basic principles:

(1) various situation monitoring in real time scale, process modelling, situation scenario developing;

(2) situation visualisation and analysis;

(3) operative decision making with application of expert data bases, modern information technologies and means of data representation;

Modern situation centers for city management solve the following tasks:

(1) information support of city's government;

(2) support of collective decision making in various situations;

(3) reduction of time and financial expanses, related to data duplication, inconsistency, acquisition and processing;

(4) integration of heterogeneous information systems in unified information space.

Situation center main operating modes are the following:

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- routine management and monitoring mode;
- operative decision making mode;
- management in crisis situation mode;
- modelling and forecasting mode.

5 CITY'S SITUATION CENTER STRUCTURE

Behind the structure of situation center lies informational (or situational) city management model. Informational (or situational) city model represents the complex of the following components:

$$M = < O, S, G >$$

where O represents a thematic component – ontology, that determines aggregation of modelled concepts in regarded subject area; S – spacial component, space and spacial relations between ontology concepts; G – graphical component, representation of ontology concepts with a number of graphical symbols (graphic primitives).

One of the distinctive traits of city management situation center is association of situation management model with geographical location, therefore geographical system is its essential part. However, situation center operation covers not only data representation according to developed model, but also modelling, estimation, forecasting of situation development, thus it is reasonable to apply intelligent geo-information systems (Popovich, 2013).

Major elements of hardware and software complex based on intelligent geo-information system concept are the following subsystems:

- geo-information interface;
- registration and documentation subsystem;
- real time scenario replay subsystem;
- cartographic information database and server;
- WMO database;
- situation awareness ontology database;
- information exchange database;
- operative support subsystem;
- intelligent support subsystem;
- electronic documentation subsystem.

Situation center's hardware and software complex design is given in Fig. 1.

As informational sources, information center uses various sensors, antenna systems, communication channels, video and audio sources. Main task of information sources is to provide adequate informational model of the city.

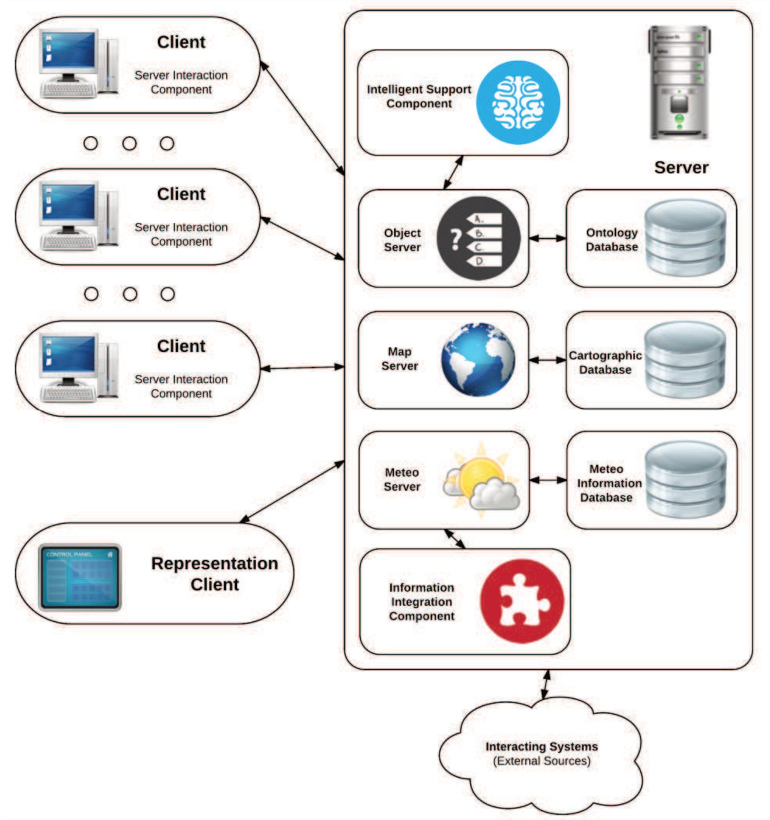

Fig. 1: Situation center's hardware and software complex design.

6 CASE STUDY OF BONCH-BRUEVICH UNIVERSITY SITUATION CENTER

As an example of successful implementation of situation center's concept on practice we present a case study of situation center, created for needs of St-Petersburg State University of Telecommunication (Bonch-Bruevich University). This situation center was designed to provide university's administration with means of operative and efficient management of university entity.

The peculiarity of this case rests on the fact that university is not concentrated in one area but is spread across the whole city: educational units and dormitory accommodations are situated in different buildings in various parts of the city, often far apart. Therefore, we use geo-information interface to provide visualisation of all university objects and attribute information about each object (Fig. 2 and 3).

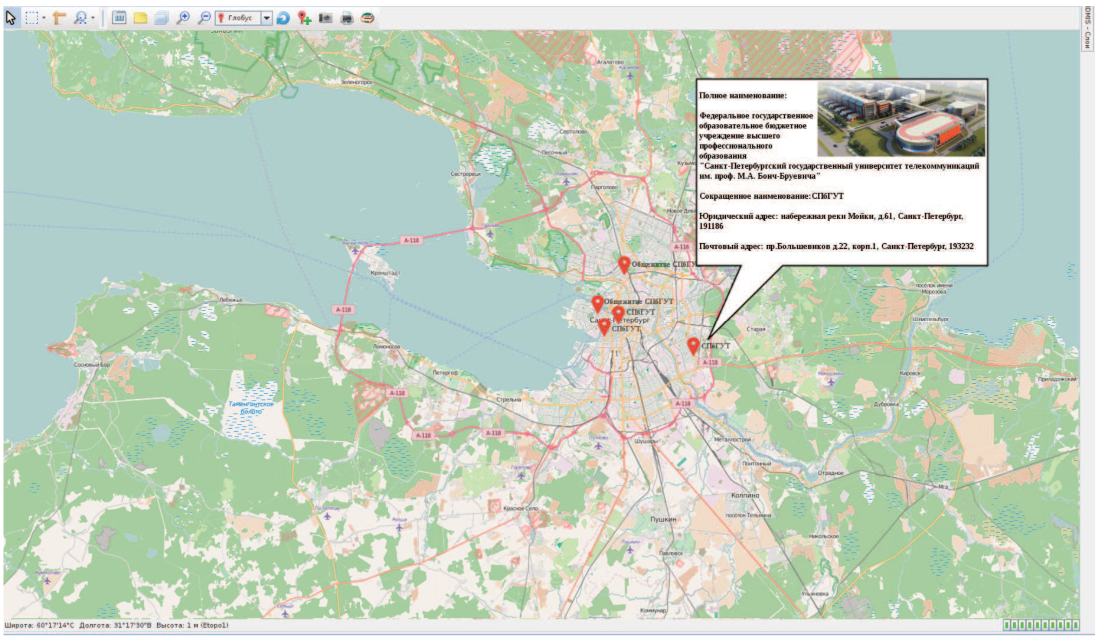

Fig. 2: Univercity's units on cartographic base.

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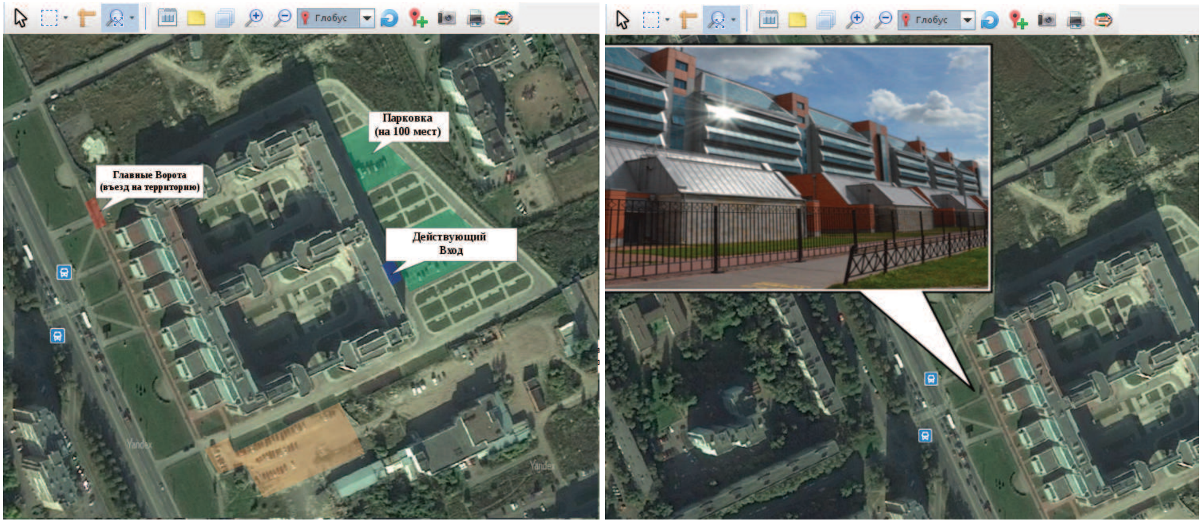

Fig. 3: Attribute information about university objects.

Software also provides access to inner structure of university buildings (Fig. 4). University staff is able to have access and to manage inner systems like: surveillance cameras' feed, fire alarms, signalisations and others. It allows to simplify management processes and decision making in case of emergency situation occurring.

Additional software for the university situation center is electronic documentation plug-in, which allows to manage all university documents from educational plans to administrative orders in one space, to exchange messages and documents between staff in real-time.

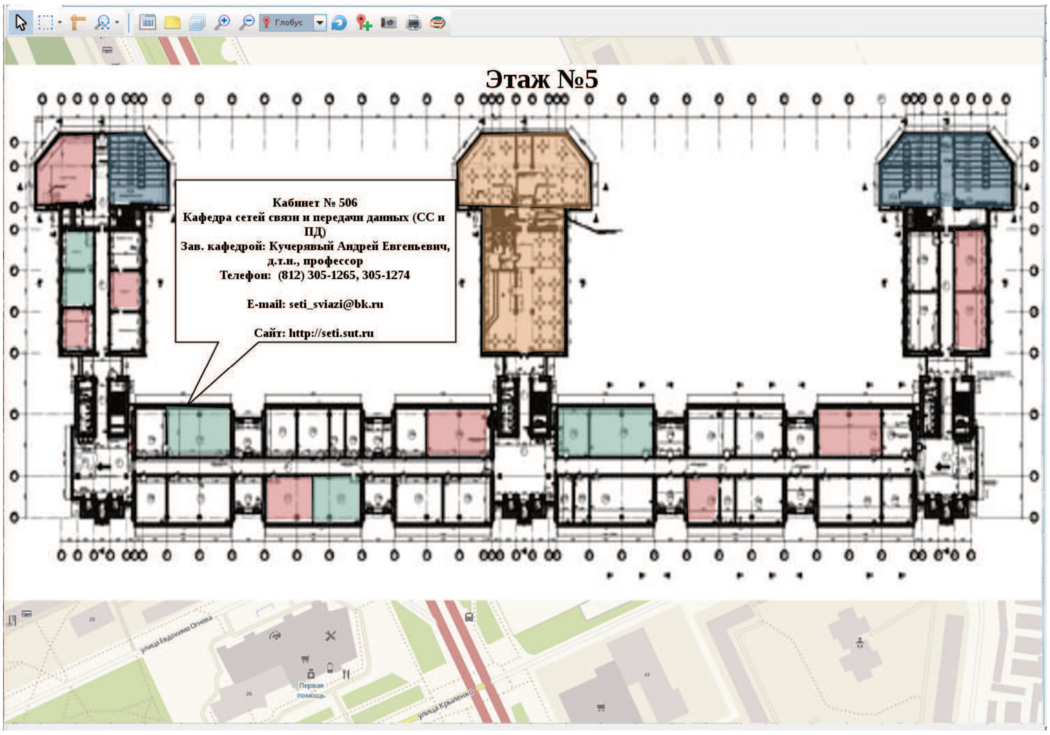

Fig. 4: University building plan of one floor with attribute information about each room.

Situation center room is presented in pic. 5. Six display panels are intended for visual presentation of aggregated actual information about university. There are six separated workplaces for situation center operators, in order to monitor different kinds of university situations and to collect various kinds of information for further display on main screens. University administration is to be seated at large table right in front of main screens.

Fig. 5: Actual look of situation center room.

7 CONCLUSION

The main purpose of city situation center development is provision of up-to-date hardware and software systems that contribute to effective decision making and city management. Development and implementation of this situation center will allow:

- to enhance opportunities of strategic management decision making;
- to rise effectiveness of data representation – to present blocks of information prepared beforehand, oriented on administration needs, in order to enhance effectiveness of decision making process;
- to rise work productivity and quality collective interaction and decision making;
- to enhance city safety;
- to optimise city resource management.

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The Influences of User Generated "Big Data" on Urban Development

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1 ABSTRACT

Cities are the nucleus for creativity and ideas, as it has all the potentials for people to work, explore and live. People always come to cities because they want to be part of something, this magnet in the cities created the problem of population (Ericsson: Thinking Cities in the Networked Society, 2012). Approximately 50% of world's population lives in urban areas, a number which is expected to increase to nearly 60% by 2030. (Mutizwa-Mangiza ND, Arimah B C, Jensen I, Yemeru EA, Kinyanjui MK, 2011).

According to the rapid change in cities' population there exists a need to utilize intelligent prediction tools to deliver a better way of living. Smart cities provide an opportunity to connect people and places using innovative technologies that help in better city planning and management (Khan, Anjum, Soomro, & Tahir, 2015).

Data is never a new thing, but data sources are always in change. The internet made everything easier and more reachable. This wide range of technologies such as IOT (internet of things) and M2M (machine to machine) (Gartner, 2015), is believed to offer a new potential to deliver an analytical framework for urban optimization. The real value of such data is gained by new knowledge acquired by performing data analytics using various data mining, machine learning or statistical methods.

According to this technologically mutated, data comes from weather channels, street security cameras, Facebook, Twitter, sensor networks, in-car devices, location-based smartphone apps, RFID tags, smart meters, among other sources (Hinssen, 2012). This massive amount of information that comes from real-time based tools, made the world in front of a new era of data called 'Big Data'. However, turning an ocean of messy data into knowledge and wisdom is an extremely challenging task.

The proposed paper will discuss the IOT developed frameworks which are used to improve cities infrastructure and their vital systems. Analyzing these frameworks will help developing a conceptual proposal of data visualizing software; with the aim of helping urban planners get a better and easier way to comprehend the usage of multi-data sources for city planning and management.

The full control of data is an open challenge, however proposing the fundamental bases of framework with the ability to extend and having an application layer above would be very helpful for urban process shifting. The Egyptian case is our main scope to have a smarter city that provides an opportunity to connect people and places using innovative technologies.

Keywords: Big Data, Cloud, Urban Development, Smart planning, Smart City

2 INTRODUCTION

It is a matter of fact that technology takes now lion's share of people's concerns. This new enthusiasm about technology, algorithms and applications can give us a better understanding of cities; it also enables stakeholders to have predictive statistics for the decision-making process.

Before going deep in technology, it is important first to simplify the major components of any city. The abstract perspective of any city will lead to the definition of city anatomy by City Protocol. City Protocol promises to put the guidance for cities like what LEED did for buildings (arch daily, 2012), to help us understand and map the interconnections between city systems.

They divided the city into three system elements which form the city ecosystem: (1) the physical structure (structure); (2) the people who live in this physical space (society); and (3) the interactions between people and their physical structure see Fig.1(ancha, 2015). In this paper, we will focus on the third element investigating how people can communicate with their physical environment.

By virtue of information communication technology (ICT), people have the ability to measure, infer and understand their surrounding environment. Nowadays there are real life urban challenges which need a variety of ICT solutions, with the presence of IOT it becomes easier to have information and communication systems invisibly embedded in the environment around us.

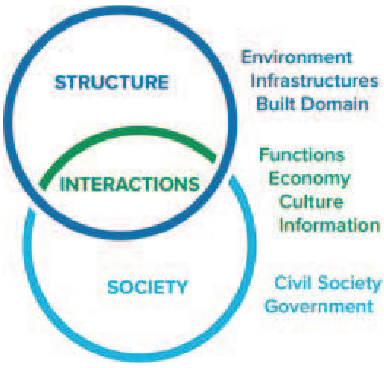

Fig. 1. City Anatomy published by City Protocol Agreement (CPA) (City Protocol)

3 TECHNOLOGIES AND TRENDS

As Gartner's IT Hype Cycle in 2015, the IOT became at the peak of the emerging technologies curve (Fig. 2) (Gartner, 2015). Gartner Hype Cycles provide a graphic representation of the maturity and adoption of technologies and applications, and how they are potentially relevant to solving real business problems and exploiting new opportunities (Gartner Inc.). It has been forecasted the IOT will take from 5-10 years for market adoption.

Fig. 2 Gartner Hype Cycle of emerging technologies. (Gartner, 2015)

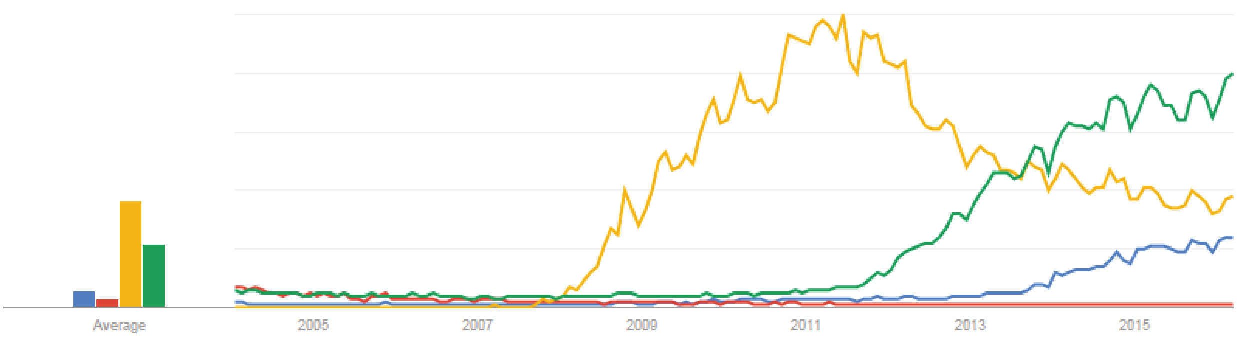

Fig. 3 Google search trends since 2005 for terms Ubiquitous computing, Internet of things, Cloud Computing and Big data.

The popularity of different technologies varies with time. Based on Google search trends measurements this is the web search popularity comparison between ubiquitous computing, Internet of things, Cloud computing and Big data; during the last 10 years shown in Fig. 3 (Google Trends, 2016).

3.1 Ubiquitous computing

ubiquitous computing (ubicomp) is an exciting paradigm that promises to provide computing and communication services to the end users all the time and everywhere; it's objective to embed technology into the background of the daily life (Gubbi , Buyya, Marusic, & Palaniswami , 2013).

Caceres and Friday (2012) discussed the opportunities and the challenges that are facing the ubicomp, they highlighted the two critical technologies that enable the growing of the ubicomp infrastructure (cloud computing and the IOT).

3.2 IOT

From a high level perspective there are three major components for the IOT that enable seamless ubicomp: (1) Hardware such as sensors, actuators and embedded communication devices; (2) Middleware for the purpose of storage, computing and data analytics; and (3) Presentation tools for visualizing the data (Gubbi , Buyya, Marusic, & Palaniswami , 2013).

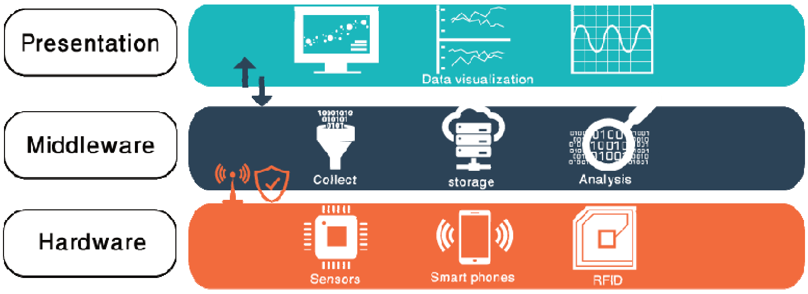

Fig. 4 High-level perspective for IOT architecture.

3.2.1 <u>Hardware</u>

Focusing on sensors, Intel said that "without sensors there is no IOT". There are enormous types of sensors that can measure anything. Briefly, the sensors system architecture: (1) sensors such as: RFID tags, ZigBee, NFC, IBeacon, etc.; (2) processor: to collect the data from sensors; (3) gateway: for accessing the internet; and (4) the data center: the place where data can be stored and analyzed (Hanafy, 2015).

3.2.2 <u>Data storage and analysis</u>

All the generated data from multi sources have to be allocated and stored for the required processing, simulation and visualization tasks. It is important to develop artificial intelligence algorithms for smart monitoring and actuation. Cloud-based storage solutions are increasingly popular to access applications on demand from anywhere (Khan, Ludlow, McClatchey, & Anjum, 2012;Gubbi, Buyya, Marusic, & Palaniswami , 2013).

3.2.3 <u>Data visualization</u>

This layer serves to convert data into knowledge and to present meaningful information from raw data (Gubbi , Buyya, Marusic, & Palaniswami , 2013). Visual analytics is a discipline in visualization science that is resulted from combining the information visualization, scientific visualization and data mining communities all that to provide techniques and tools that support end users to have interactive visual interfaces (Telea, 2007).

3.3 Cloud computing

Cloud computing is a term wherein the capabilities of business applications are exposed as service that can be accessed from anywhere in the world on demand. Thus, the computing world is rapidly transforming to develop software for millions to consume as a service rather than having it on their individual computer and that is the meaning when referring to an infrastructure as "Cloud" (Buyya, Yeo, Venugopal, Broberg, & Brandic, 2008).

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Cloud providers offer some services that can be grouped into three categories: (1) Infrastructure as a service (IAAS), where the providers offer the consumer processing, storage, networks, and other fundamental computing resources; (2) Platform as a service (PAAS), where the providers offer the consumer programming languages, libraries, services, and tools; and (3) Software as a service (SAAS), where the consumer can use the provider's applications running on a cloud infrastructure which can be accessed through various devices (Fig. 5) (Mell & Grance, 2011;TeachMeCloud, 2013).

Fig. 5 Cloud service models.

3.4 Big data

The physical world is now becoming a platform for generating a lot of data "Big data". Big data is the term referring to the large, complex streams of data generated by ubiquitously sensors and the digitized lifestyle (Rabari & Storper, 2013).

Marr (2015) described "Big Data" technology by the following five "V"s: (1) Volume: referring to the huge amount of data generated every second; (2) Velocity: referring to the speed of generating new data; (3) Variety: which refers to the different types of data; (4) Veracity: referring to the trustworthiness of data; and (5) Value: referring to the ability of turning this data into value.

4 CASE STUDIES

Many cities are currently trying to involve technology in their vital systems. Thus, there are various initiatives from all the leading companies to come-up with a matured platform for cities to use. The presented case studies will focus on cities that use IOT and technologies to deliver a better way of living and smart urbanism for their inhabitants and visitors.

4.1 Amsterdam Smart City.

Project description:

"The Amsterdam Smart City (ASC) Public-Private-People-Partnership is a unique partnership between companies, governments, knowledge institutions and the people of Amsterdam" , it is a community-oriented initiative through an open platform toward addressing city challenges (Vermast, 2015). It uses the 4P collaboration (Public-Private-People-Partnerships) which is supported by the European Network of Living Labs (ENOLL) (Cohen, 2014). This project has applications that cover the main aspects of any smart city: smart mobility, smart living, smart society, smart areas, smart economy, Big and open data, infrastructure and living labs; underneath every category there are many projects and implementations.

4.1.1 iBeacone Living Lab:

Becones are a low-cost hardware, they use a low-energy Bluetooth connections to transmit messages or prompt directly to smartphones or tablets (Danova, 2014). "Beacons give objects a personality" As described by the Amsterdam smart city (Smart Areas, 2015), Beacons make every object talk about itself, for example, the doorway could say welcome to you. They can tell you the nearest coffee shop that offers coffee with half price, even if you are a tourist they can explain themselves in your language. Beacons are a great way for developing apps engaging IOT. The city of Amsterdam is running this project through 2015 and 2016 under the smart area category to create a series of installations that enable inventors to test their products, prototypes, and ideas. The project will provide a route of up to 2 Km with beacons lining it for inventors to test their applications, which cover:

- public wayfinding,
- tourist routes,
- iBeacon signing,
- Hyperlocal point of interest,
- Augmenting existing apps with additional proximity data.

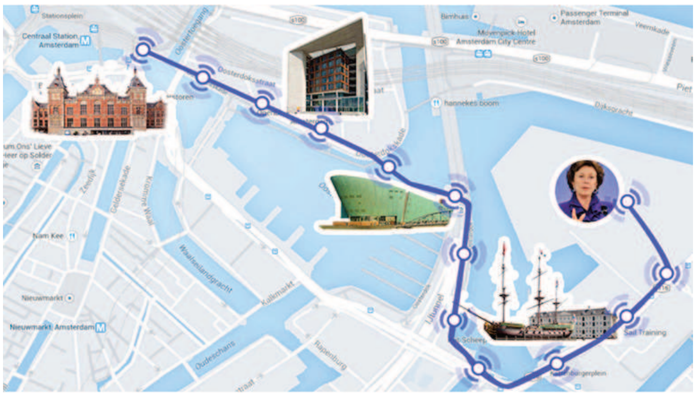

Fig. 6 A route of 2 Km with beacons lining it (Amsterdam smart city: Smart Areas, 2015).

4.1.2 Smart CitySDK

"CitySDK is a service development kit for cities and developers, it aims at harmonizing application programming interfaces (APIs) across cities". It is an open source project for cities to use, since January 2012, eight European cities have worked together to create some reusable interfaces and processes.

During the development of the CitySDK the concentration was on participation, mobility and tourism and the result was these three APIs (application program interface): Open 311 API, Linked Data API and Tourism API (What is CitySDK?, 2016).

Amsterdam has implemented the Linked Data API, which makes city services easier to implement, data easier to distribute, and applications easier to build, and works for both real-time and static datasets (Waag Society, 2016). It collects open data of governments in order to provide several data sets and connect them to the open street map as shown in Fig. 7.

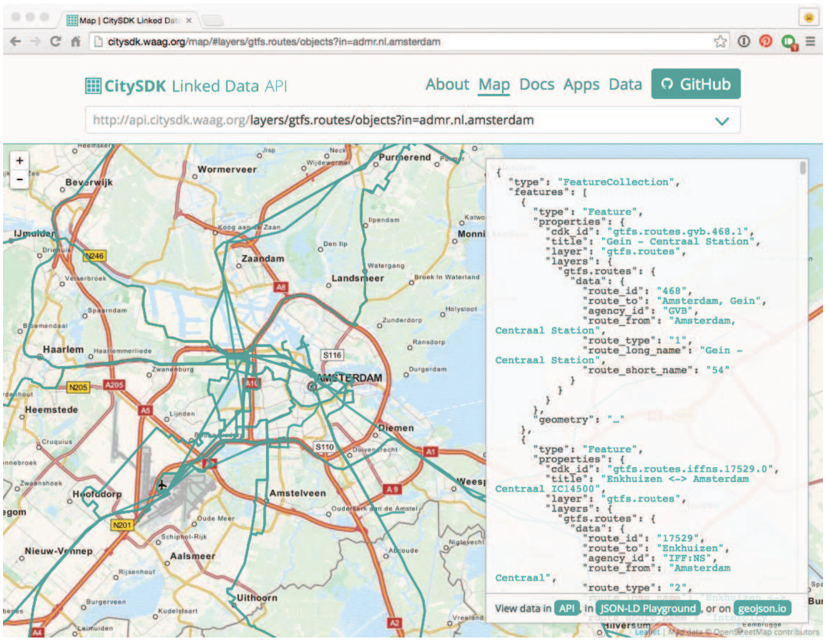

Fig. 7 CitySDK Linked Data API implementation on Amsterdam (WaagSociety, 2015).

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The Waag society was responsible for the mobility domain. One of the Waag society developers Bert Spaan has made a map within the framework of European smart citySDK; showing the age of Dutch buildings. The project was to show all 9,866,539 buildings in The Netherlands, shaded according to their year of construction (Fig. 8), whether they are still relatively young (in blue, built after 1960) or very old (in red). This project gave Amsterdam a completely new image about their country and clearly shows the age of cities. For example, a city like Haarlem of which the old inner city clearly lights up, or Almere covered in blues as it is built in recent times (Waag Society, 2013).

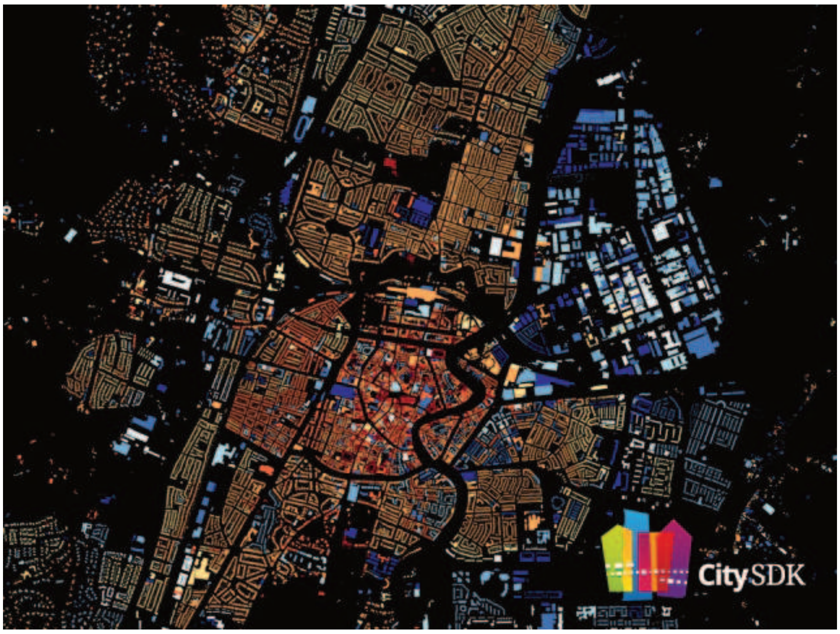

Fig. 8 Map shows the age of Dutch buildings (Waag Society, 2013).

4.2 New York City24/7.

Project description:

The aim of the project was making the public communication more accessible to everyone, everywhere. In collaboration with Cisco IBSG and the city of New York, “an interactive platform that integrates information from open government programs, local businesses, and citizens to provide meaningful and powerful knowledge anytime, anywhere, on any device” was launched. Smart screens were located at bus stops, train stations, major entryways, shopping malls, and sports facilities (Fig. 9) to deliver the information people need to know, where and when it helps them the most (Mitchell, Villa, Stewart-Weeks, & Lange, 2013).

Fig. 9 City24/7 Smart Screen Locations (Mitchell, Villa, Stewart-Weeks, & Lange, 2013).

City 24/7 smart screens combined touch and voice technology to deliver a wide range of information and services in real-time to all citizens with different languages as well as supporting people with disabilities. The smart screens include: a headphones jack for the hearing-impaired, a high contrast mode for the sight-impaired, visual recognition for people with guide dogs, way-finder key-fob access and mobile applications for the blind and a patent-pending flip screen for people in wheelchairs (Frazier & Touchet, 2012).

Inform, Protect, Revitalize were the main goals of the City 24/7 project, the smart screens benefits citizens and visitors, city governments and business (Frazier & Touchet, 2012).

- Inform people interact with City 24/7 screens to have full information about what they want. For local residents “they can view real-time neighborhood news, explore local events and programs, find reviews of nearby restaurants and bars, and receive offers and promotions from merchants within walking distance”. For visitors, the smart screens provide them with attractions, discounts at a local hotspot and make suggestions about their travel plans.
- Protect the smart screens play an important role in the safety and security of people in their surrounding area. City 24/7 smart screens offer the police and fire department a citywide sensing, communication and response network that can direct needed personnel and resources to the right place. They also have sensors that predict dangerous chemical, biohazard, and environmental conditions before they do harm and enable the public officials to alert people about this disasters.
- Revitalize by helping citizens and visitors and provide them with the needed information and protect them, cities are more likely to improve their levels of commerce, investment, and tourism. City 24/7 smart screens create a new connection between advertisers and the local shoppers, “For example, ads offered on the Smart Screens or delivered to nearby smartphones and tablets can be tailored to local conditions, including the time of day (e.g., a coupon for free entry to happy hour at the corner club), weather (e.g., a discount on a cup of coffee when temperatures fall below 50 degrees), and even ambient light (e.g., a promotion for sunscreen at the local convenience store when the UV index reaches dangerous levels) ”.

4.3 Barcelona

Project description:

Barcelona has emerged as one of the global leaders in the smart cities movement. In launching its IOT program, it had a solid foundation of the network made of fiber optic cable within the city. This network provides now 90 percent of the home coverage and serves as a backbone for all the city systems (Adler, 2016).

Barcelona used this fiber network to build out individual IOT systems across the urban context. In transportation, Barcelona has implemented a sensor system that guides the drivers to the available parking spaces. The sensors were embedded in the asphalt, they can sense whether or not a vehicle is parked in a given location. By directing drivers to open spaces, the program has decreased congestion and emissions (Fig. 10) (Adler, 2016).

ApparkB is the application that is used by the drivers to find parking lots, it enables them to pay for parking online. After a year of implementation, the city was issuing 4,000 parink tickets per day through the application (Adler, 2016).

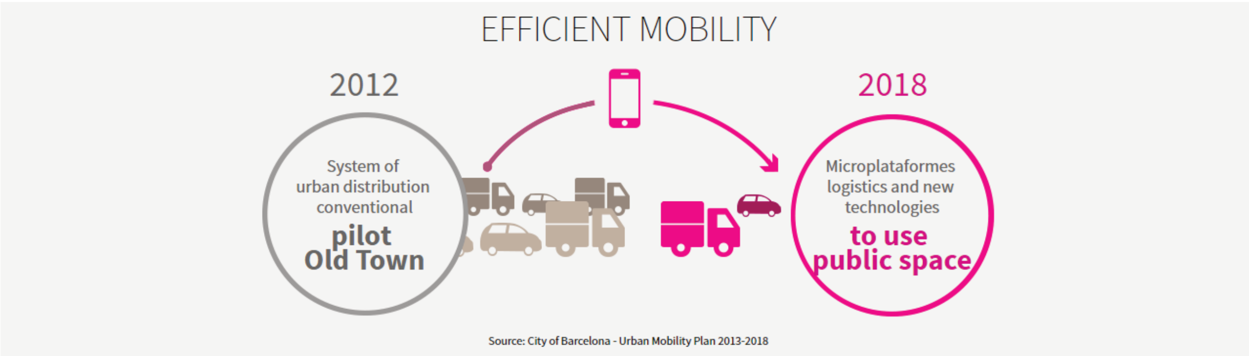

Fig. 10 The Efficient Mobility model by Barcelona (Efficient mobility, 2016).

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5 APPLICATION

5.1 Trend

5.1.1 Open Government Data

Nowadays, there is a global movement called the "Open Government Data", it came from Open Data methodology which is described as "being the data that can be freely used, re-used and redistributed by anyone - subject only, at most, to the requirement to attribute and sharealike" (Open Data Handbook, 2016). Governments started to share their data with citizens mainly for three reasons: transparency, releasing social and commercial value and participatory governance (Open Knowledge, 2016), (Open Government Data, 2016).

5.1.2 IOT Applications

Potential applications of the IOT are numerous and diverse, interfering into all areas of everyday life of individuals, communities and industries. The IERC has identified the domains of the IOT applications as follow: smart energy, smart health, smart buildings, smart transport, smart industry and smart city (Fig. 11) (Vermesan & Friess, 2014).

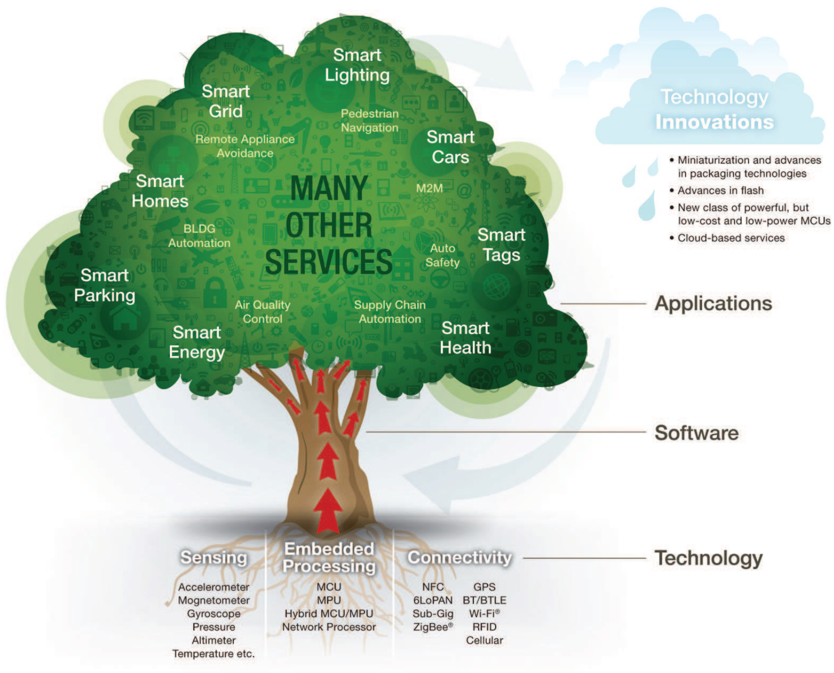

Fig. 11 the IOT: different services, technologies, meanings for everyone (Vermesan & Friess, 2014).

Libelium Company (2016) has created 50 sensor applications for smarter world. In the smart cities domain they created this applications: smart parking, structural health, noise urban maps, smartphone detection, electromagnetic field levels, traffic congestion, smart lighting, waste management and smart roads.

5.2 Egypt "Open Government Data" Model

Egypt followed this trend, it has a data portal at "Open Data For Africa". Providing data about the following categories: Demographics, Marital Status, Disability, Egyptian Internal Migration, Education, Health, Population by Economic Activity, Households, Employment and Living conditions (http://egypt.opendataforafrica.org/).

It has another open data initiative to improve citizen involvement, participation and to make it possible for users to analyze and create value from public sector information

(http://www.egypt.gov.eg/english/general/Open_Gov_Data_Initiative.aspx).

5.3 Project description

There exists plenty of data to be used, which created the Big Data in the first place. Our main challenge is putting this data in its right place, and getting the maximum benefits from them. By following Amsterdam model in consuming the government data in the Smart CitySDK project, one will have a map with datasets (static- real-time). The static part would be from the Open Government Data and the real-time part would be from sensors, RFID tags, smartphones signals, tweets, etc.

5.4 Application Architecture

The application architecture will be as portrayed in Fig. 12. It is a bottom-up approach that depends on the data provided by the government, and which will be combined with the real-time data generated from sensors. This application will help the vital systems of the city by visualizing the given data for better city management.

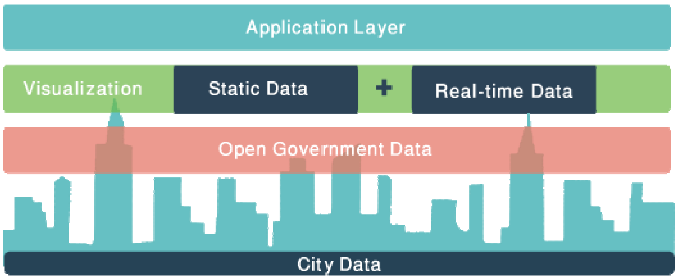

Fig. 12 Application Architecture.

5.5 Prototype demo

If cities stockholders want to determine the energy consumption at a specific sector of a city and they want to combine this data with the population in the same area to calculate the consumption rate, then using this application will offer a great help.

The application consists of three main menus: (1) the main menu; (2) the viewing window; and (3) the data selection window.

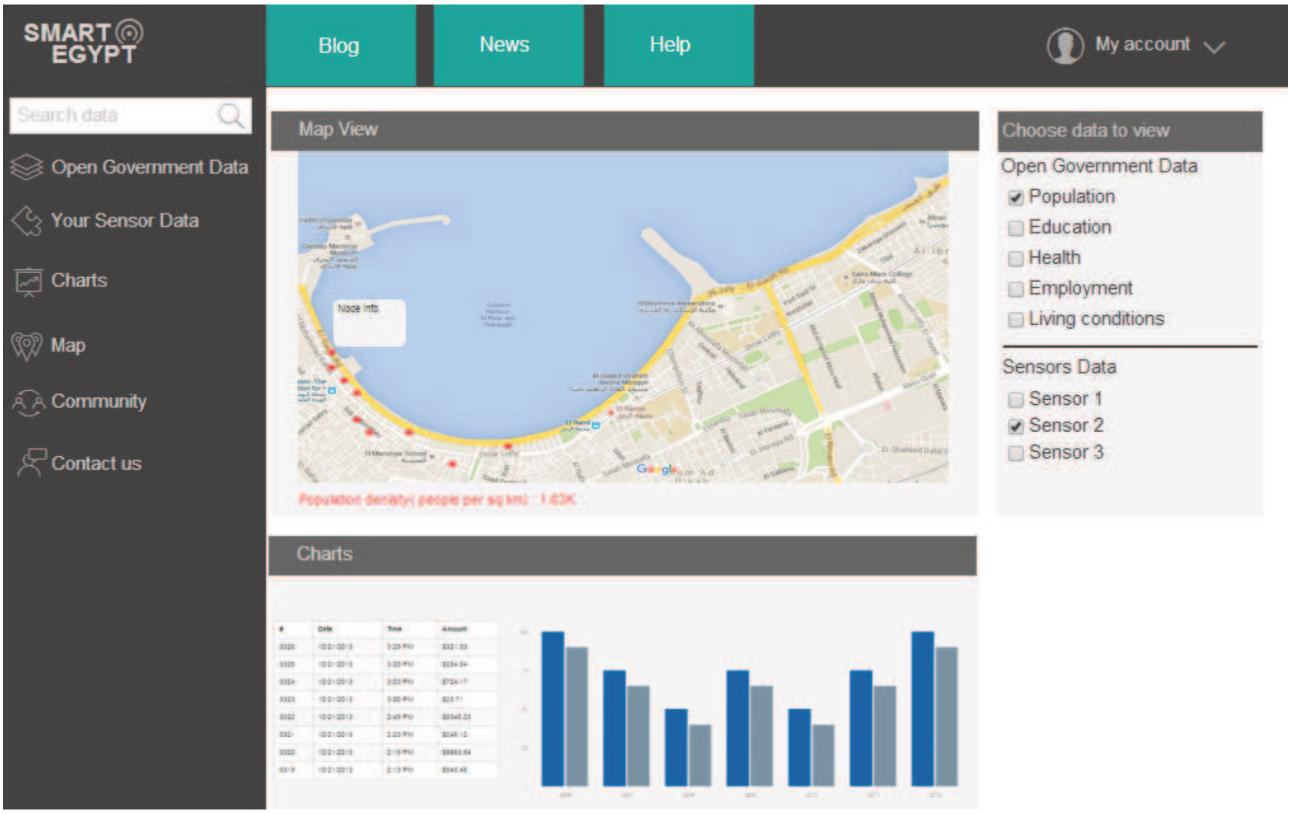

Fig. 13 Application prototype.

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reviewed paper

The Pivotal Role of Public Transport in Designing the Integration of Mobility Services and in Operating MaaS Offer: the Concept of Shared Mobility Centre and the Experience of Arezzo

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1 ABSTRACT

The paper identifies the emerging trends and requirements in the mobility demand and the gaps between them and the offer. The paper shows how Public Authorities and Mobility Operators should provide a seamless mobility offer able to answer to mobility demand which is becoming more flexible and varied in typologies and needs. Public Transport must be the backbone of this integrated mobility offer including conventional services for main urban axes/corridors and FTS/ridesharing services for feeder, last mile and target groups services. ITS for Public Transport are the base systems to provide MaaS and Public Transport Operators should leader MaaS initiatives. Central role in the MaaS initiative must be allocated to Shared Mobility Centre as “umbrella” platform/organization able to coordinate conventional different transport services in a seamless mobility offer (from planning to operation to back-office functionalities interesting both Operators and Authorities). The experience of MaaS activated/under development in the city of Arezzo will be the opportunity to highlight some critical factors that must be guaranteed as supporting actions for MaaS.

Keywords: integrated info, interoperable payment, MaaS, Public Transport, Smart Mobility

2 CURRENT URBAN MOBILITY CHALLENGES IN EUROPE

In this section the main relevant urban mobility challenges are identified in terms of gaps between the current mobility demand requirements and new emerging trend, on one side, and the features of current mobility offer, on the other. The analysis carried out at European level show that old and new challenges continue to afflict the mobility field: unsolved and “well known” problems as traffic congestion and pollution are still on the ground, added to this, in recent years and even more in the future, urban mobility is substantially changing due to emerging societal trends and new demand which is becoming more and more differentiated in terms of users segmentation and needs. Outcomes from the analysis carried out in the following sections can be found also at European policies level [1],[2], [3], [4].

2.1 Current urban mobility trends on demand side

Cities in Europe continue to grow. Currently, over 74% of EU-28 citizens live in urban areas, a proportion expected to exceed 80% by 2030 [5]. This creates challenges for policy makers and transport stakeholders, in terms of mobility, city accessibility and connection from the centre to/from neighbourhoods but also health and quality of life. Data collected in the most relevant mobility surveys around Europe show that “well known” challenges as traffic congestion and pollution are still unsolved problems in the urban areas. Main factors identified by national ([6], [7]) and cross-national surveys are the following ones. The private cars use is still the largely dominant mobility modalities in urban areas (an average of 70-80% of the total commuter trips are carried out by cars at EU level, more than 650 cars each 1000 inhabitants are registered in Italy, …). The use of private cars is still dominant for covering small distances (50% of the trips carried out by car are under 5 Km, 25% under 2 Km, …) and it is still affected by poor occupancy rate (85%-90% of the vehicles have 1.2 occupants). Traffic congestion is a negative experience daily tested moving in our cities and it affects mostly the medium-small urban areas (most of them constituting of historical centres with limited accessibility and narrow streets) which represent the largest part of cities in EU (where 1364 cities are between 40000 and 200000 inhabitants). Air and noise pollution continue to cause serious health impacts, particularly in urban areas, and are expected to worsen: as example we can refer to the repeated cases of overcoming of pollution thresholds in various Italian towns (Milan, Rome, Naples …) in December 2015 and following temporary circulation restrictions.

Furthermore the mobility demand is becoming more and more flexible in terms of users segmentation and needs, use of transport mode, time of use. People are always on the move (work, social education, pleasure, health…). Smartphones, internet and social media channels are transforming the traditional mobility concepts which were based on the differentiation of users segmentation and transport modes in a similar way to the transformation of the access and use modalities of a large part of personal, community and public services. “Virtual mobility” is the emerging concept pushed by citizens aiming to consider mobility services as a seamless offer in terms of comodality, integrated access, payment and use of services without matter of the mode and the operator. Users ask to be more flexible in choosing their transport modes, even day by day or trip by trip but not being penalized in terms of accessibility, information and tariff schemes. Moreover the increased flexibility on demand side lead to the request of tailored and customized service to suit niche groups and individual needs. Another emerging trend which is becoming more and more significant in USA but also in Europe (especially among the young generations as millenials) consists of the increased preference of ridesharing services whereas the possession of a car is largely decreasing. This follow the general transition from ownership to sharing concept: the car is not seen as a “status symbol” as years before and the possession of the driving license itself is not more considered a priority among younger generation being postponed. This trend have been analyzed by some H2020 European projects as CIPTEC [10] and MINDSET [11].

On one hand, these mobility trends could probably change the approach for car use in the future: on the other, for sure, they have already pushed the growing of alternative ride sharing schemes.

2.2 The state of art of mobility offer

The mobility offer has not been still fully able to answer to the “well know” problems and emerging trends described in section 2.1.

Even if relevant achievements have been accomplished in terms of the integration of data and end-users services (multimodal real-time info, interoperable payment tools) among different operators and ITS, standardization, etc., the mobility offer is still largely fragmented in terms of ticketing, info, marketing and accessibility. Historically the mobility sector is customized to a “classification view” on services, transport modes and users segmentation but currently the traditional contrast between collective and individual transport solutions is gradually blurring. More than this there is a lack of validated private-public collaboration schemes and business models across Europe: collaboration between mobility operators is hardly to be achieved, no consolidated institutional and regulatory framework has been developed at national level, commercial agreements required to integrate the offer in terms of tariff schemes and payment tools are deeply affect by the conflicting needs among the Operators in the management of accountability of the revenue. At the same time, Authorities are not able to promote attractive integrated mobility solutions and to develop effective sustainable mobility policy and plans involving all market stakeholders.

The mobility offer has been demonstrated to be still ineffective in providing integrated solutions able to comply with the current challenges and the emerging needs and requirements.

3 EMERGING RIDESHARING SERVICES

Public Authorities (Municipalities, Mobility and Public Transport Agencies, etc.) have been very interested in the uptake of ridesharing services but considering them as a substituting solution for Public Transport than an integration at it could be. This inappropriate approach took place in particular in medium and small cities and in the context (as in Italy) where budget cut to public financing affected the Public Transport services.

Ridesharing services cover a wide range of flexible and intermediate individual and collective transport modes: from well established schemes as bike and car sharing to collective taxi and car pooling, from dynamic ridesharing services to peer-to-peer transport schemes and new forms of “institutionalized hitchhiking". Ridesharing schemes are pushed by the mobility trends described in section 2.1 and they have been until now successfully deployed mainly by commercial operators who apply the available technologies (smartphone, web access, ICT platform) and innovative marketing and business approaches to service schemes which were already been developed and introduced.

From the service point of view, the models promoted by ridesharing services are not new as they are a replication of the well known DRT or Flexible services concepts which have been already implemented from '90 by initiative of Public Transport Operators and Authorities. In particular, Flexible Transport Services (FTS) can be defined as a transport service which is adapted for meeting users needs, typically on a trip-by-trip basis with a certain level of flexibility on three operational dimensions (routing, timing of the service, vehicle used) in order to enhance service offer and minimize costs in response to demand. FTS include a larger range of services and schemes, such as: general use and feeder services, local and feeder services to trunk haul services, replacement of low-frequency conventional services, replacement of fixed routes in evenings, weekends and other low-demand periods, dedicated/special services restricted to specific users groups, services in low-density rural areas, efficiencies in social mobility resources, niche urban markets, fuzzy lines between small buses and big taxis, etc. These different operational schemes have been validated and evaluated from the feasibility and technology aspects to the organization and business models in several EU projects (SAMPO, SAMPLUS, FAMS, CONNECT, FLIPPER [8], …) and real applications, with different results. Some of the experiences were successful, some other partially; anyway later DRTs were the first victim of the economic crisis affecting in particular some EU countries as they have not come up with a consolidated business model and performances indicators (especially for including them as part of the tender and contracting of Public Transport services). Also the technologies available in ’90 (GSM/GPRS communication network, on-board devices) were not performing enough compared to the “advanced” service schemes they should support.

4 ROLE OF PUBLIC TRANSPORT IN THE OVERALL URBAN MOBILITY OFFER

4.1 Role and measures in Public Transport

Considering that bus services are the primary form of public transport in European cities (conventional bus services globally represent the largest part - between 50% - 80% - of the whole PT offer and this situation will last in the short and medium future despite the current trends on the mobility), it is evident that the adoption of any effective mobility solution must include Public Transport as key component. Buses have a very high efficiency potential: in fact one single bus carries the equivalent of 60 cars, consumes 3 to 5 times less energy per passenger, creates 11 times less noise and reduces serious injuries and fatalities from 10 to 20 times then buses are a cost-efficient transport means for passengers. On the other hand other ridesharing services cannot be considered “win-to-win” solutions tackling all the problems: for example, an electrical fleet for car sharing operation allows to achieve large impacts in environmental pollution and emissions but limited for traffic congestion, the extensive use of bikes is not “zero emissions” as the bikes circulation and lanes construction impact on other transport modalities.

In order to improve its quality and to gain market potential towards the citizens, the measures implemented in conventional Public Transport are ([2], [4]): implementation of BHLS (Bus High Level Services, [9]), integration of services both for planning and for operation, interoperability of fare and payment tools, improved accessibility both physically than for info access. Horizontally to these measures, technological investments and operational and organizational efforts have been assured by Public Transport Operators and Authorities to optimize the control of bus service quality and performances (also under a unitary approach when services are operated by different Operators on the network). A key role for guaranteeing the service quality is assured by the operation of AVM Fleet Monitoring System not only for the functionalities it enables but also for the operation of ancillary systems (e-ticketing, infomobility, surveillance, …).

4.2 Challenges for Public Transport

Despite its relevant role in the mobility offer, the Public Transport has been one of the public services mostly affected by budget cut due to public financing constraints (i.e. in Italy). As a result the Public Transport is not able to overcome its “Cinderella” position in particular in the medium and small urban areas where Public Transport potentials are affected by poor image, unreliability and low performances. Despite this, however, over the past fifty years the operating conditions for buses have deteriorated. As buses have become caught in congestion, the quality, reliability, ridership and image of the bus has also deteriorated. This lack of efficient public transport services (both in quality and in quantity) forces many European citizens to use private vehicles for their trips (even short-range in urban areas). This vicious circle must be broken, not only to improve urban mobility, but also to enhance overall city liveability, to reduce pollution and emissions and to promote social inclusion.

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5 REPOSITIONING AND REQUALIFICATION OF PUBLIC TRANSPORT IN A INTEGRATED MOBILITY OFFER

The experiences of most advanced cities and towns in the world highlight that we cannot achieve sustainable urban mobility without an efficient, extensive and accessible collective transport system. Across urban areas it is clear that robust and efficient mobility solutions, well integrated with the conventional Public Transport services that can help overcome the barriers described in section 2 and improve living conditions and environmental quality of towns are required. Implementing innovative measures to break the downward spiral, by increasing the quality of bus services and strengthening the efficiency of newly emerging mobility schemes, cannot be delayed further. Emerging ridesharing services must be considered as part of the wider range of FTS (Flexible Transport Services) and planned as integration of the “backbone” services provided by conventional Public Transport [12].

5.1 Restructuring Public Transport services: acting on planning side

Public Transport stakeholders must be able to take again the leadership on ridesharing services in order to operate them as option of DRT or Flexible schemes. Conventional Public Transport and DRT/Flexible services (including ridesharing services) must be planned under a coordinated approach in order to design an integrated mobility offer. Conventional Public Transport should serve main axes and corridors, DRT/Flexible and ridesharing services should be reserved for last miles and feeders services including, among the others, niche solutions for low demand area, weak time period, target groups, added value services, etc.

The integration between conventional and DRT/Flexible services (including ridesharing services) must be specifically designed site per site: in the same way the identification of the most promising Flexible/Ridesharing services to be considered (on which scale, on which area, …) must be tailored for each city context.

5.2 Towards the MaaS concept: acting on the service operation

From the service operation point of view, this new integrated offer must be supported by the implementation of MaaS concept in order to solve the current fragmentation in terms of ticketing, info, marketing, accessibility and cooperation among different mobility services and operators.

E-ticketing, AVM and User information systems are the base systems for any MaaS (Mobility as a Service) concept implementation. Usually, in Europe, these systems are designed, contracted and operated under responsibility of Public Transport Operators or Agencies. Many times these systems are extended (mainly smart cards) to other services and rarely they are planned under a “city approach”. These systems are often designed separately and their integration must be carried out on a “bottom up” approach.

The role of Public Transport Operators/Agencies is fundamental in MaaS as Public Transport services are the backbone in terms of data and services providers, responsible for system’s operation and management and responsibility for assuring the quality and reliability of services and data MaaS offer is built on.

Indeed MaaS initiatives must strongly involve the Public Transport Operators/Agencies.

5.3 Towards the MaaS concept: acting on operational and organizational issues

In the section 4 we anticipated that any high quality MaaS services will be possible without an efficient and integrated mobility services offer (based on the backbone role of Public Transport) and without the certification of the quality of data provided by the base-level ITS.

The operation of a wide range of ITS dealing with MaaS offer must guarantee the monitoring of system performances and the provision of reliable services and data. In order to achieve this objectives ITS must be operated with a strong organization structure and proper operational procedures: suitable data certification procedures are required and high quality data must be assured by each Operator on the basis of contract prescriptions and related rules which should be issued by the coordinator of MaaS initiative.

6 TOWARDS THE SHARED MOBILITY CENTRE

The approach proposed in this paper focuses on the need to reconcile and enhance the two parallel axes of urban mobility (collective transport and flexible/ridesharing services) by testing and demonstrating different innovative mobility solutions to be integrated under the "umbrella" of the Shared Mobility Centre for planning and managing the different transport services. The Shared Mobility Centre [13] addresses the two main levels of urban mobility in a coordinated way, where both public (collective) and private components interact with each other: major transport axes and corridors, on the one hand, and flexible/ridesharing services on the other. Fostering the interaction between public and private mobility through various connected mobility schemes (parking, P+R, interchange facilities with shared vehicles schemes, integrated payment, etc.) is pivotal for improving urban mobility as a whole. To achieve seamless integration between collective and shared mobility the Shared Mobility Centre works on three interrelated levels (collective transport, personal mobility and connected systems). The Shared Mobility Centre will offer integrated access to several "on demand and shared" individual and collective services, by coordinated management of the various actors and services through an ad-hoc organization framework, technology-enabled services and soft measures.

Enabling technological component for the Shared Mobility Centre is an ICT infrastructure, based on the emerging paradigm of the Internet of Services, provide several core facilities including: (1) services for transport users (Business-to-Consumer (B2C) services) enabling access to information, search for transport options, travel planning, booking, ticketing; (2) services for the co-ordination of different transport and mobility schemes and the interaction with the relevant operators (Business-to-Business (B2B) services); (3) services supporting the interactions among different authorities and entities involved in the control of transport services (Business-to-Administration (B2A) services).

Figure 1 offers a first outline of the conceptual architecture for the Shared Use Mobility Centre.

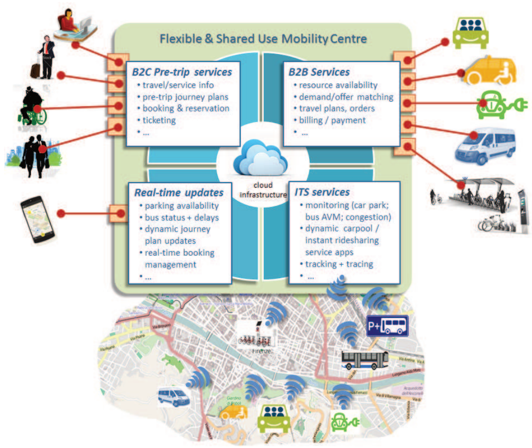

Fig. 1: Conceptual architecture for the Shared Use Mobility Centre

The core concept of the Shared Mobility Centre must be adapted to local policy objectives, stakeholder requirements, users needs and mobility market opportunities, leading to local implementations coordinating a range of different measures.

7 EXAMPLE OF MAAS SERVICES IMPLEMENTATION IN AREZZO

Arezzo is a medium size historic town located in the western area of Tuscany Region (about 75 km far from Florence near the A1 motorway direction Rome). The inhabitants are about 100.000 within the Municipality boundaries (380 Km2) but the inner urban area is even more reduced both in terms of population (about 70.000-80.000) and area. As all the historical medium and small cities, Arezzo is affected by the poor accessibility of city centre, the traffic congestion, the low number of free parking lots, the management of tourist flows and peak demand. In order to face these challenges in the last years different measures took place: investment in infrastructures (new parking, cycling lanes), new services (bike sharing, car sharing) and implementation of a wide range of ITS solutions: for traffic (access control, traffic flow counting system sensors, VMS for guidance to free parking lots and visualization of news on traffic, road work and mobility events, Parking Management System, smart park meters, etc.) and for transport (AVM, e-ticketing). More recently the Public Authorities and the Mobility (ATAM) and Transport (Tiemme) Operators have committed to better integrate the mobility services and supporting ITS in a more integrated offer. In this section the paper will detail two of the main MaaS initiatives developed in Arezzo: the integration of the access and payment of the mobility and transport services based on an interoperable contactless smart card

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Editors: Manfred SCHRENK, Vasily V. POPOVICH, Peter ZEILE, Pietro ELISEI, Clemens BEYER

(Arezzo Card) and the integration of data provided by different sources and ITS in order to provide multimodal integrated infoservices. The following sections will present the main achievements of the abovementioned MaaS initiatives developed in Arezzo.

7.1 Arezzo Card: the interoperable payment system in Arezzo

The following mobility services are currently accessible through Arezzo Card:

- Public Transport services (n.20 lines, n.50 buses) with with e-ticketing system provided by AEP Ticketing Solutions and activated in 2013;
- On-street parking service (65 smart park meters, about 1500 parking lots) provided by Parkeon operated through "proprietary" magnetic cards up to 2013 and updated to Arezzo card in 2013;
- House parking service (centralized through a PMS connecting n.3 house parking) provided by Designa operated through "proprietary" magnetic cards up to 2014 and updated to Arezzo card since the beginning 2015;
- Bike sharing system provided by Bicincittà (main Italian provider of bike sharing systems) operated through "proprietary" MiFare smart cards up to 2013 and updated to Arezzo card in 2013;
- Car sharing system provided by TRS (main Italian provider of car sharing systems, for front-end modules) and CART (Italian sw development and integration company, for back office and accounting modules) operated since June 2015 through Arezzo card.

Arezzo Card is an example of “bottom-up” approach to integration as any specification has been not defined at regional or city level.

7.1.1 Arezzo Card functionalities and operational scenario

Smart cards are emitted in a Ticket Point which sells tickets (contracts) both for Tiemme (Public Transport) and ATAM (parking, bike sharing, car sharing). Ticket Point performs also the enabling operations to allow the user to access different services (assigning the required user profile).

Integrated payment system in Arezzo enables the following operational scenarios:

- the access to PT urban services with personal subscriptions and multi-trips tickets. Recharge of PT tickets is managed by Ticket Point;
- the purchase of single trip urban tickets (for one or more passengers) to be carried out on-board at validators by e-purse credit;
- the access to parking services with contracts related to vehicle plat. Renewal of parking contracts is available both at Ticket Points and at on-street payment device or at automatic payment machines in off-street parking;
- the payment of hour tariff both for on-street and house parking by the e-purse credit;
- the access to bike sharing and car sharing services for the pick up and return operations.

The tariff scheme managed by Arezzo Card includes policies and promotional incentives fostering the use of Public Transport and the P&R services: for example, for Public Transport, the application of a monthly free pass (flax rate) if the user has purchased n.30 on board single-trip tickets with e-purse credit over the month.

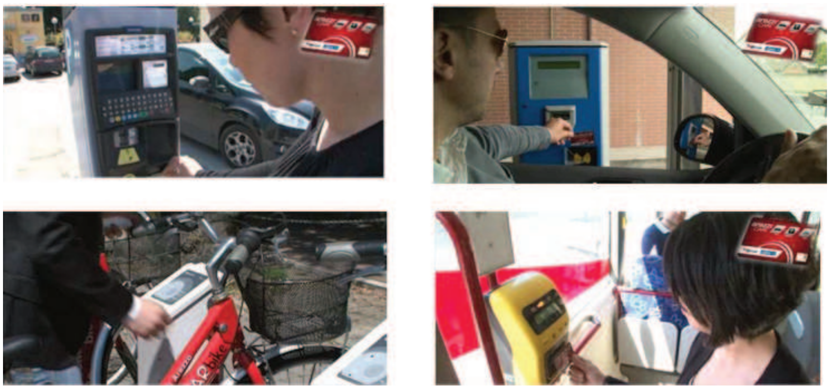

Fig. 2: Use cases of Arezzo Card

Figure 2 shows main uses cases of Arezzo card.

7.1.2 Cards specifications

Interoperable smart cards used in Arezzo comply with "Calypso" – release 2.4 operative system specifications (please see Calypso Network Association site for more information). Arezzo card is a multi-application smart card providing dedicated application (card data area) for each service and a common e-purse application. Each service application stores data profile of the user, service flat contract for the use of service and operational data. The file structure complies with ISO 7816 part 4. As no specification was defined at regional level, the design process considered standardized solutions both in terms of specifications and data models, where available. Figure 3 details the Arezzo Card data model.

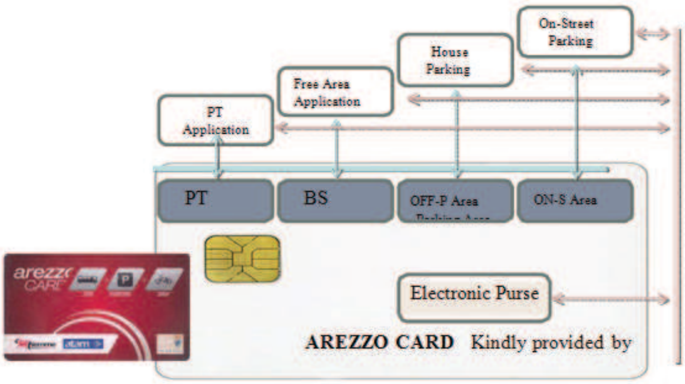

Fig. 3: Arezzo Card data model

7.1.3 Arezzo card system's architecture

The architecture of Arezzo integrated payment system (Figure 4) is based on the following components:

- a common database storing data on smart cards and users shared by all the systems through webservices;
- the various centralized sw modules/DB of each ITS system (PT, PMS, sharing services);
- peripheral devices (validators, park meters, house parking devices - in/out gates and APM, bike sharing stations, car sharing on-board equipment);
- a clearing module to collect data on e-purse credit/debit operations (recharge, payment) and to calculate the incomes of both operators and to guarantee the financial balance of e- purse amount;
- data exchange based on webservices.

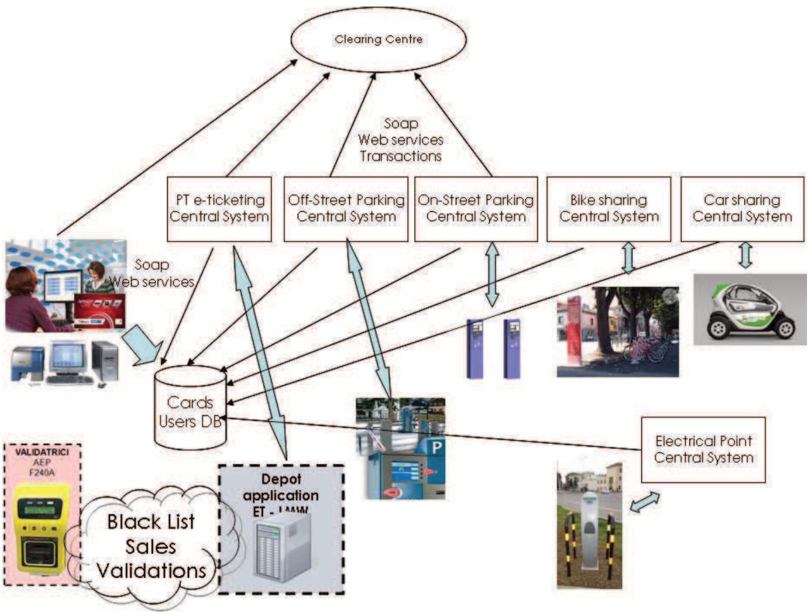

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Fig. 4: Architecture of Arezzo Card integrated payment system

7.1.4 History of the implementation

The design of the integrated payment system for the overall mobility services in Arezzo started in 2012 on the basis of the objectives of both the operators who agreed to have a common and interoperable smart card for promoting P&R schemes and the cooperation with the green mobility services (the existing bike sharing and the planned electric car sharing): Arezzo will be selected then as pilot for this initiative.

The integrated payment system is operated:

- since April 2013 providing interoperability for PT, on-road parking and bike sharing;
- since January 2015 providing interoperability also for house parking;
- since June 2015 providing the interoperability also for car sharing.

Currently about 5000 smart cards are active, about 15000 contracts (PT+parking) are sold per year and about 6000 e-purse transactions are processed per year.

Implementation milestone were:

- design of smart card specifications to enable services interoperability;
- design of sw modifications and adapting for each proprietary systems;
- design and implementation of "interoperable" databases/sw modules;
- definition of the commercial agreement between the operators (tax, revenue accounting and clearing rule);
- integration of different system with "interoperable" databases/sw modules.

7.1.5 Future step of implementation

In mid 2016 Arezzo Card system will be extended to electrical car sharing service.

7.1.6 Commercial agreements between operators

Relevant activities of the design phase related to the definition of commercial agreements between the operators. This activity included: the definition of clearing rule and the requirements for the accountability of the revenue, the management of taxation to be applied to the revenue, the identification of the accessibility level to data (those which are proprietary of the single operators and those must be shared).

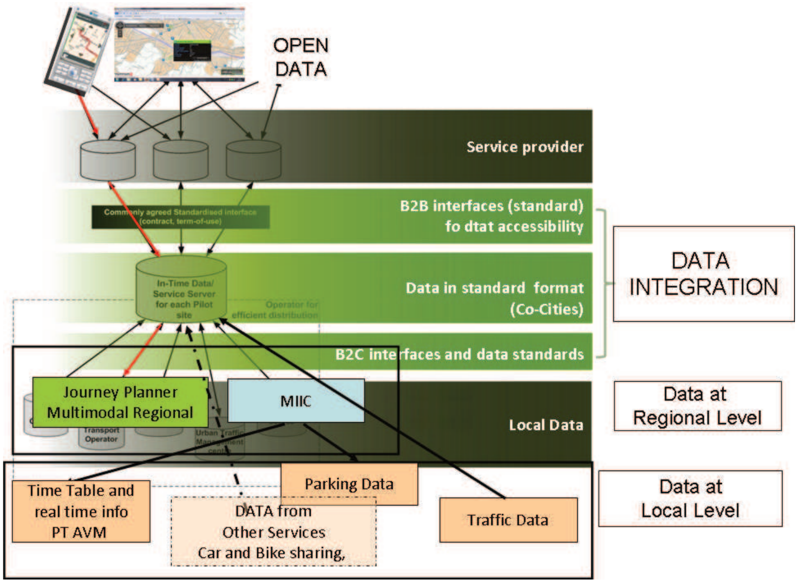

Fig. 5: Logical scheme of the platform for data integration and provision of aggregated multimodal infoservices

8 MULTIMODAL INTEGRATED SYSTEMS

A platform is been developing to aggregate the data accessed from different sources in a centralized middleware, elaborate them and provide aggregated multimodal infoservices on different channels: smartphones, webportal and open data available for third parties. The implementation is articulated in following steps: a first version of the APP will be published in June 2016 providing a core base of services. In the second half of 2016 APP will be enhanced with other services and the management of feedbacks info from users; in parallel also webportal will be published. At the beginning of 2017 open data will be published. Figure 5 shows the logical scheme of the aggregation platform and adapting interfaces.

8.1.1 Design phase

The main actions carried-out for the design phase has been:

- survey of databases already and detailed info available for the integration and infoservices provision;
- identification of data sources (format) and technical solutions for data access;
- definition of services to be provided by aggregating/elaborating base data;
- identification of the requirements for the platform (adapting interfaces for data access, middleware, APP/web portal/open data);
- definition of platform architecture and functionalities;
- identification of operational use cases to be guaranteed by the platform.

8.1.2 Databases survey and technical solutions for data access

Different ITS systems, database and applications are operated in Arezzo urban area.

The identification of data available and the design of the technical solution for data access and update has been part of the design phase.

8.1.3 Definition of aggregated services to be provided

The following aggregated services are under development:

- Static and Dynamic Public Transport Information;
- Static and Dynamic Parking Information;
- Static and Dynamic Bike Sharing Information;
- Static and Dynamic Traffic Info;
- Multimodal Journey Planning;
- Point of Interest;
- PT tickets payment via web/SMS;
- News and meteo alert;
- Feedback Services for notification of comments on APP usability, info quality and new events.

8.1.4 Architecture for data integration and infoservice provision

The architecture for data integration and infoservices provision (Figure 6) consist of:

- Feeder services accessing to base data/services:
    - request/access of base data and info (this process can be managed on "push" or "pull" modalities) carried out through appropriate adapting services;
- Integration and elaboration process (middleware creation):
    - implementation, management and updating of a common standardized middleware of data from accessed base info;
    - integration and elaboration of the base info to provide aggregated services;
- Displaying process on end-users devices:

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  - contents formatting;
  - contents visualization of mobile devices and web portal;
  - publication of middleware data as "Open Data" services.

The middleware of the platform must gather the base data from their sources and collect them in a centralized structure according to the following requirements:

- adoption of standardized technologies and data format:
  - use of SOA (Service Oriented Architecture) tools;
  - use of W3C web services standard;
- XML for data exchange;
- standardized data model: DATEXII, SIRI;
  - appropriate performances in terms of updating time of data;
  - appropriate security standard level (i.e.: HTTPs protocol).

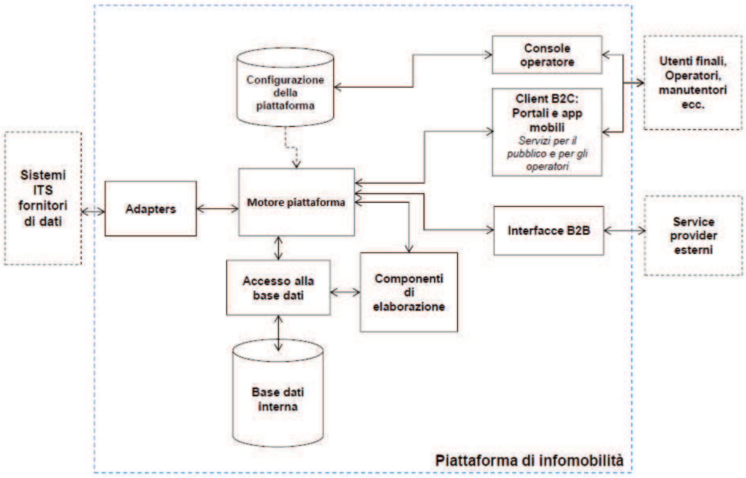

Fig. 6: Architecture for data integration and provision of multimodal integrated services

9 CONCLUSION

The challenge mobility stakeholders must face is to provide a seamless mobility offer able to answer effectively to emerging mobility needs and to impact deeply in traffic congestion, environmental sustainability and liveability in our cities. Far from what it could be argued, the role of Public Transport in this seamless offer should be enhanced rather than being less relevant. Mobility Operators and stakeholders must gain the leadership of ridesharing services which now is mainly managed by commercial operators and plan and operate them as integration of a restructured conventional Public Transport serving main urban axis and corridors. FTS and ridesharing services should be cover feeder/last mile and low demand services (for area, time, target groups). This will be a “win-win” solutions both for larger cities than medium and small ones. Case by case Public Authorities and Operators must evaluate which kind of FTS/ridesharing service is more suitable to integrate the conventional Public Transport offer in order to tailor and to optimize the mobility offer from the planning point of view. From the operation point of view, the integration between conventional Public Transport and other mobility service (FTS/ridesharing) leads to the concept of MaaS where still the Transport Operators/Authorites must take the leadership of the MaaS initiates being the main data/services providers. In this context the role of the Shared Mobility Centre must be considered as “umbrella” platform/organization able to coordinate integrated access to several “on demand and shared” individual and collective services and to manage the various actors and services through an ad-hoc organization framework, technology-enabled services and soft measures. Taking example from Arezzo experience in the implementation of the integrated payment and aggregation of data for the provision of infoservice some critical issues related to MaaS must be highlighted. Firstly in a large part of cities, in particular in the medium and small ones, the integration of data and services will be carried out on the top of the existing legacy systems and technological background which is different from city to city; then an integration model would probably not fit all the cities but it should be customized. Secondly the experience of Arezzo shows that a strong private-public collaboration between mobility actors and Public Authorities is a preassumption to support the provision of MaaS. Furtherrmore commercial agreements will be defined and solutions provided to manage business issues like revenue accountability and clearing rule and solving potential conflicts between the operators. Lastly MaaS will act on the top of high quality services and data then a strong organizational structure and proper operational procedures are required to guarantee reliable and high-quality base data and an efficient operation of the legacy system to enable MaaS. Otherwise MaaS should represents a new term to identify old problems.

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Track me if you plan – Aufzeichnung urbaner Aktivitätsmuster mittels Smartphonetracking

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1 ABSTRACT

Der vorliegende Beitrag beschreibt die Ergebnisse der Studie „Track me if you plan“, die im Rahmen des DFG-Projektes „Urban Emotions“ an der TU Kaiserslautern durchgeführt worden ist. Inhalt der Studie ist die Fragestellung, wie Personen sich im Stadtraum bewegen, was ihre Beweggründe für gewisse Bewegungsmuster sind, wie diese Muster zu identifizieren sind und welchen Mehrwert das Arbeiten mit diesen Daten und das Wissen um diese Muster für die räumliche Planung bietet. Inhalte neben der Beschreibung der Studie sind Aspekte der Verwendung von Humansensorik für die räumliche Planung, der Exkurs in die Bewegung des „Quantified Self“ und welche einfach handhabbaren Trackingmethoden für solche Experimente zur Verfügung stehen. Anhand statistischer Aussagen zur Verkehsmittelwahl, sowie am Beispiel räumlicher Phänomene werden zudem die Einsatzmöglichkeiten innerhalb der Stadtplanung erörtert und sowohl die Vor-, als auch die Nachteile der Methode diskutiert.

Keywords: Mobilitätsmuster, Raumwahrnehmung, Smarte Planung, Tracking, Urban Emotions

2 EINLEITUNG

"The smart city needs smart citizens" - und smarte Planer. So wie Michael Batty die Forderung nach dem smarten Bürger der Smart City formuliert, so stellte Jane Jacobs 1961 schon fest, dass Städte nur dann jenem Anspruch gerecht werden, wenn sich deren Nutzer auch um diese Ansprüche kümmern: "Cities have the capability of providing something for everybody, only because, and only when, they are created by everybody" (Jacobs 1961, S. 238). Der „smarte Planer“ versucht diese Rahmenbedingungen für eine städtebauliche Entwicklung zu nutzen.

Jeder Bewohner hinterlässt in seinem persönlichen Umfeld einen individuellen Fußabdruck, welcher sich aus verschiedenen Faktoren wie beispielsweise dem Mobilitätsverhalten und den Aktivitäten im Raum ergibt. Für die Stadt und deren Planer ist das Wissen über die Bewegungsmuster der Nutzer ihrer Stadt unabdingbar. Denn kennen die Stadtplaner diese Wege, so können beispielsweise städtische Infrastrukturen an die tatsächlichen Bedürfnisse angepasst werden. Bewegungsmuster können Hinweise über zahlreiche stadtplanerische Aspekte und städtebauliche Missstände liefern, doch wie sind diese zu identifizieren (Folz et al. 2015).

Kann der Bürger aktiv die Informationsbeschaffung unterstützen und die Stadtplanung verbessern, indem er seine Wahrnehmungen, Empfindungen und Bewegungsmuster teilt? Die Antwort auf diese Frage ist ein eindeutiges "JA!", doch viel wichtiger ist die Art und Weise der Informationsbeschaffung. Wie können die Daten so schnell wie möglich aber gleichzeitig auch einfach nutzbar gemacht werden? Die Life-Logging-Bewegung liefert hierfür einen guten Impuls. Mittels GPS-basierten Smartphone-Applikationen können einzelne räumliche Datensätze ohne Eigenbewertung des Probanden erhoben und anschließend im aggregierten Zustand analysiert werden. Geografische Informationssysteme erlauben zudem eine einfache visuelle Aufbereitung aller Daten. Das vorliegende Paper ist eine verkürzte Fassung des Projekts "Track me if you plan", welches diese Entwicklung und Technik aufgreift und sich mit der Frage beschäftigt, welche Informationen die Tracking App "Moves" der Stadtplanung liefern kann und wie diese inhaltlich und grafisch aufbereitet werden können.

3 STAND DER FORSCHUNG

Das folgende Kapitel beschreibt, wie in der Stadtplanung Datenbeschaffungstechniken mit dem Fokus des Menschen als Sensoren eingesetzt werden und zeigt auf, an welcher Stelle noch Forschungsbedarf besteht.

3.1 Der Mensch im Mittelpunkt der Datenerfassung

Intelligente Informationsbeschaffung und Analysetechniken sind unabdingbar für die Idee der Smart Cities, dennoch stellt die zielgerichtete Datenbeschaffung und –aufbereitung für viele Planer immer noch ein großes

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Problem dar. Dies verdeutlicht auch das nachfolgende Zitat: "Oregon wants to make its roads safer and more convenient for cyclists, but has a problem – it has very little data on where people ride and what influences their choices" (Davies 2014). Denn viele Methoden, besonders im Bereich der Verkehrsplanung, sind arbeits- und kostenintensiv. Des Weiteren sind subjektiv erhobene Daten, beispielsweise durch Befragungen, schwer deutbar und die Reliabilität der Ergebnisse ist nicht immer gegeben. Im Zentrum dieses Problems steht die Frage: "Wie kann ich etwas messen, über das die Probanden selbst keine verlässliche Auskunft geben können? Denn es bleibt bei der Tatsache, dass sich das alltägliche Verkehrsverhalten in Form von Routinen abspielt und nicht abfragegerecht im Bewusstsein verankert ist." (Schelwsky et al. 2014, S. 2f). Zwar ist der Ansatz, sowohl der Voluntered Geographic Information (VGI) nach Goodchild (2007) als auch der der Humansensorik nach Zeile et al. (2009) bzw. „People as Sensors“ (Resch 2013), der den Menschen in den Fokus der Informationsbeschaffung stellt und räumlich verknüpft, wegweisend für planerische Analysen, dennoch ist der Einsatz des "Menschen als Sensor" methodisch begrenzt. Es muss ein Konzept gefunden werden, bei welchem der Mensch Mittelpunkt der Erhebung ist, ohne eine aktive Rolle zu spielen und somit auch seine subjektive Einwirkung auf das Ergebnis ausbleibt.

3.2 Quantified Self und Lifelogging als Impulsgeber

Das Smartphone ist mittlerweile ein ständiger Begleiter des Menschen und "bewegt sich" damit auf denselben Wegen wie sein Besitzer. Zugleich möchten immer mehr Menschen ihren Tagesablauf optimieren, ihr Leben dokumentieren und Bilanz ziehen. Das sogenannte „Quantified Self“ steht hierbei im Vordergrund. "Der Begriff quantified self wurde 2007 von den Wired-Journalisten Gary Wolf und Kevin Kelly geprägt. Er bezeichnet die Methoden zur Vermessung des Menschen mit Apps, Fitnesstrackern und anderen Geräten, gleichzeitig aber auch das Netzwerk von Anbietern und Anwendern dieser Technik" (Beuth 2015). Der Mensch beobachtet und vermisst sich also selbst, um sein Zeitmanagement zu optimieren und mehr über seine Gewohnheiten zu erfahren. Diese sogenannte Lifelogging-Bewegung hat als Resultat einige Applikationen (im folgenden Apps genannt) zum Selbst-Tracking auf den Markt gebracht, die auch aus raumplanerischer Sicht sinnvoll erscheinen und die nun das Aufsehen der Stadtplaner erregen.

3.3 Tracking für die Aufzeichnung urbaner Aktivitätsmuster

Tracking an sich, also die Beschreibung eines zurückgelegten Weges mittels einer zeitlichen Aneinanderreihung von Punkten und Verknüpfung derer mit ihren Positionskoordinaten, ist keine neue Disziplin. Bereits Hänsel und Gretel dokumentierten ihren Weg mittels Brotkrümeln und trackten sich somit selbst (Magic Maps 2015). Es ist die Art und Weise des Trackens, welche einem ständigen Veränderungs- und Verbesserungsprozess unterliegt. Heute bilden die Basis des Trackens Systeme für Satellitennavigation wie GPS, GLONASS oder in Zukunft auch GALILEO. 1996 wurde z.B. GPS das erste Mal in der Verkehrswissenschaft im Rahmen des "Lexington Area Travel Data Collection Test" eingesetzt und erprobt (Wagner 1997). Der Einsatz der GPS-Empfänger und Datenlogger war noch mit einem enormen Aufwand verbunden, und erzielte nicht die genauen Ergebnisse, wie es uns heute mit Hilfe der Trilateration möglich ist. Heutzutage sind GPS-Tracker bis auf wenige Meter genau und passen in eine Hosentasche. Um "bislang verborgene Prozesse der Raumnutzung und –aneignung" (ESRI Deutschland GmbH, 2010) sichtbar zu machen, wurden 2009 am KIT in Karlsruhe 100 Studenten mit GPS-Trackern ausgestattet und mit statistischen Kennzeichen wie Alter und Geschlecht verknüpft (Berchtold & Krass 2010). GPS-Empfänger befinden sich mittlerweile in jedem Smartphone und bieten somit die Möglichkeit, Geodaten über Apps zu sammeln und zu aggregieren. Die Vorteile dieser Entwicklung liegen klar auf der Hand: Die Verfügbarkeit der Technik in jedermanns Hand spart Kosten, erhöht die Benutzerfreundlichkeit und erweitert den Probandenkreis. Bussche & van der Coevering (2015) entwickelten im Rahmen des NISTO-Projects z.B. die Fahrrad-Motivations-App BiKE-Print, die via Smartphone Bewegungsdaten der Radfahrer sammelt. Verknüpft ist diese mit einer interaktiven Computeranwendung, welche die Identifikation von Problempunkten und Simulationen ermöglicht (BMVI 2014). Da viele Apps bereits jahrelang Bewegungsdaten sammeln, welche für die Stadtplanung von Nutzen sein können, gerät nun auch die Möglichkeit des Datenankaufs aus dem privaten Sektor in den Fokus der Planer. So hat z.B. das Verkehrsamt des US-Bundesstaates Oregon die Nutzerdaten der Fitnessapp Strava erworben, um ihre Radverkehrsplanung auf diesen Datensatz zu stützen.

Vor dem Hintergrund dieser Entwicklungen stellt das Smartphone für Stadtplaner ein großes Potenzial im Bereich der Datengewinnung dar, konfrontiert die Planung aber auch mit einem enormen Erhebungs- und Aufbereitungsaufwand, sowie der allgegenwärtigen Frage der Datenschutzproblematik.

4 PROJEKTGRUNDLAGEN

Im nachfolgenden Abschnitt wird erläutert, wie überhaupt Bewegungsmuster entstehen und wie diese mit einem einfachen Versuchsaufbau aufzunehmen sind.

4.1 Wie entstehen Aktivitätsmuster?

Um Aktivitätsmuster qualitativ untersuchen zu können ist es zunächst notwendig, sich mit der Begrifflichkeit und der Entstehung solcher auseinander zu setzen. Bewegungs- oder Aktivitätsmuster entstehen nicht plötzlich und ohne Grund, vielmehr sind sie der aktuelle Stand eines (schleichenden und eines unbewussten) Prozesses. Ein Muster bildet sich im Laufe der Zeit, kann sich aber auch aufgrund verschiedenester Einflüsse ändern - beispielsweise bei einer Änderung des Wohnortes. Es ist die Routine, das Aufsuchen der gleichen Orte, das Wählen der selben Strecke dorthin oder die Parallelen in der Fortbewegungsart. In erster Linie sind diese persönlichen Aktivitätsmuster selbstbestimmt und der Mensch trifft jeden Tag erneut die Entscheidung über die Orte, die er aufsucht sowie die Wege und Verkehrsmittel, die er wählt. Diese Entscheidungen hängen stark von der Raumwahrnehmung jedes Einzelnen ab. Besonders in einer fremden Stadt ist die Raumwahrnehmung, verglichen mit dem alltäglichen, routinierten Verhalten sehr ausgeprägt. Je bekannter das räumliche Umfeld, desto mehr gerät die Raumwahrnehmung in den Hintergrund des Bewusstseins und das Verhalten wird zur Gewohnheit. Auf der Grundlage dieser wiederkehrenden, unterbewussten Entscheidungen entstehen Bewegungen, die als Aktivitätsmuster beschrieben werden können.

4.2 Versuchsaufbau

In einer vierwöchigen Testphase haben sich alle acht Bearbeiter des Projekts "Track me if you plan" selbst mit ihrem Smartphone und einer Trackingapp getrackt. Um die Wege aller Personen vier Wochen lang – Tag und Nacht – aufzuzeichnen, wurde die Trackingapp „Moves“ verwendet. Die App zeichnet die zurückgelegten Wege des Smartphones mittels GPS auf und unterscheidet selbstständig zwischen den vier Fortbewegungsarten Gehen, Joggen, Radfahren und Transport (PKW, Bus, Zug, etc.). Außerdem erkennt die App, wenn sich das Smartphone längere Zeit an einem Ort aufhält und fügt diesen Ort als Stationspunkt in die Wegstrecke ein.

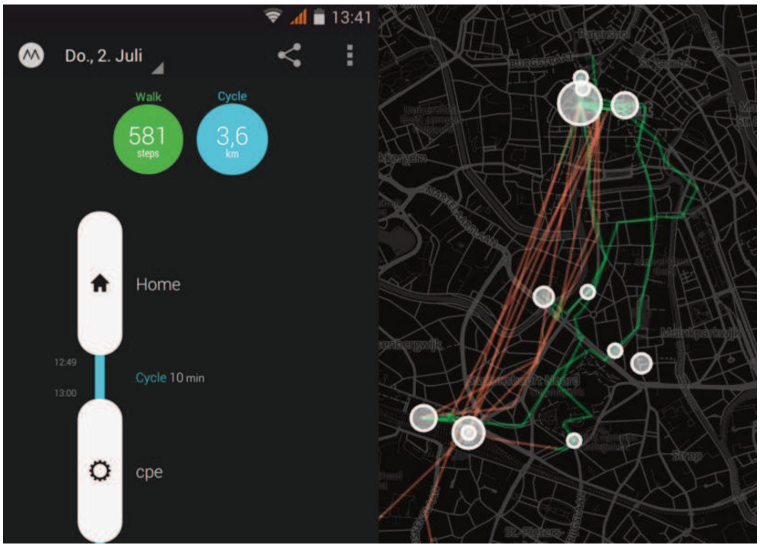

Abb. 1: Screenshot aus der App Moves (links) und ausgewertete Kartendarstellung (rechts)

Die Orte können vom User selbst benannt und mit einem Attribut, wie beispielsweise „Zuhause“ oder „Arbeiten“, belegt werden. Ebenso können auch die zurückgelegten Strecken der Kategorie Transport nachträglich spezifiziert werden (z.B. Flugzeug oder Fähre). Die somit erzeugten Daten sind für den User nicht nur direkt in der App abrufbar, sondern sind auch auf der Homepage von Moves sowie in Verknüpfung mit vielen weiteren Apps nutz- und anzeigbar. Auch der Export der Grundlagendaten in Dateiformaten wie KML, CVS oder GPX für eine Weiterbearbeitung mit verschiedenenen GIS-Systemen ist möglich. In der

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App ist ein Tag des Nutzers auf zwei unterschiedliche Arten darstellbar, welche in der Abbildung 1 dargestellt sind.

Hier sind die Fortbewegungsart, die Strecke, die auf diese Weise zurückgelegt sowie die Zeit, die dafür benötigt wurde, ablesbar. Zudem sind die besuchten Orte angegeben. Darüber hinaus lassen sich die Wege und die Ortsaufenthalte auf Karten sichtbar machen. Auch diese ist Kartendarstellung in der App möglich.

Hin und wieder kommt es beim Tracking zu Problemen, die beispielsweise aus einem schlechten GPS-Empfang resultieren. Vor allem beim Nutzen von Transportmitteln wie Bussen oder Zügen kommen diese Ungenauigkeiten vor. Auch in der Karte in Abbildung 1 sind diese Ortungsungenauigkeiten an den Wegstrecken erkennbar. Hier ist eine manuelle Bereinigung nötig, wobei lediglich die Fortbewegungsart und die Bezeichnung sowie Position der erfassten Orte anpassbar sind. Die Wegstrecken lassen sich in Moves nicht manuell verbessern, sodass die Genauigkeit der Aufzeichnung maßgeblich von der Qualität des GPS-Empfangs abhängig ist und die Wegewahl der Probanden nicht immer genau nachvollziehbar ist. Die Trackingergebnisse der Projektgruppe bildeten die Grundlage der weiteren Bearbeitung und Untersuchung.

5 ANALYSE DER AKTIVITÄTSMUSTER

Die mit der App Moves generierten Grundlagendaten sind zur Analyse von Aktivitätsmustern vielfältig einsetzbar. Aus raumplanerischer Sicht sollten jedoch weniger die Bewegungsmuster Einzelner betrachtet werden, als vielmehr die aggregierten Daten einer Gruppe. So können stadtplanerische Handlungsansätze und Problemstellungen identifiziert werden, ohne hierbei den Fokus auf die Aktivitäten einzelner Personen zu legen. Um dem Anspruch der Anonymisierung gerecht zu werden, ist eine grafische Überlagerung aller Wege der Probanden notwendig. So ist die Fokussierung auf Einzelpersonen nur noch mit Wissen über deren Aufenhaltsorte möglich. Diese Überlagerung aller Wege und Orte, die alle Personen innerhalb von vier Wochen zurückgelegt und besucht haben, liefert erste räumliche Informationen. Durch die zur Verfügung stehenden dezidierteren Attribute wie Zeit, Zeitpunkt und Dauer oder Wegelänge können spezifiziertere Analysen durchgeführt, einzelne Aspekte herausgefiltert und grafisch aufbereitet werden.

Als Ergebnis der Analysen entstehen Infografiken aus dem numerischen Gesamtdatensatz und Kartensätze, die entweder vereinfachte Darstellungen in Form von Punkten oder Linien darstellen, oder Häufigkeiten mithilfe einer Kernel-Density-Berechnung – als sogenannte „Heatmap“ – visualisieren.

5.1 Statistische Auswertung

Die folgende Abbildung 2 stellt die Gesamtdauer der zurückgelegten Wege und Aufenthaltszeiten an Orten grafisch dar. Im Trackingzeitraum (insgesamt 31 Tage) befanden sich die Probanden an 14,4 Tagen „an Orten außer Zuhause“ (Orte außer Zuhause sind beispielsweise die Universität oder Orte an denen sich zum Ausgehen aufgehalten wurde) an 13,2 Tagen „Zuhause“ und an 4,4 Tagen „unterwegs“.

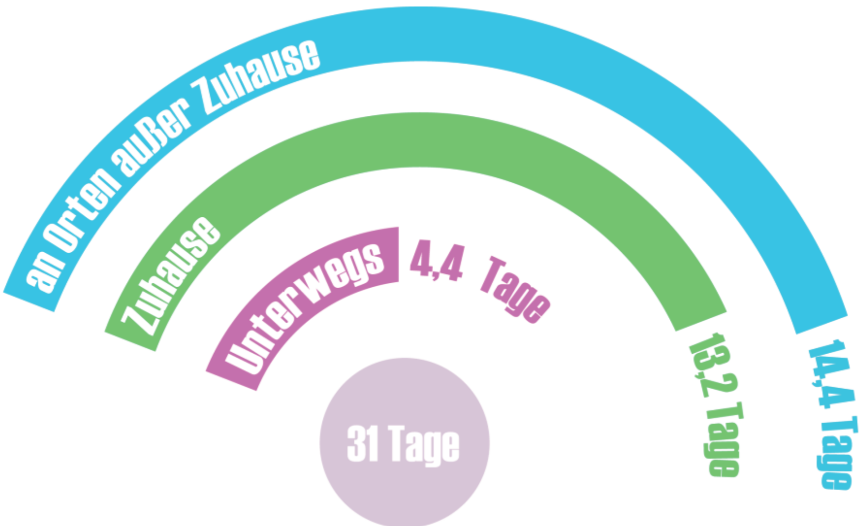

Abb. 2: Gesamtdauer der zurückgelegten Wege und Aufenthaltszeiten an Orten

Auffällig ist, dass sich „Zuhause“ und „an Orten außer Zuhause“ fast gleich lang aufgehalten wurde. Dies liegt daran, dass die Zeit nachts überwiegend „Zuhause“ verbracht wurde und tagsüber „an Orten außerhalb“.

Die Strecken, welche in der Kategorie „unterwegs“ zusammengefasst sind, beschreiben die Wege zwischen „Zuhause“ und „Orten außer Zuhause“. Diese Wegstrecken sind statistisch in Abbildung 3 zusammengefasst.

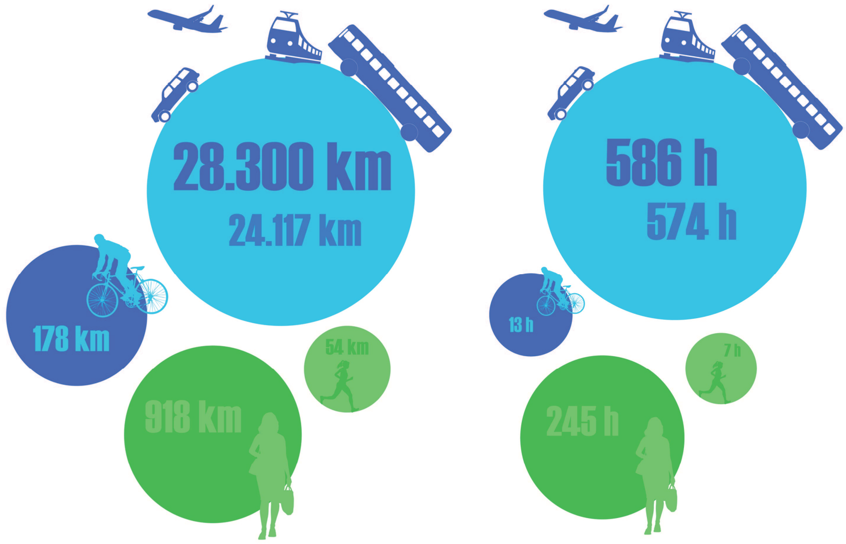

Abb. 3: Strecke und Zeit der zurückgelegten Wege nach Fortbewegungsart

Während des Trackings wurden insgesamt 29.450 Kilometer zurückgelegt, wobei die Personen 851 Stunden zum Zurücklegen dieser Entfernung benötigt haben. Der motorisierte Transport (ÖPNV, MIV usw.) macht mit 28.300 Kilometer den größten Anteil der zurückgelegten Wege aus. Werden hierbei Flugreisen aus der Statistik ausgeschlossen, so sinkt der Wert auf 24.117 Kilometer bzw. 574 Stunden. Zwar fehlen Vergleichswerte aus anderen Experimenten, doch trotzdem erscheint dieser Wert für acht Projektteilnehmer innerhalb von 31 Tagen sehr hoch. Zustande kommt dieser Wert beispielsweise dadurch, dass während des Projekts Reisen nach Gent und Berlin unternommen wurden. Mit dem Fahrrad wurden in 31 Tagen 178 Kilometer in 13 Stunden zurückgelegt, 54 Kilometer in 7 Stunden gejoggt und 918 Kilometer in 245 Stunden gegangen. Bemerkenswert ist der hohe Anteil des Gehens, welcher fünf Mal höher ist als der der zurückgelegten Strecken mit dem Fahrrad. Eine Erklärung hierfür ist unter anderem, dass während der Studie viele unbekannte Städte und Orte zu Fuß erkundet wurden.

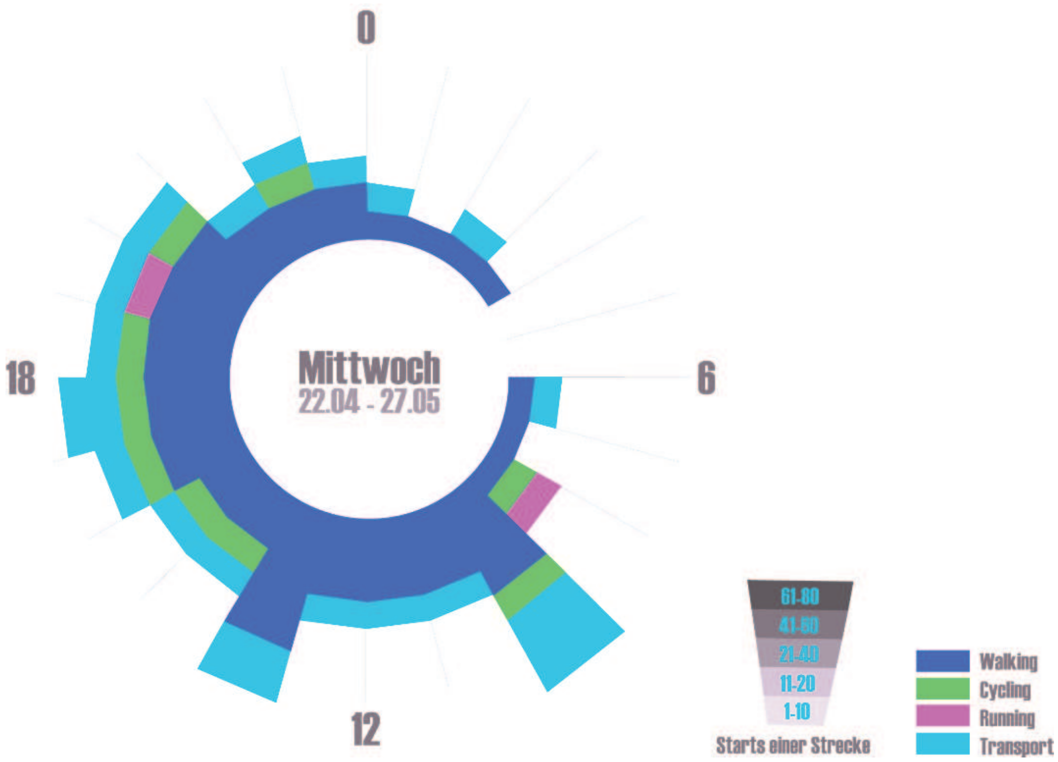

Abb. 4: Transportmittel nach Tageszeit an einem ausgewählten Wochentag

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Abbildung 4 verdeutlicht, dass dezidiertere Aussagen zu bestimmten Tagen und einzelnen Zeiträumen getätigt werden können. Beispielsweise können aus dieser Abbildung die Transportmittelwahl und die Intensität der Aktivitäten im Tagesverlauf abgelesen werden. In dieser Grafik wurden alle Aktivitäten an Mittwochen während des Trackingzeitraums addiert.

Ein Durchschnittswert hat sich bei dieser Darstellungsform nicht angeboten, da sonst einige Strecken nicht angezeigt werden würden. Die Grafik ist in Form einer Uhr visualisiert und unterteilt die Aktivitäten in die 24 Stunden des Tages. Die Transportmittel richten sich nach der von Moves erkannten Wahl: Gehen, Joggen, Radfahren und Transport. Es sind immer nur die Starts einer Strecke dargestellt.

Für die Starts einer Strecke wurden nach Menge der Starts fünf Kategorien gebildet. Deutlich erkennbar ist, dass zwischen Mitternacht und sechs Uhr die wenigsten Aktivitäten stattgefunden haben und zwischen vier Uhr und sechs Uhr gar keine, da die Probanden zu dieser Zeit meistens geschlafen haben. Im Vergleich dazu sind die Aktivitäten zwischen neun und zehn Uhr sowie zwischen 13 und 14 Uhr und zwischen 17 und 18 Uhr besonders hoch. Diese Stunden stellen die Spitzenstunden der Fortbewegungsarten Gehen und Transport dar. Zu diesen Zeiten begibt sich ein Student üblicherweise in die Universität und verlässt diese zur Mittagszeit oder abends. Ebenfalls sind aus der Grafik die Zeiten ablesbar, zu denen gejoggt wurde. Beliebt waren hier acht bis neun Uhr, also vor der Universität/Arbeit und 19 bis 20 Uhr, als Tagesabschluss. Darüber hinaus lässt sich insgesamt ablesen, dass fast über den ganzen Tagesverlauf Strecken zu Fuß zurückgelegt wurden, und diese auch in der Anzahl am häufigsten auftreten. Ein Grund dafür könnte sein, dass zu Fuß häufig kürzere Strecken zurückgelegt werden und diese daher häufiger in der Grafik erscheinen. Da Kaiserslautern eine mittelgroße Stadt ist und die addierten Daten von einem Wochentag stammen, kommen größere Strecken eher selten vor (Biesewig et al. 2015).

5.2 Heatmaps

Die erste Heatmap (Abb.5) vergleicht alle zurückgelegten Wege und alle mit Hilfe von Transportmitteln zurückgelegten Wegen.

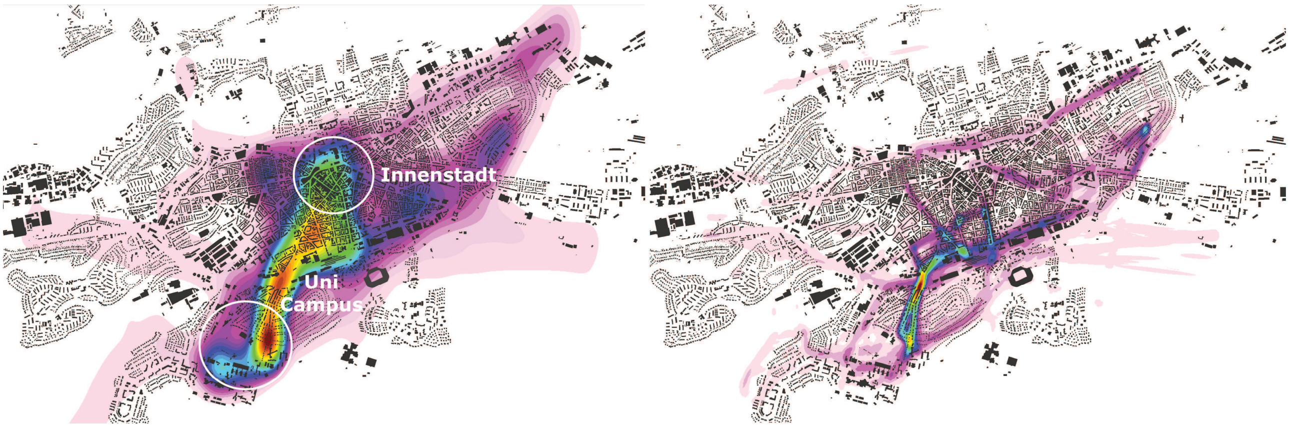

Abb. 5: Darstellung aller zurück gelegten Wege (links) und Detailansicht der mit Hilfe von Transportmitteln zurückgelegten Wege als Heatmap (rechts)

Unter die Wege mittels Transportmitteln fallen alle motorisierten Fortbewegungsarten. Zu erkennen ist auf der linken Heatmap, dass Wege innerhalb eines großen Teils des Stadtgebietes unternommen wurden. Reduziert man diese Ansicht hingegen auf die Wege, welche mit Transportmitteln (PKW, ÖPNV, etc.) zurückgelegt wurden, so ist erkennbar, dass hiermit lediglich einige Hauptverkehrsachsen abgedeckt sind und ein viel kleinerer Stadtbereich abgedeckt ist. Dies ist darauf zurückzuführen, dass in der Innenstadt keine Transportmittel benötigt werden, da es einfacher ist, sich in der Innenstadt zu Fuß fortzubewegen. Auch auf dem Universitätsgelände, am unteren Rand der Grafiken erkennbar, bewegen sich die Personen überwiegend zu Fuß fort. Mit Transportmitteln ist eine Strecke, welche in den Süden der Stadt führt, besonders beliebt. Diese Strecke beschreibt den Weg von der Innenstadt zum Campus und stellt einen der Hauptzielwege aller Studenten in Richtung der Technischen Universität Kaiserslautern dar. Zusammenfassend ist zu erkennen, dass im Bereich der Innenstadt und der Universität die meisten Strecken zurückgelegt wurden. Bei einer Gegenüberstellung der Heatmap der insgesamt zurückgelegten Wegstrecken in Kaiserlautern mit den zurückgelegten Wegen im Zeitraum von 22 Uhr bis 5 Uhr, zeichnen sich deutliche Unterschiede ab, die in Abb. 6 dargestellt sind.

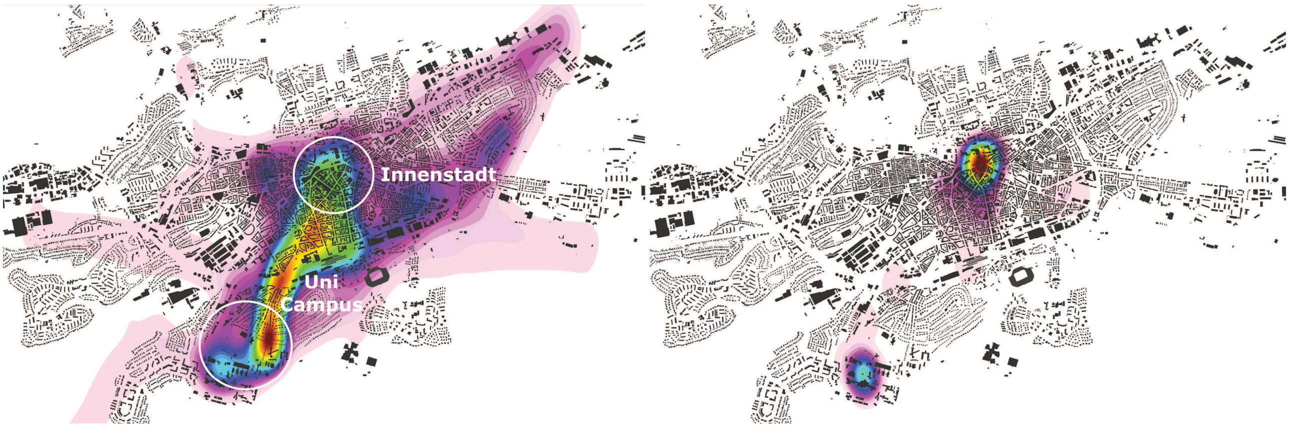

Abb. 6: Heatmap aller besuchten Orte der Probanden (links) und Aufenthaltsorte „Nachtleben“

Wählt man aus allen besuchten Orten lediglich die Orte aus, die nachts im Zeitraum von 22 Uhr bis 5 Uhr besucht wurden und nicht als „Zuhause“ eines der Teilnehmer definiert sind, fällt auf, dass sich statt der breiten Verteilung der besuchten Orte über das Innenstadtgebiet und Unigelände nur noch zwei Hot-Spots identifizieren lassen. Ein Hotspot findet sich in der Altstadt und einer ist an der Universität erkennbar. Der Hotspot in der Altstadt kommt dadurch zustande, dass dort einige Bars und eine Diskothek ihren Standort haben, welche von den getrackten Personen besucht wurden. Abendveranstaltungen fanden während der Trackingphase ebenfalls an der Universität statt, wie zum Beispiel Grillabende und Uni-Partys.

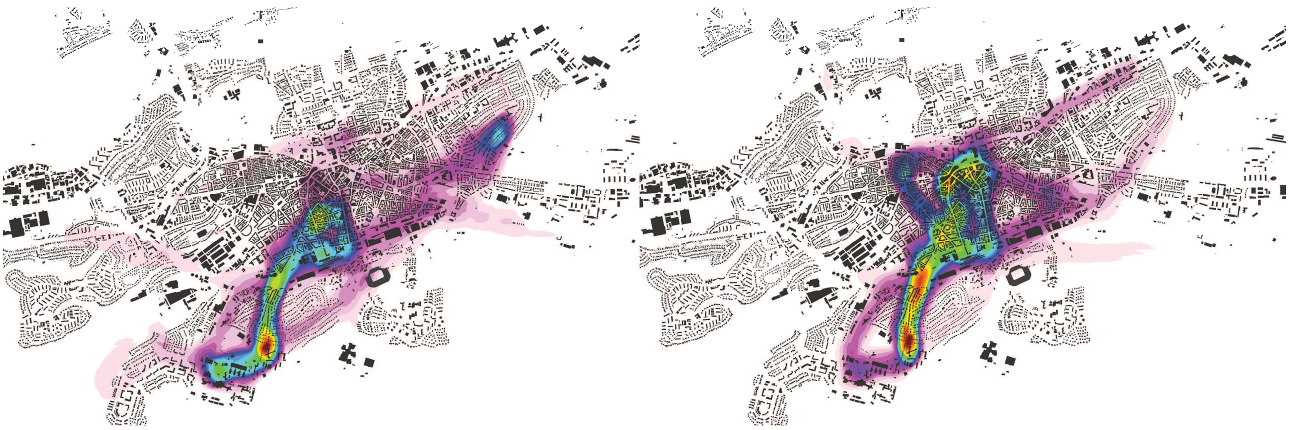

Abb. 7: Heatmap aller Wege männlicher Teilnehmer (links) und weiblicher Teilnehmerinnen (rechts)

Ein weiterer Indikator, mit dem die gesammelten Daten zum Beispiel analysiert werden können, ist die geschlechterbezogene Auswertung (siehe Abb. 7). Teilt man beispielsweise die zurückgelegten Strecken nach diesem Unterscheidungskriterium ein, wird deutlich, dass die weiblichen Teilnehmer in den 31 Tagen des Trackings aktiver waren. Bei geschlechterspezifischer Betrachtung der besuchten Orte sind Bereiche wie Einkaufsstraßen und die Shopping Mall von den weiblichen Teilnehmern öfter besucht worden als von den männlichen. Da die Gruppe der Teilnehmer jedoch aus lediglich vier weiblichen und vier männlichen Teilnehmern bestand, ist dieser Indikator nur bedingt aussagekräftig.

6 EINSATZMÖGLICHKEITEN IN DER STADTPLANUNG

Wie im vorangegangenen Kapitel ersichtlich, sind die Auswertungsmöglichkeiten von Aktivitätsmustern sehr vielfältig. In Bezug auf konkrete stadtplanerische Maßnahmen bieten sie ein breites Spektrum möglicher Untersuchungen. Diese Vielzahl an Möglichkeiten umfasst auch zahlreiche Auswertungs- und Interpretationspotenziale, ist allerdings auch an Voraussetzungen geknüpft. Zwar sind bereits bei der Auswertung der Wegstrecken und Orte der acht Projektteilnehmer einzelne Beobachtungen und Schlussfolgerungen möglich, Planungsmaßnahmen lassen sich hierauf allerdings nicht begründen. Vielmehr ist nicht nur das Tracken einer Personengruppe notwendig um wirklich zuverlässige Daten zu erhalten, sondern auch die Menge der getrackten Personen muss einen repräsentativen Anteil der Stadtbevölkerung ausmachen. Das Erfassen und Nutzen von Aktivitätsmustern ermöglicht dann auch der praktischen Anwendung, im stadtplanerischen Kontext, ein breites Band denkbarer Einsatzzwecke und Potenziale, grafisch verdeutlicht in Abbildung 8. Die Analyse der genutzten Verkehrswege der getrackten Personen kann etwa in der Verkehrsplanung Nutzung finden. Vielgenutzte Strecken, ineffiziente Ampelschaltungen oder die Identifikation fehlender Wegeverbindungen können hieraus ersichtlich sein (Biesewig et al., 2015).

Abb. 8: Einsatzmöglichkeiten in der Stadtplanung

Der Fahrradwegebau kann hiervon beispielsweise enorm profitieren. Sind eine Vielzahl von Radfahrern über einen längeren Zeitraum getrackt, kann ein Vergleich zwischen den von ihnen tatsächlich zurückgelegten Strecken mit den Karten der ausgebauten Radwege eventuelle Handlungsspielräume aufzeigen. Vielleicht sind vielgenutzte Radstrecken erkennbar, welche aktuell nicht durch Radwege erschlossen sind. Hieraus wäre der Bedarf für Lückenschließungen oder Neubaumöglichkeiten klar ableitbar. Demnach kann nicht nur die Verkehrswegeplanung profitieren, sondern auch die Verkehrssicherheit durch entsprechende Maßnahmen, die aus den Aktivitätsmustern ableitbar sind, Verbesserung erfahren. Im Beispiel der Radwege etwa durch den Neubau von Radwegen und somit einer Verbesserung der Sicherheit von Fahrradfahrern.

Nicht nur der Radwegebau kann Profite durch die Trackingdaten erlangen, auch andere notwendige verkehrsplanerische Maßnahmen können erkannt und umgesetzt werden. So sind auch stauintensive Straßenabschnitte, je nach Umfang des Trackings, erkennbar und eine planerische Reaktion ist darauf möglich. Aber nicht nur die zurückgelegten Wegstrecken bieten zahlreiche Potenziale, auch die besuchten Orte und die Verweildauer an diesen ermöglicht den Planungsbehörden Chancen. Durch die Analyse der besuchten Orte der getrackten Personen sind auch Hot Spots oder Nice Spots erkennbar. Diese beliebten beziehungsweise stark frequentierten Orte geben Aufschluss über die bevorzugten Aufenthaltsorte innerhalb des Stadtgebietes. Zudem sind Erreichbarkeits- und Frequentierungsanalysen in Bezug auf einzelne Orte in der Stadt erstellbar. Sowohl die aus den Aktivitätsmustern erkennbaren Wegstrecken als auch die frequentierten Orte können Best- und Bad-Practice-Beispiele städtebaulicher Maßnahmen aufdecken. Ein Park, der zum Verweilen gedacht war, wird nur als Durchgangsstrecke genutzt? Dies wäre nur eins von vielen Beispielen, wie bereits abgeschlossene Planungsmaßnahmen auf ihre tatsächliche Wirkung hin untersuchbar sind. Die reale Nutzung kann also nach Planungsabschluss mit der angedachten Nutzung verglichen werden, um Best-/Bad-Practice-Beispiele zu identifizieren und bei Bedarf erneut stadtplanerisch tätig zu werden.

Ein ganz wichtiger Faktor, den der Einsatz von Tracking in der Stadtplanung bietet, ist die automatische Integration der Bürger und Nutzer der Stadt in den Planungsablauf. Das Sammeln und Auswerten der Aktivitätsmuster der Bürger einer Stadt und mögliche daraus resultierende Planungen beruhen direkt auf dem täglichen Verhalten und den urbanen Bewegungsgewohnheiten der Bürger. Dadurch, dass der Bedarf planerischer Maßnahmen direkt aus dem Verhalten der Bürger ablesbar ist, kann eine neue Wechselwirkung zwischen den Bürger und den Planungsverantwortlichen entstehen. Der Begriff der Bürgerbeteiligung erfährt eine Stärkung durch die direkte Einbeziehung der Bürger, welche mittels ihrer Trackingdaten die Grundlagen für Planungsvorhaben liefern können. So kann nicht nur eine direkte Integration der Bürger geschaffen, sondern auch ein besseres Verständnis für deren raumwirksamen Bedürfnisse erlangt werden. „Dieser neuartige Ansatz der Planung ermöglicht eine ganz neue Form der Bürgerbeteiligung, außerhalb der mittlerweile typischen Bürgerversammlungen oder Workshops“ (Biesewig et al. 2015) und kann somit auch das Verständnis und Interesse der Bürger für stadtplanerische Maßnahmen stärken.

Gerade aber dieses Nutzen von personenbezogenen Daten zu Planungszwecken stellt im Hinblick auf die allgegenwärtigen Datenschutzdiskussionen die größte Herausforderung dar. Hier gilt es, den Mehrwert, den Bürger durch den Einsatz dieser Möglichkeiten erhalten, klar und deutlich herauszustellen. Außerdem muss der sensible und anonyme Umgang mit den Daten gewährleistet sein.

Alles in allem bietet der Einsatz von Tracking im stadtplanerischen Kontext ungeahnte Möglichkeiten, effiziente Planungsmaßnahmen zu realisieren. Vor allem als Instrument der Bedarfsanalyse wie auch der Planungsüberprüfung und –nachbetrachtung kann das personenbezogene Tracking in der Stadtplanung Anwendung finden. Um einen tatsächlichen Einsatz dieser Verfahren zu ermöglichen, sind die Herausforderungen des Datenschutzes sowie das Finden einer ausreichenden Zahl frewilliger Bürger zu bewältigen.

7 FAZIT

Die Sammlung großer Datensätze, speziell personenbezogener Daten, birgt zweifellos ein gewisses Risiko und stößt kaum auf Gegenliebe seitens der Bevölkerung. Privatsphäre und Datenmissbrauch sind hier die Stichwörter. Da die gesammelten Daten einer Tracking-App in den falschen Händen durchaus viel Unheil anrichten können, ist neben einer ausreichenden Datensicherung vor allem die frühzeitige Einbindung der Bürger und deren Sensibilisierung wichtig. Eine gesellschaftliche Etablierung smartphone- bzw. trackingbasierter Planungsmethoden ist schwierig und bedarf zuvor einer weitreichenden Klärung der Rahmenbedingungen zum Thema Datenschutz. Dazu gehört vor allem die komplette Kontrolle über die Datensätze durch den Erzeuger. In der Praxis sieht dies leider noch häufig anders aus: Über die Köpfe der User hinweg werden die Daten von Tracking Apps beispielsweise auf dem amerikanischen Markt gehandelt. Das Erwerben bereits vorhandener Daten sollte aus planerischer Sicht daher weniger das Ziel sein. Vielmehr ist der Planer hier mit einem konzeptionellen und frühzeitig kommunizierten Ansatz in Verbindung mit transparentem Methodeneinsatz im Vorteil. Die Planung könnte daran anknüpfend etwa bestehende Apps verwenden, oder eine speziell für diesen Zweck konzipierte App nutzen, um die benötigten Daten aktiv im Zuge eines Prozesses der Bürgerbeteiligung zu erheben (Folz et al. 2015).

Da sich heutzutage bereits „Etwa jeder Dritte (32 Prozent) […] grundsätzlich vorstellen [kann], gesundheits- und fitnessbezogene Daten zu messen und mit der Krankenversicherung zu teilen, um dadurch Vorteile zu erhalten“ (Soldwedel 2015), ist der breite Einsatz dieser Methode zur Datengewinnung für die Stadtplanung nicht mehr länger nur ein Hirngespinst. Denn: "Wenn der Mensch seine intimsten Daten preisgibt, weil es zu seinem Vorteil sein könnte, warum sollte er dann in Zukunft nicht auch seine Daten für eine Verbesserung des eigenen Lebensumfeldes nutzen?" (Biesewig et al. 2015).

8 DANKSAGUNG

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Unobtrusive, Seductive and Profound? The Silent Transformation of Mobility in the Region of Stuttgart

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1 ABSTRACT

Information and communication technologies are increasingly transforming our urban lives, giving rise to what is commonly referred to as the 'smart city'. Understood as technologically enhanced urban services (i.e. metered, networked, monitored and computed, mostly and preferably in real-time), the ICT industry showcases a full range of perfectly integrated 'smart city' technologies in pilot projects around the world. While still focusing on the technological understanding of 'smart', this paper, however, explores the less advertised and seemingly more trivial transformations happening in our existing cities. By doing so, three aspects of the process of becoming 'smart' are identified, highlighted and exemplified by a case in Stuttgart, Germany. First, the sector and often company connected and incremental approach make it unobtrusive and hardly noticeable as an integrated 'smart city' concept. Second, democratic and public debate is absent, as the promised or envisioned results are on the one hand seductive and desired and consequently (rightly) assumed to be a priori supported by majorities and on the other hand often designed and implemented by the private sector. Third, although individual transformations may not seem radical, their combined implications and potential for urban governance and planning can be profound, especially in combination with the renewed idea of rational, non-ideological decision making through algorithmic data analysis. This paper describes these aspects on the basis of the case polygo in Stuttgart, a recent effort to further digitalise and network public transport and private e-mobility services, effectively and incrementally implementing a 'smart mobility' concept throughout the Region of Stuttgart.

Keywords: Transformation, Mobility, Transition, Smart City, Regional Planning

2 INTRODUCTION

Increased computational power and networking, wide-spread data collection and automatic and algorithmic data processing rapidly change the way we interact with and make sense of the world. Data becomes big data, which is often spatially and temporally attributed and analysed in real-time (Kitchin 2013, 2014). At the same time the city—despite earlier doubts—proves to be still the single most important form of human settlement, as Graham and Marvin (1999) already pointed out. In fact, a rising urban worldview attributes cities a much greater ability and efficiency in solving today's problems than nation states (see for instance Barber (2013) for a discussion about cities' advantages). The 'smart city' seeks to combine these two developments—ubiquitous computing and the city—and promises urban governments and businesses the necessary technological infrastructure to become—or stay—sustainable, resilient, innovative, competitive, attractive, safe, transparent and responsive to social needs like healthcare and education (Kitchin 2014, see also the IBM Smarter Cities website). In the 'digital age' urban areas are no longer just home to a new industry and culture (Graham and Marvin 1999), but increasingly also a recipient of transformational forces towards what Kitchin (2014) calls "technocratic governance and city development". The vision of internationally operating technology firms, that digitalise and network urban services and process the collected data in real-time, is to support what is envisioned to be non-ideological, smarter and more effective decision-making (IBM 2011a; Kitchin 2015). The proclaimed 'Internet age' is also, it seems, an age of quick technological solutions to all (urban) problems. Pilot-projects of the Global North tech industry showcase and promote the 'digital urban age' around the world, while often at the same time evading real problems in existing cities by constructing new districts or entire cities.

Although these 'smart cities' are receiving a torrent of advertisement and media attention, the author argues in this essay that most transformations in developed countries happen on the one hand in existing and over centuries grown cities, and on the other hand much more silently and pragmatically than suggested. Although not necessarily called 'smart', the changes nevertheless seem to qualify as 'smart city' concepts. A closer look reveals the reason for the initial modesty: the deployed solutions seem hardly new or profoundly impacting the respective cities. However, the author argues that profound changes do indeed happen, yet not in expected or envisioned ways. For instance, when separately looking at the upgrading of urban services into 'smart' ones, these may not reveal anything profound, but the combination of various such efforts, their networking, technological potential and underlying ideologies suggest a profound change in urban development, planning and governance. Important to note here is that "history shows that [technology] more generally reflects and mirrors the culture in which it evolves rather than guiding and directing it" (Barber 1998). In other words: to understand the 'smart city' it is vital to also understand the culture of the very technologies it is built on, i.e. "The Culture of the Internet" (Breton 2011).

Hidden in their unobtrusiveness and allure, it is difficult to notice the 'smart city' transformations and their potentially profound impacts. But even when aware of them, "solutionism" (Morozov 2014) and the prevailing ideas of and values attributed to "the Internet" (cf. Breton 2011) seem to silence a critical debate and hinder questioning the very ideas and values. Tech solutions, it seems, transcend questions of whether we actually need them (i.e. whether they actually solve a real problem) and whether we want them (i.e. in preference to "old age" responses). Thus, much of our cities' future is determined by and dependent on unquestioned beliefs and assumptions and the private companies transforming them into world-wide deployable tech solutions.

Understanding how 'smart city' concepts (especially when not labelled as such) and underlying "Internet values" and "solutionism" transform cities can help to become aware of their potential profoundness and start a political debate, similar to the ones we already have for example about privacy and data collection. When aiming at becoming or staying 'smart', we need to ask questions such as: do we want these levels of interconnectedness, centrality and automation? Do we want to deploy 'smartness' on this scale and with that reach? Do we want what Pasquale (2015) calls "black boxes"? Are we confident markets, private partners and entrepreneurs can solve the problems at hand best? The case of Stuttgart shows that it is possible to design a 'smart city' concept while still answering at least some of these questions negatively— although, it seems, solely motivated by and on the basis of privacy and data protection regulations.

By describing and looking at the inconspicuous case of polygo the author identifies three aspects of 'smart city' transformations in existing and grown cities: unobtrusiveness, seductiveness and (ostensible) profoundness. After a brief overview of the term 'smart city', the essay is structured in two parts, discussing the three aspects first on a general and later on a specific level of the case of polygo in Stuttgart.

3 UNAMBIGUOUS AND UNPRECEDENTED?

The term "smart" seems to be as ambiguous as it is used in both academia and the public and private sector. Moreover, depending on their perspective and intentions, scholars, politicians and industry spokesmen stress or highlight specific aspects of what is commonly understood as the 'smart city'.

Vanolo, for instance, states that "the term smart city is basically an evocative slogan lacking a well defined conceptual core" (2014:884). An international team of scholars with technological and e-government foci agrees that despite the term's frequent use, "there is still not a clear and consistent understanding of the concept among practitioners and academia" (Chourabi et al. 2012:2289). Giffinger et al., in their effort to rank European medium-sized cities, propose a holistic understanding, in contrast to its current use "for various [single] aspects which range from Smart City as an IT-district to a Smart City regarding education (or smartness) of its inhabitants" (2007:10). Their definition encompasses the performance and progressiveness of cities in six different sectors (economy, people, governance, mobility, environment and living) and stresses the aspect of 'smart citizens', who act independently and decide for themselves. Kitchin gives a similar definition: "'Smart cities' is a term [...] to describe cities that, on the one hand, are increasingly composed of and monitored by pervasive and ubiquitous computing and, on the other, whose economy and governance is being driven by innovation, creativity and entrepreneurship, enacted by smart people" (2014:1). In this essay, the 'smart city' is understood in Kitchin's way, i.e. with its two sides.

3.1 Contextualising the 'smart city'

Both concepts, the pervasive computing and monitoring as well as the entrepreneurial, 'smart' citizenship (and urban governance respectively) build on ideas much older than the 'smart city' discourse. It is thus important to put the 'smart city' into context to understand its history, origin and overall ideas shaping it. Two main influences stand out: first, neoliberalism and a shift from managerialism to entrepreneurialism in urban governance in the 1980s and second, the visions of cybernetics, born in the 1940s.

The fundamental idea of liberalism is an economic, political and societal organisation based on free choice, taken rationally and in self-interest. The implications are, in sum, economically the proliferation of the market economy and politically a stripped down, minimal state. Neoliberalism extends these ideas globally, promoting privatisation and discouraging state intervention. Or, as Jessop (2002) writes, "the state can retreat to its proper, minimal role, acting only to secure the conditions for the continued expansion of the liberal market economy and a self-organizing civil society". Urban areas are hereby increasingly relevant for their role as competitive nodes of the self-organising society, especially on the path to the 'information society' as innovation and learning hubs (cf. Jessop 2002).

Another development rises at around the same time as a response to the inflation crisis under the Keynesian welfare state in the 1970s. In the 1980s a change in urban governance takes place: a shift from managerialism to entrepreneurialism. Rising mobility of capital, goods, services and people, as well as the nation state's declining control over them, increasingly forces cities to negotiate directly with international capital to attract capitalist development. In turn, cities found themselves in competition with one another, resulting in various efforts of place making either by actual construction or by enhancing conditions. Harvey describes three developments of importance here: first, the efforts to create a competitive environment to attract global labour, consumption and command-and-control functions, but also a larger share in national redistribution surpluses; second, the rise of external forces affecting cities through the inter-urban competition (see also Vanolo 2014); and third, the preference of isolated developments over comprehensive urban planning (cf. Harvey 1989).

About three decades earlier, in the 1940s, another influential idea emerged: cybernetics, an effort to understand and design systems of communicating nodes, self-stabilised through the feedback of information. But cybernetics was not limited to technical systems alone (cf. Breton 2011). Rather, it was a vision of a 'new society', a society of a new man and a new intelligent machine, 'living' peacefully next to each other. And as cybernetics considered everything information, the 'new society' was, unsurprisingly, a "global information society", where communication "between man and machines, between machines and man, and between machine and machine, [...] play an ever-increasing part." (Wiener in: Breton 2011:44) Underlying this vision is the belief that politics is incapable of governing on a global scale, which the machine would not only be capable of, but could also do so rationally. It "is a society without a State, founded upon small communities of life and on a global communication system" (Breton 2011:44). In the words of poet Richard Brautigan, it is a society—or rather everything—"[...] watched over by machines of loving grace" (1967).

However, the initial dream of artificial intelligence within a decade proved to be greatly too optimistic. Furthermore, in the 1960s and 1970s the cybernetic understanding of the society was strongly criticised for the ideological promotion of technology. But by the 1980s and 1990s, the necessary technology—computers and computer networks—were fully developed and powerful enough to rekindle cybernetic ideas: 'the Internet' set out to reorganise all spheres of society, our thinking and culture (cf. Breton 2011; Morozov 2014).

4 TECHNOPHILE OR TECHNOPHOBE?

The ambiguity of the term 'smart city' results in a multiplicity of understandings and critiques of the concept. A binary view of technophiles versus technophobes is thus far too limited and mainly reflects the former's dominance in the public discourse. In fact, scholars have scrutinised and criticised the 'smart city' on many different levels.

The overarching vision of advocates, mostly technologists and what Morozov calls "solutionists", much in line with neoliberal and entrepreneurial ideas, is a more competitive and efficient economy and administration of cities while at the same time improving their sustainability and resilience (Hollands 2008; IBM 2010, 2011a, 2015). Equally fundamental is the cybernetic notion of rational, non-ideological decision-making through the use of data analytics: big data, collected through monitoring networked infrastructure and tapping of social media, is either used for algorithmic governance or analysed and visualised to inform and aid decision-making (IBM 2011a; Kitchin 2015). The cybernetic idea is further stressed by IBM's new advertisement effort to promote the 'cognitive city'.

The critique to this technological and entrepreneurial understanding of the city addresses a range of problems and false claims. Both Kitchin (2015) and Shelton et al. (2014) see nothing new about the 'smart city'.

Moreover, Kitchin (2013) regards the notion of non-ideological, apolitical decision-making and the idea of self-speaking big data an illusion and Shelton et al. point to a long history of the seemingly new approaches like computational data analysis or rational planning. In addition, they highlight the fact that 'smart cities' are rarely built from scratch and as perfect as envisioned or advertised. Thus, they promote the idea of "The 'actually existing smart city'".

A rising critique is related to the neutrality and ethics of algorithms or, more precisely, their authors. Naughton (2015) thus calls for a code of conduct for algorithm writers and Pasquale (2015), in his analysis of the "black box society", for new regulations and more auditing. Sadowski and Pasquale (2015) further argue that the 'smart city's' data collection and subsequent processing in the private 'cloud' (IBM 2011b) through little known algorithms, combined with the transition to entrepreneurialism, give rise to "corporatized governance". Consequently, they ask who is ultimately in charge. Hollands (2008) further "explores to what extent labelled smart cities can be understood as a high-tech variation of the 'entrepreneurial city'" (2008:303).

A related point of critique are rising inequalities. Graham (2002) argues that ICT increases polarisation both at a global (among cities) and local (within cities) scale, favouring and strengthening groups already in power and control and more generally whoever is connected and "digitally literate". Castells 1989 highlighted the move from an industrial to an informational economy and society with its implication of the "rise of the dual city" 25 years ago and argued that decision-making becomes increasingly centralised. Furthermore, Vanolo calls attention to the use of 'smart city' concepts as a disciplinary strategy of national governments or intergovernmental organisations in how they "impress a new moral order on the city [...] to distinguish between the 'good' and 'bad' city" (2014:883). Finally, Schneier (2014, 2015), a prominent security expert, argues that the 'Internet of Things' is "widely insecure" and that these vulnerabilities are not easy to fix.

5 THE TRAITS OF BECOMING 'SMART'

To add to the understanding and critique of 'smart cities', this article explores how the restructuring process of existing and grown cities takes place and identifies and outlines three characteristics: unobtrusiveness, seductiveness and profoundness. This section describes these aspects in a general way; the next section exemplifies them by the case of polygo in the Region of Stuttgart.

5.1 Hidden in plain sight

Forty years into the era of personal computing, the 'black box' (Pasquale 2015) is ubiquitous and ironically a well established normality expected by consumers and vigorously worked on by producers. As 'black' suggests, the inner mechanisms are hard, if not impossible to understand and access. Both is seldom possible, as access is often restricted (on trade secret grounds) and skilled auditors rare (Kitchin 2015; Pasquale 2015; Sadowski and Pasquale 2015). Consequently, crucial components of the 'smart city' are hidden and worked out inconspicuously, predominately by private tech companies.

In contrast to pilot projects that are built from scratch, existing cities are upgraded incrementally and assembled piecemeal. The fragmented nature makes it much harder to see an actual 'smart city' being implemented instead of isolated efforts to improve particular services or parts of the city. Often that also means that these projects are not only commissioned by the public sector and implemented by private firms, but, as a legacy of neoliberal privatisation efforts, often also both commissioned and implemented by them, as contracted or privatised service providers constantly improve their services to reduce costs and respond to customer demands.

The latter point is vital in itself: in an "Internet-centric" (Morozov 2014) world abundant of 'smart' devices that are deeply embedded into our everyday lives, citizens notice rather the absence of information and communication technology (ICT) than their presence. It is not seeing the wood for the trees.

5.2 Smart is the new sexy

But it is not only about noticing. ICT is highly seductive, both on the theoretical level of its promises and the practical level of everyday life, both for citizens and local governments. Whether managing or using urban services, governing a city or participating in it, the 'smart city' offerings seem irresistible (Hollands 2008:304f). Technological solutions are envisioned for a whole range of urban challenges: IBM (2010, 2011a, 2012a) for instance promises long-term smarter growth and improved services without increasing costs. To add to that, the 'smart city' is at the same time advertised as a vital response to environmental issues and citizen involvement (Giffinger et al. 2007; IBM 2012a).

The visions for consumers and citizens are similarly hard to resist: better integrated and running services that are also more easily and more comfortably accessible from anywhere (given one is part of the 'digitally literates') promise a streamlined urban experience, freed from constraints of time and space where possible. 'Hack your city' events and platforms, combined with 'open data' efforts, speak directly to the 21st century entrepreneur—the hacker—aiming at nothing less than the cybernetic dream of "Reinventing City Hall" (Townsend 2013) and ultimately society. As Morozov (2014) and Breton (2011) point out, 'the Internet' is not seen as pure ICT, that is a collection of wires and devices connecting them, but became a "cult" with a particular "spirit" of an open, transparent, bright, peaceful and, of course, smart future. Who would not desire that?

As a consequence of the seductiveness of the 'smart city' and its implementation and sometimes also commissioning by private companies, public debate is often absent or is predominantly and one-dimensionally concerned with data protection and privacy issues.

5.3 Big data, big scope

The unobtrusive and seductive transformations in existing cities are seldom profound, at least when seen isolated and individually. Although advertisement campaigns and 'Internet' advocates may disagree, an improved service that now also comes with an App is nothing radical or far-reaching. In fact, Morozov argues that nothing about 'the Internet' is and points to a long technological history (see also Shelton et al. 2014 and Townsend 2013).

However, the 'smart city' idea comprises more than improved services. Embedded and borrowing from more overall ideas like the cybernetic, neoliberal and entrepreneurial ideas, it affects and targets essentially all urban sectors and services: government, safety, planning, healthcare, education, energy, water and transportation (IBM 2012b). Control and power become increasingly centralised, on the one hand locally at the public sector in so called "urban control rooms" (Kitchin 2015), like IBM's "Intelligent Operations Center" (IBM 2011a), and on the other hand globally at private ICT corporations and algorithm developers, often locked behind trade secrets (Pasquale 2015). Furthermore, Sadowski and Pasquale (2015) argue that 'smart cities' exercise power not only in Foucaultian forms of sovereign power ("to take life or let live") and disciplinary biopower ("to administer and manage bodies and populations"), but also in the Deleuzian notion of "societies in control" (cf. Deleuze 1992). Sadowski and Pasquale (2015) describe a "spectrum of control" that ranges from subtle to aggressive, from an "operation of power that does not immediately affect what humans can do—their potentiality—but rather their 'impotentiality,' that is, what they cannot do, or better, can not do" (Agamben 2010, in: Sadowski and Pasquale 2015) to a "severe and militarized" (Balko 2013, in: Sadowski and Pasquale 2015) and increasingly automated execution of power (see also Morozov 2014:181).

The scale and scope at which the 'Internet of Things', of which 'smart cities' are a part, is deployed, Schneier (2016) argues, also mark a change in kind: "None of these technologies are new, but they're all becoming more prevalent. I believe that we're at the brink of a phase change around information and networks. The difference in degree will become a difference in kind." (Schneier 2016)

Moreover, favouring particular societal groups, especially 'hackers' and the educated, informed and affluent, intensifies existing polarisation. Take 'smart' efforts to improve street conditions as an example: while driving, sensors of mobile devices collect data about the street condition without any human interaction. While this is certainly a clever use of technology to collect data, using this data, or collecting it in the first place, might not be so 'smart', as the data tends not to reflect general societal needs and fixing the streets cannibalises other projects.

In general, the 'smart city' has a great potential in easing and thus changing the planning and governance of urban areas. However, falling into technophile/technophobe extremes in its understanding or seeing it as something completely new and segregated from other ideas can lead to profound impacts on fundamental issues for the democratic city, like social justice, cohesion and inclusion. Especially combined with the unobtrusiveness and seductiveness, the transformations can be profound in the way they transform our societies without citizens noticing or deliberating on it.

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6 POLYGO—THE MODEST ‘SMART CITY’

polygo initially started in 2012 as ‘Suttgart Service Card’. From 2013 to 2015 it was researched and developed as ‘Stuttgart Services’ and partly funded by the German government as one of its “Schaufenster Elekromobilität” (showcase e-mobility) projects. Although its main goal, motivated by traffic condition and air quality in Stuttgart, is to promote e-mobility and car-sharing as one of the showcase projects, an SSB (2012) presentation suggests the project aimed to be a ‘smart city’ concept early on. As such, the project was envisioned to be more than “only a mobility card” (SSB 2012) by integrating not only mobility services, but also targeting citizens as well as businesses and tourists more broadly. However, it is very seldom particularly labelled as a ‘smart city’ project.

The implementation happened incrementally: by the end of 2012, interested customers were able to use the so-called “Mobilpass” and in 2014, Verkehrsverbund Stuttgart GmbH[1] (VVS) ran a “friendly user field test” (VVS 2014). In 2015 the public facing brand polygo was created, which is operated by VVS. Currently, the existing paper-based subscription passes are phased out and replaced by the new chip cards. VVS wants to complete the transition throughout 2016.

Key development partners, both from the public and private sector, are technology companies and research institutions (see stuttgart-services.de/projektpartner.html). Operating and service partners are currently mostly mobility related, like VVS as public transport provider and private car- and bike-sharing providers. Other services already connected to polygo include the provision of parking spaces and e-mobility charging stations as well as (limited) payment services. The goal is to further extend the scope of the card by also making public services like the library, sport and leisure facilities and potentially also museums accessible through it.

6.1 Unobtrusiveness: smartening up behind the scenes

polygo was initiated by the public sector as a showcase project for e-mobility. However, one declared goal was to gain “vital know-how” (Recklies 2013) in the region through its development. Consequently, the project is a public/private partnership.

The polygo card and platform is developed in a way to include various services easily. However, apart from public transport subscriptions, the card is always an additional possibility next to the existing one to access services of other partners, which, moreover, have to be explicitly enabled first and are billed separately. In other words: polygo is currently not only mostly connected to the mobility sector, but also limited in its ways to attract attention (car2go, the free-floating car-sharing service, for instance, so far does not mention it on its site).

This is also due to the strategy of an incremental introduction. Just like for instance an automatic update of applications on modern mobile devices, the transition is meant to be as frictionless and unobtrusive as possible. After all, the connected services are nothing particularly new, neither is the effort to digitalise mobility services. Private partners were mostly accessible via mobile phone apps for years, and also VVS and public transport received various ICT improvements over the last decade, most notably EFA, the electronic journey planner. The changes are hardly noticed, especially when (deliberately) implemented at a slow pace, or, like the new control devices at the entrance to busses, seen as ‘yet another electronic device’ that hardly strikes as unusual. In the end, all that changes noticeably is the transition of subscriptions to a ‘card with a chip’, a change many customers are very much familiar with from other parts of their lives. A considerable number of VVS customers even trashed the letter with the new card, as they were unaware that it is their renewed subscription.

The other part invisible to the public are the technological changes. Key infrastructure and software is developed and implemented by private partners. Data protection and privacy concerns played a strong role in the design of the card, yet the precise implementation is unknown and for security reasons not disclosed. However, the operating company is mostly publicly owned and thus subject to democratic control.

[1] VVS is a limited liability company (LLC, German GmbH), located in Stuttgart. Shareholders come mostly from the public, but also private sector: Stuttgarter Straßenbahnen AG, Stuttgart; DB Regio AG, Frankfurt am Main/Berlin; Gesellschaft bürgerlichen Rechts der Kooperationspartner des VRS, Stuttgart, VerbandRegionStuttgart (VRS); Land Baden-Württemberg; Landeshauptstadt Stuttgart; Landkreis Böblingen; Landkreis Esslingen; Landkreis Ludwigsburg and Rems-Murr-Kreis (VVS 2014)

6.2 Seductiveness: the allure of ‘smartness’

The vision presented in 2012 is certainly hard to resist for citizens, the public and private sector. While key goals are mainly the improvement of environmental sustainability by strengthening environment friendly mobility, stimulating growth and competitiveness of the local economy, improving the “image of the city and region” (SSB 2012) and economic feasibility (including lower costs for the public sector), a variety of alluring “side effects” are envisioned (SSB 2012). Among them are the improvement of the quality of life and more streamlined and networked mobility services with various discounts.

One of the key benefits advertised (and considered necessary for the acceptance of the concept) is the “one card for everything”, or, as Fritz Kuhn, the mayor of Stuttgart, put it, getting rid of the “Kartensalat” (Recklies 2013) (card tangle). It is the alluring comfort of accessing all urban functions at one place with a single “password” (cf. Deleuze 1992), i.e. the polygo card and platform—from everywhere with just a few finger taps. Although for the time being mainly mobility services are available, this comfort is envisioned to be extended to services like access to leisure and sport facilities and the library, as well as to some city hall functions.

Public debate, however, is missing. The project is implemented ‘top-down’, by private companies, without public deliberation. While ‘top-down’ may not be per se problematic—although ‘the Internet’ and Silicon Valley entrepreneurs may try to convince us otherwise—, the potentially profound implications call for public deliberation. However, due to the project’s seductiveness, politicians can rightly assume broad support from citizens for becoming ‘smart’. Ironically, this fact seems to be in turn exploited by politicians to lure citizens into environment friendly mobility, to lessen the particulate matter and dust pollution in Stuttgart.

For the local government another aspect is vital: the competition of the Region of Stuttgart with other regions and cities. It is thus not surprising that the mayor sees polygo as a “product of innovation” (Recklies 2013) and the SSB presentation explicitly mentions place-making goals like image improvements, flagship project status and “Smart Business” efforts, i.e. placing the Region as a strong economic location. In addition to the inter-city competition, private online services offering for instance electronic journey planning and booking increasingly enter the market. The ‘smart city’ with its promises seems to be not only an alluring solution for cities to stay competitive, but also an imperative to keep the ‘smart city’ at least partially public.

6.3 Profoundness: a “milestone” towards a new culture of mobility?

The unobtrusiveness and absence of public debate suggest a lack of profoundness of the polygo project—despite claims of politicians of being a “milestone” (Recklies 2013). In fact, a cooperation on the marketing level between public transport and car-sharing services existed previously for two decades. The new model extends this cooperation to other service providers and to the sales level, a joint tariff however is not intended. Moreover, compared with public transport the capacity of car-sharing is minuscule and in the case of free-floating services also comes without any guarantee of availability. As such, the tighter integration of public transport and private car-sharing may rather benefit existing public transport users in edge cases (like, for instance, at times of less frequent public transport or when being late) than profoundly changing mobility patterns, like giving up a second car. Yet, luring citizens into switching modalities or at least to e-mobility is, of course, the long-term vision. As this step is motivated by seduction rather conviction, its profoundness in changing behavioural patterns is questionable. Furthermore, although e-mobility may lessen the environmental impact, it still produces particulate matter and may even have rebound impacts due to increased usage as it is supposed to be environment friendly (cf. Graham and Marvin 1999 about the rebound effect of teleworking). And although bike-sharing services are part of polygo: how safe and comfortable is it in Stuttgart to use the bike or walk to work? polygo, it seems, takes the easy way and avoids touching areas that could make a profound impact.

The project at its current state still lacks the overall ‘smart city’ idea of connecting various sectors. However, the platform and card are developed in a way that various other services can be integrated. In fact, this is already planned or even partially implemented, effectively using the existing spread of public transport subscriptions to push forward the transition to one card for all services. Consequently, polygo centralises various scales and sectors in one place (SSB 2012) and makes opting out difficult as it involves hurdles or financial disadvantages, or is even impossible for subscription users. Yet, as the cooperation of partners stays on a marketing and sales level, the power that comes with this centralisation is limited.

Other profound changes may happen in unexpected and unintended ways. Especially in combination with the unobtrusiveness and seductiveness, urban planning and governance is changed without much public deliberation. The ‘quick fix’, for instance, replaces struggles to make more streets bike- and pedestrian-friendly—or even -only. Similarly, technical ticket control devices in busses replace human (self) control. While this is certainly alluring to the operator, Morozov 2014 argues that technology replaces morality through so called situational crime prevention (SCP, that is making crimes impossible by design). The case in Stuttgart is not clear-cut, trains for instance lack the ticket control system, instead still relying on random human ticket inspection. However, the risk of the underlying point of “moral disability” (Kerr, in: Morozov 2014:195) still remains. These risks are rarely discussed, most public debate or concerns focuses around privacy and data protection. In fact, privacy regulation seems to be the only limiting factor—and in case of polygo a strong one.

7 CONCLUSION: STAYING DUMB, THE SMART THING TO DO?

The case of polygo in Stuttgart shows three aspects of the transition of mobility into ‘smart mobility’. Firstly, the transformations are alluring and seductive, as they promise improved services at lower costs, environmental benefits, a more direct access to urban politics and management, and thus increased participation possibilities for citizens as well as a higher quality of life. Secondly, they are unobtrusive: ICT is hardly noticed anymore and large parts of the deployed technologies are developed in closed and opaque ways by private tech companies, predominantly from the Global North. Thirdly, the restructuring is profound, affecting multiple sectors and scales and also increasingly centralising power and control, which limit not only the potentiality, but also the ‘impotentiality’ of citizens.

It is important to note that the technological aspect of the ‘smart city’ is not only shaped by overall ideas it is embedded in, but also seems to magnify them. ‘Internet values’, ‘solutionism’, and greater '-isms' like neoliberalism, entrepreneurialism, or cybernetics in turn play a stronger role in urban planning and governance. The rise of the ‘smart city’ thus calls for a debate beyond the extremes of a technophile or technophobe perception. This is particularly vital as the ‘Internet’ rapidly becomes the ‘Internet of Things’ and as such extends its reach substantially, spreading its “cult” (cf. Breton 2011) as well as culture of “amelioration” (cf. Morozov 2014) and quick technological fixes.

Undoubtedly, ‘smartness’ has its rightful place and benefits citizens in many vital ways, for instance in forecasting and responding to crises. Yet, its alleviation to a pervasive cult is risky. The pursuit of ‘smart’ order and certainties by replacing democratic conflict, struggle and debate with seductive technology may be alluring, but ultimately also leading to dumb citizens (cf. Sennett 2012). Paradoxically, especially the city has the potential to be a home for democratic struggles and a place for “cultivating a common citizenship” (cf. Sandel 2012). A not completely ‘smartened up city’ with its occasionally chaotic and messy urban experience and random encounters of differences (e.g. different opinions) may seem ‘dumb’, but may ultimately also turn out to be a smart thing to be for a democratic society.

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reviewed paper

URBIS Decision Support for Integrated Urban Governance

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1 ABSTRACT

The challenges for the management of cities and city-regions in addressing the economic and societal dynamics facing Europe and Europe's cities today is evident in the complexity and interconnectedness of the global and pan-European drivers of change and their associated socio-economic, environmental and territorial impacts for urban environments. Integrated urban management processes emphasising horizontal integration across the sectoral agencies at the local level, and vertical integration between government agencies from city to EU level is identified as critical to the management of the city-region in relation to the key political objectives defined at both local and EU levels.

The clear need for enhanced intelligence to support inter-agency collaboration and decision-making on territorial development as a central feature of integrated management is identified as a prime opportunity for URBIS solutions. Accordingly this paper presents an overview of the EU funded URBIS project (ICT PSP 2014–17) www.ict-urbis.eu. The project coordinated by GISAT, Prague investigates vacant land potentials in urban areas, and the opportunities for previously developed land or brownfield to support urban regeneration safeguarding greenfield sites. URBIS delivers assessment methodologies and tools to provide accurate up-to-date intelligence on urban vacant land opportunities that is comparable across European cities to support the definition and implementation of sustainable planning and governance strategies in cities and city-regions throughout Europe.

The background to this innovative research and city pilot development are growing pan-European concerns with land taken for urban use, which annually converts almost 1000 km2 of agricultural or natural land into artificial areas, as part of a wider European land degradation process. This land take process is driven by urban sprawl and infrastructure development, for example when new urban industrial or commercial areas are built on highly fertile agricultural land, rather than recycling abandoned or underused artificial sites. Land use efficiency is today a prime political objective at both European as well as city level, and the EU Land Communication aims to establish “zero net land take” across the EU by 2050. Central to the delivery of this policy is accurate intelligence on the availability and supply of previously developed “brownfield” land, as a key component of land-use decision making, maximising the net socio-economic benefits from land-use without degrading natural capital.

The core objectives of URBIS presented in this paper aims to deliver this intelligence via urban planning decision support tools methodologies and assessments to realise the development potential of vacant and underused land in urban areas.

Keywords: transition, integrated urban management, planning decision support tools, urban sprawl, urban vacant land

2 URBAN SPRAWL IN EUROPE

European urban and regional planning on all levels is increasingly being challenged by economic globalisation and this will continue to intensify over the coming decades. Traditional European cities have developed into regional agglomerations, but planning methods and the associated management tools have not progressed and these are still applied within a “traditional” model of land use planning and non-integrated environmental management. In addition, poorly integrated and unsystematic approaches in land use policies with limited linkage to environmental quality will further impact on the environmental problems seen in many European cites. It could also be claimed that this may increase land-related conflicts in densely urbanised regions and in turn seriously threaten the social function and competitiveness of all European cities and regions, including those in the new Member States. Moreover the current financial and economic crisis has the potential to enlarge land related problems due to the reluctance of financial institutions to take higher risks for projects in the existing urban context.

The never ending extension of built-up areas and migration of the population from rural to urban areas across Europe has been recognised as a long term trend as most of the economic activities are concentrated around major urban areas. A more recent trend is the migration of population and some economic activities from city centres to the urban fringe and neighbouring rural areas encroaching onto “greenfield” land, i.e. land that has not previously been developed. This phenomenon is referred to as urban sprawl and has been recognised as one of the most significant land use changes in the last two decades across Europe (EEA 2006). Urban sprawl is accompanied by the conversion of land to artificial surfaces resulting in soil sealing, thus further increasing the environmental consequences of urban sprawl. Indeed over this period, the extent of built-up areas in many western and eastern European countries has increased by 20 % while the population has increased by only 6 % (cf. Figure 1).

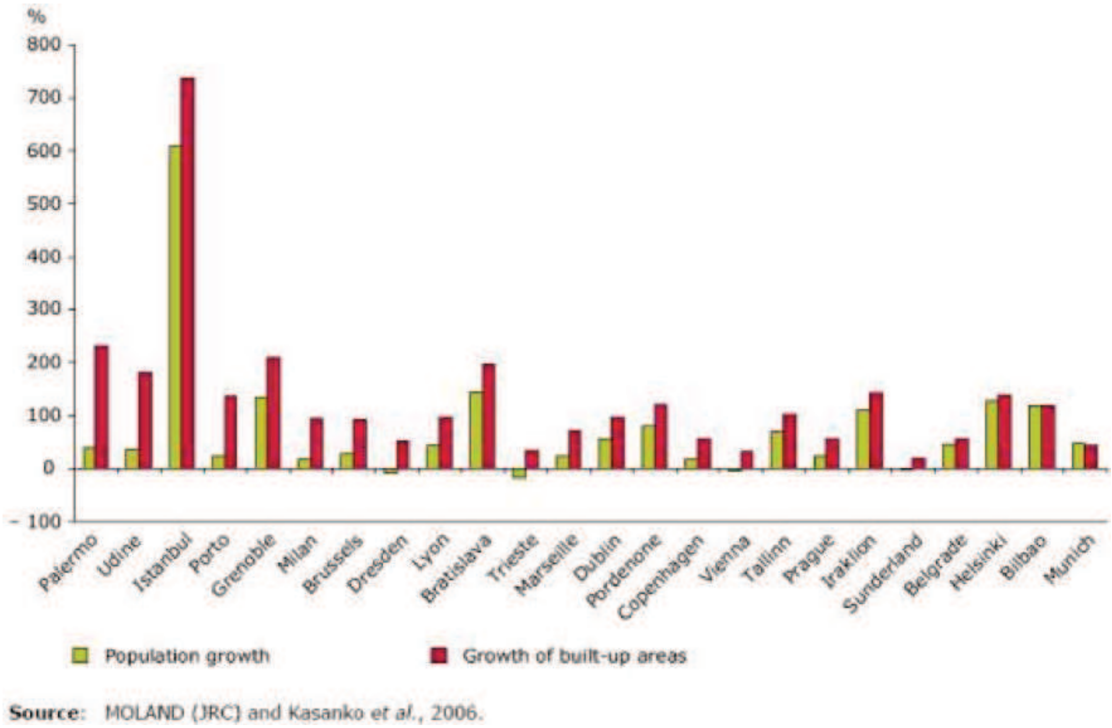

Figure 1:Population growth and the growth of built-up areas (mid-1950s to late 1990s), for selected European cities

The land and property market across Europe is a multi-billion Euro business. It is difficult to separate the land market from the overall real estate market, but a recent study undertaken by the EPF NPdC (Establissement Public Foncier Nord Pas-de-Calais, France) shows that in the Nord Pas de Calais region alone, the land property market amounted to 850 million Euros between 2000 and 2002, a 6% increase on the previous period 1997-99. The annual average land area developed represented around 1,000 ha. However, vacant land represents less than 1% of the total of land developed, despite an estimated 1,800 ha of vacant land available for redevelopment in 2006. Moreover, in another report linking urban sprawl and recycling of land, EPF NPdC estimated that if all 1,800 ha of vacant land located within the urban area was recycled it would save an equivalent of 8000ha of mostly agricultural land in the periphery of urban areas. This is possible because vacant land is already close to transport and utilities infrastructure, and so not requiring the construction of new infrastructure.

Unbalanced and uncontrolled development puts high risks on competing market led developments in the redevelopment of urban land and brownfield projects, and could lead to market failure as illustrated in several American cities (e.g. Detroit). These risks are also highlighted in a report by the RICS Foundation (RICS 2012) on the development of land and property markets in central and Eastern Europe where the Czech Republic and Poland are respectively ranked second and third in a combined growth and stability/risk indicator in the region. However, the authors of the report stress the importance of reliable market data and transparency.

At the same time, a significant proportion of artificial areas is not actively used and could potentially be redeveloped instead of encroaching on non-urbanised land. In this context, vacant sites are defined as previously developed land or derelict and vacant land and building sites. This includes any form of development, e.g. former housing estates as well as disused industrial or military sites as well as disused social or technical infrastructures. The term “vacant sites” is preferred to brownfields which are often associated with previous industrial or commercial sites that are potentially contaminated. In some cases, vacant sites can be represented by gaps in urban structures, without any current nor previous use. They can also include patches of agricultural or natural land surrounded by urban areas. Vacant sites are a natural reservoir of land that can potentially be redeveloped.

One important key to unlocking the vacant site potential is the provision of accurate and up to date land cover/use information. The implementation, validation and wide European adoption of specific inventory, typology and decision support services for vacant lands provide the basis for a system aiming at mitigating urban sprawl. URBIS services enable consideration of the land reuse strategies in the context of ecosystem services whereby the supporting, regulation, provisioning and ecosystem services provided by the vacant sites could be identified to inform future planning policy and decisions to foster a more holistic planning approach critical to sustainable urban development.

3 ROLE OF COPERNICUS LAND MONITORING CORE SERVICES (LMCS)

Vacant urban land can present very different characteristics depending on the level of development and previous use of the land. As a result, depending on size, location and previous use, vacant land may be redeveloped with minimum inputs (for example development of a green park from land with no previous use) or at the other extreme require substantial remediation work (for example development of a housing estate on potentially contaminated land). However, lack of knowledge about site conditions and characteristics typically hampers redevelopment, whatever its readiness for redevelopment. Although information exists locally, it is often patchy, incomplete and distributed between different organisations. Moreover, there is a lack of consistent information at the European level making it difficult to exchange and compare data. However, opportunities exist to overcome these constraints via the development of a methodology to develop a European information service on vacant land with the deployment of Copernicus LMCS. In particular, the Fast Track Services (FTS) on Land Monitoring developed by a number of EU research projects including geoland (1 and 2), and the follow-up GIO Land pan-European and local components (Urban Atlas 2012, High Resolution layers) introduce new more detailed layers of information focused on urban areas essential for the development of an information service aimed at identifying and characterising vacant and derelict urban sites. The development of such an information service will play a major role in the promotion of the recycling of existing urban sites, thereby directly addressing the reduction of urban sprawl.

Such an information service currently does not exist or is incomplete. In addition, the various initiatives that exist are locally based and lack a common methodology making it difficult to exchange and compare data. The availability of Copernicus LMCS open data makes it possible to develop new EO services for urban planning. In particular, availability of the GIO Land five High Resolution layers (Imperviousness degree for 2006, 2009 and 2012, tree density, grassland, water bodies and wetlands for 2012) and the Urban Atlas (2006 and 2012) combined with outputs from geoland2 regional and local Core Mapping Services (CMS) and Spatial Planning Core Information Services (CIS) concerning spatial planning provide realistic data to explore and build such a service. The Urban Atlas in particular with its characterisation of "land without current use" facilitates the development of the URBIS proposed vacant land inventory and typology information service. Furthermore, EO data acquired for LMCS services can be easily re-used to gather additional information about urban vacant land, which is not available in the Urban Atlas thematic layer so far (because it often lies under Minimum Mapping Unit of this dataset) as well as to tailor the proposed URBIS service to the specific thematic needs of the users. Without it, the development of such a service would be very costly and time consuming, and the level of sustainability on the data supply side would be questionable.

The Urban Atlas and other core services are primarily for use at European level, but URBIS is also focused on providing an information service relevant at the regional and local levels. In addition, other land cover/use data sources can be used as a basis for URBIS should they be available from user organisations.

4 OPEN DATA AND GIS

URBIS services will be built upon various sources of open geographical information data from local, regional, national and European level. According to the a recent communication paper from the European Commission (Com 2011) the market size and growth of the geographic information sector shows the potential of public data as an engine for job creation. The German market for geo-information in 2007 was estimated at 1.4 billion euro, a 50 % increase since 2003. In the Netherlands, the geo-sector accounted for 15 000 full time employees in 2008.

Recently, a number of initiatives have made it possible to open up the access to geographical information. At institutional level, these initiatives are encouraged globally notably through the GEO. The aim of GEO is to build a GEOSS whereby the duplication of data and initiatives is minimised through the development of a system of systems. In Europe, the GEO initiative is supported through Copernicus and INSPIRE. INSPIRE fosters interoperability between information services whilst Copernicus provides core information services on which to build value added services. The fact that most of the Copernicus core services adopt an open data policy facilitates the development of downstream services.

Crowd sourcing initiatives such as Open Street Map will also contribute to the development of URBIS services. Worth noting is that Copernicus core services were initially integrated in Open Street Map for areas where precise field observations were lacking such as in some Eastern European countries.

5 URBIS OBJECTIVES, SERVICES, USERS

5.1 Objectives

The URBIS project aims to develop, implement and validate in real environment innovative information services related to urban vacant land, based on open geospatial data, to support planning of European Large Urban Zone's (LUZs) in a sustainable way.

The specific objectives of the project are:

- Objective 1: To assess the potential reuse strategies of vacant urban land based on its past uses and characteristics and through wide involvement of end-user organisations, to establish common ground for the development of URBIS services.
- Objective 2: To develop a methodology for an inventory and typology of European vacant urban land based on Copernicus LMCS FTS Urban Atlas and soil sealing layers and the analysis of multi-temporal imagery to determine potential constraints to redevelopment.
- Objective 3: To develop, implement and validate interoperable services on a number of representative LUZs across Europe under operational conditions in collaboration with key European stakeholders/practitioners.
- Objective 4: To develop a sustainable operational and business model for the URBIS information services

The proposed service architecture is illustrated in Figure 2 below and shows the main sources of data for the planned URBIS services and linkages between EO based service providers, land development agencies, land use planning consultancies and end user organisations.

URBIS will rely primarily on the Copernicus LMCS FTS Urban Atlas, soil sealing layers and their associated source image data. In particular, the 'Land without current use' category of the Urban Atlas will be further investigated in combination with historical imagery to determine past use. In situ data when available will be sourced from land development agency partners and stakeholders and used to provide local knowledge and contribute to the development of a validation data set.

5.2 URBIS Services

The project will develop and implement three main categories of URBIS services:

(1) Baseline services: initial inventory and typology of urban vacant land, not only to identify sites that can be used for re-development, but also to identify sites that should be preserved and not used for further development (e.g. high ecological value). The inventory will be based on data from the Urban Atlas.

(2) Update services: an update service, with the regular update of the vacant urban land inventory synchronized with the planned Urban Atlas updates.

(3) Thematic services: a set of added-value services tailored to end-users (local authorities, policy makers).

In the initial phases of the project, a detailed assessment of end-users requirements was undertaken with following list of requirements identified:

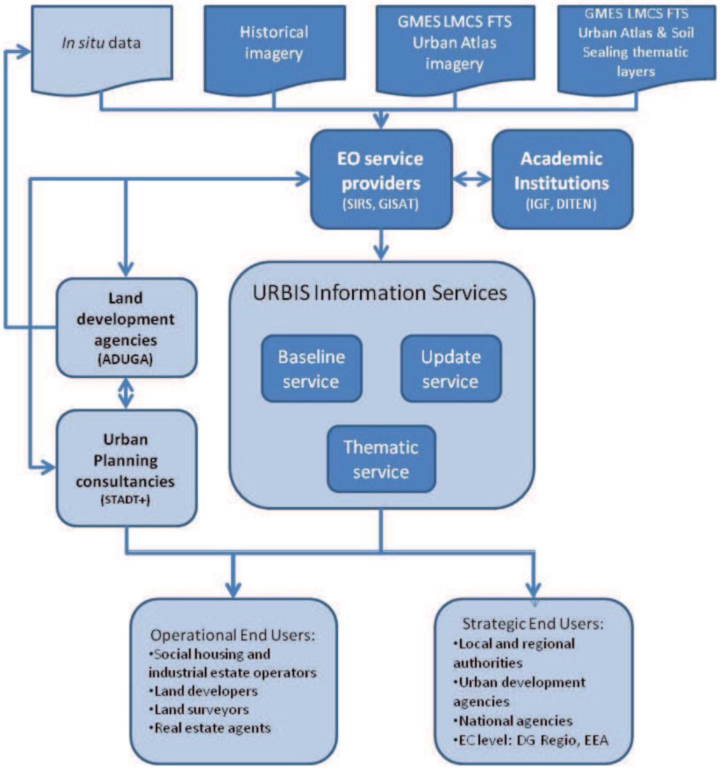

Figure 2: URBIS service architecture

(1) Identification of sub-optimally used or vacant sites

(2) Identification of inner development site potentials for new urban uses (residential, industrial, etc.)

(3) Identification of land use change dynamics (i.e. urban sprawl and urban green areas)

(4) Identification of site specific information (i.e. building material, object volume, etc.)

(5) Identification of site suitability for agricultural purposes

(6) Identification/monitoring of urban green areas (potential for city environment improvement)

(7) Automatic detection of the degree of soil sealing in urban areas

(8) Identification of risks which can limit future use of the vacant site/PDA

5.2.1 Baseline Services

Based on these requirements, as well as on the feasibility of source datasets and available methods, the following three layers representing three main domains of users´ interest were defined to create the URBIS baseline service:

- Green Layer: will include both vegetated and non-vegetated "gaps" in urban structure. A two-step approach is applied for preparation of this Green Layer. First, Urban Atlas polygons assigned to classes 13400 - Land without current use and 14100 – Green urban areas, selected as a first “basic” version of the Green Layer. This basic version of the layer will be limited by Urban Atlas MMU – 2500m2. For these polygons, site specific criteria describing each site, will be further calculated.

Second, sites smaller than this MMU, but larger than 500m2, will be detected, mostly using methods based on EO data analysis, to complement the basic version of the layer and create an enhanced version of the Green layer. This analysis will be primarily based on the original Urban Atlas imageries (SPOT5 Supermode, 2.5m pixel size), but also other ancillary data will be utilized..

- Grey Layer: will include brownfield sites identified on the basis of local brownfields surveys, with a help of OpenStreetMap or information incorporated in the Urban Atlas thematic layer; each brownfield site will be described by using a set of characteristics which can help to identify the

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potential for optimal future (re)use of the site. These characteristics will include the following site description:

- Physical properties (location, area, slope)
- Shape characteristics (convexity, rectangularity)
- Statistical and texture characteristics (vegetation index, imperviousness)
- Land cover (degree of sealing, characteristics of potential vegetation coverage, characteristics of non-vegetated surfaces)
- Land use (both current and previous)
- Existing development (number and area of buildings, existence of parking lots, existence of storage sites, degree of site deterioration)
- Existence of infrastructure networks (connection to infrastructure: water, electricity, heating, connection to street system)
- Surrounding local context (proximity to city and regional center, minimum distance to highway, main road or railway station)
- Environmental conditions (presence of environmental risk, contamination, presence of protected area)

- Urban Land Use Typology and Dynamics Service Results: this will include the information related to the characterization of urban land internal typologies, spatial patterns, and their dynamics. Urban Atlas thematic layers will be a primary source of information, but other thematic datasets will be considered as well. Besides the land-use and land-cover results already available in the Urban Atlas, state-of-the-art processing techniques for land-cover classification and multi-temporal analysis will be applied to the related source satellite data (in particular Urban Atlas imageries – SPOT5 and Pleiades) to derive detailed thematic maps of a restricted set of land cover classes with optimized classification accuracy especially in the case of very-high spatial resolutions.

5.2.2 Update Services

Update services are based on the same methodology as the baseline products, synchronized with Urban Atlas updates (year 2012).

In this regard a prime objective of URBIS is the implementation, testing and validation of the above mentioned services in real world environment of 3 Large Urban Zones (LUZ), geographically coherent with regards to partner's location, and which encompass a various set of specific criteria's and requirements in the field of vacant land reuse.

The 3 selected LUZs which will participate to these pilot studies are:

- Greater Amiens (France)
- City of Osnabruck (Germany)
- Moravian-Silesian Region (Czech Republic)

5.2.3 Thematic Services

URBIS baseline and update products will be used to derive a series of thematic services, which can be specific for different pilot studies. The type and detailed characteristics of these thematic services have been defined and developed in collaboration with end user organizations and will include the following:

Greater Amiens:

(a) Vacant land potential for local plan

(b) Brownfields' renewal potential

City of Osnabruck:

(a) Demolition costs

(b) URBIS Street Photos

(c) Activity Map

Moravian-Silesian Region:

(a) Analysis of urban free spaces (including vacant sites and green areas)

(b) Analysis of the urban spatial pattern and its dynamics

(c) URBIS Integration Tool (an interactive web tool which will permit the display and interactive analysis of the results of the URBIS services. This tool will integrate results of all three main domains of URBIS services (Green Layer, Grey Layer and Urban Land Use Typology and Dynamics) with other ancillary socio-economic datasets (e.g. Urban Audit) into user-defined visualizations or interactive analysis.

These types of services are also planned to be demonstrated at the EU level.

The definition and content of thematic services can be enriched by the experience of the implementation of the pilot studies during project, when the baseline and update services will be developed. This set of specific added value services will also target the private sector requirement, for example:

- Support the establishment of new business activities: logistic platforms, tertiary and commercial activities areas;
- Allow site identification for housing construction;
- Allow site identification to assist shrinking cities strategies (demolition/Interim Use concepts);
- Inventory of sites with conversion potential to green spaces;
- Identification of sites for creation of natural environments (protection of species, blue and green corridor).

5.3 Users of URBIS services

The first priority users of URBIS services are local and regional planners. In more general terms, end users in the URBIS context can be separated in terms of operational and strategic users.

- Strategic users: such as local and regional authorities, European and national agencies in charge of urban planning, would directly benefit from URBIS services as for the monitoring of the implementation of particular territory planning policy (e.g. the 30 ha goal on reduced land consumption in Germany). Furthermore, URBIS services may be used to support the allocation, monitoring and evaluation of ERDF funds in urban areas, or to assess to which extent urban development is meeting targets for the redevelopment of vacant sites.
- Operational users: such as industrial estates operators or private land developers are likely to require the URBIS services for meeting the requirements of a specific need such as a to know where suitable vacant sites are located within metropolitan areas greater than a certain size for the construction of supermarkets, or a local authority in charge of social housing looking for suitable sites for the construction of a new project. Financial institutions might be interested in general land data to improve project business plans. Sites from developers are also required to place renewable energy production. Regional and local planners also need information on the different vacant land development options as a critical component of urban and regional planning in relation to the management of urban sprawl, and more generally in relation to the creation of green belts, nature conservation and leisure areas and their connectivity.

URBIS will contribute to the development of a new market for EO derived information (vacant land inventory and typology) led by EO service providers, SME’s based on Copernicus products (LMCS FTS Urban Atlas and Soil Sealing layers) and addressing the needs of various stakeholders involved in land development at an operational and strategic levels

6 EU DIMENSION

This project is in line with the strategy proposed by the Commission to improve land use planning and management. Many reporting obligations in relation to international conventions (UNFCCC, UNCCD, Agenda 21, UNCBD, Ramsar convention) require land use/cover spatial data. Up until now, most of these reporting obligations were fulfilled by Corine Land Cover. However, new European legislation and policies such as the Water Framework Directive, the Soil Thematic Strategy, the Urban Environmental Management and the Thematic Strategy, European Spatial Development Perspective and the Biodiversity strategy, now require more detailed spatial information.

Reconciling land use with environmental concerns is a challenge that involves all governance levels and sectorial agencies. Monitoring and mediating the negative environmental consequences of land use while sustaining the production of essential resources is a major priority of policy-makers around the world.

In 1999, the European Spatial Development Perspective (ESDP) developed European policy orientations for territorial balance and cohesion, improved competitiveness, access to markets and knowledge, as well as the sustainable management of natural and cultural resources. More recently, integrated spatial development has been addressed by the Territorial Agenda of the EU that aims at mobilising the potential of European regions and cities for sustainable economic growth and job creation.

Efforts to modify land use practices to reduce non-point pollution of air and water include integrated river basin management and, in particular, the Nitrates Directive. Flooding caused by the construction of impervious surfaces (e.g. buildings and roads) and provoked by extreme weather events is addressed by a new European Floods Directive. The cross-cutting nature of land use is also emphasised by the EU rural development and regional policies.

Furthermore, the UNFCCC (UNFCCC 1997) Kyoto Protocol promotes among other practices the reduction of emissions of methane and nitrous oxide from agricultural land. EU policies on climate change adaptation are directly relevant to current and future land use practices and economic sectors depending on this.

The European Environment Agency report demonstrated that urban sprawl is a serious environmental threat evident in city regions throughout Europe. Each country has its own specificities in terms of land and urban characteristics and in terms of indicators and policies as well. Therefore, specific sets of expertise from individual regions are required to develop the URBIS information service based on a common, consistent and up to date Europe wide inventory and typology of vacant urban sites.

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Virtual 3D City Model Support for Energy Demand Simulations on City Level – The CityGML Energy Extension

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1 ABSTRACT

Due to the transition from fossil energy carriers to more renewable energy resources, the availability of energy in future will be fluctuating. Under these conditions, an accurate energy demand simulation for buildings is strongly needed as planning instrument on district or city level. This paper introduces a new data model for the energy relevant properties of buildings. It extends the existing standard CityGML for 3D city models by energy relevant properties like, e.g., physical materials, thermal zones and thermal boundaries, and building occupant's behaviour. The energy extension of CityGML is designed as system-independent interface to energy simulation systems and shall support detailed simulation on the level of single buildings as well as energy demand assessments on district and city level.

Keywords: 3D Model, Virtual Reality, CityGML, Energy Demand, Simulation

2 INTRODUCTION

Actually, one of the biggest challenges for cities is the implementation of the German energy transition process. In future, energy will more and more be produced by fluctuating, renewable sources like solar or wind energy. Under these conditions, an accurate energy demand simulation for buildings is strongly needed as planning instrument on district or city level. Potential application areas for such simulations are the planning of energetic renovation measures or of infrastructures like district heating systems.

For simulating or estimating the energy demand on district or city level, normally the same techniques and software tools are used as for single buildings. Simulation systems like TRNSYS (TRNSYS 2016) or EnergyPlus (ENERGY+ 2016) are based on a physical model of a building, describing the heat or energy exchange and conversion within the building and between the building and its environment. In order to apply such a model on a concrete building, a number of input data must be available. They can roughly be separated into four categories:

- Parameters describing the building geometry and its location in the 3D world;
- Parameters describing the physical condition of the building, especially heat capacity and thermal transmittance of exterior and interior building elements (walls, slabs etc.) and optical properties of windows;
- The weather conditions (e.g. temperature, solar radiation, wind speed) on the building's location;
- The behaviour of the buildings occupants.

An exact determination or prediction of all these parameters and influence factors is difficult and sometimes (e.g. for future weather conditions and occupants behaviour) only possible in a limited way. For the generally needed model simplifications, national regulations like the German norm DIN V 4108-6 (VDI 4108-6 2003) exist. The usage of such norms shall ensure that building energy estimations performed by different persons, eventually using different software systems, result in comparable results. All national norms try to minimize the needed effort to determine the input parameters of the simulation. Thus, one must be aware that the calculated energy amount may under- or over-estimate the actual situation significantly.

In using such systems for simulating groups of building, additional problems occur. On the one hand, in this case also the mutual influence of neighbouring buildings (e.g. shadowing, closed development) should be taken into account, which normally is not possible with existing simulation tools. The most significant problem normally is the availability of reliable input data. In the case of single buildings, missing information in principle can be collected by measurements or by interviewing the building owners /

occupants. For simulations on district or city level, this is normally impossible due to effort reasons and privacy protection restrictions.

To enable software systems to perform energy simulation under these conditions, a number of methods have been developed (Carrion 2010) to estimate missing parameters on base of a few existing data like, e.g., the year of construction of a building, its function, or statistical data from a census. For these estimations and derivations no standards exists, they normally are performed heuristically by the user of the simulation system or even automatically by the software. In consequence, the reproducibility of energy simulations for groups of buildings is poor, which strongly reduces the reliability of the results.

This paper describes a new approach for enhancing quality and reproducibility of energy simulations for single buildings, city quarters or whole cities. Central approach is the specification of a system-independent ("neutral") data model, being able to represent all input data for a simulation as well as the generated simulation results. The possible usage of this data model shall be independent from quality and amount of available input data and the used physical building model. By a standardized description of simulation parameters, it becomes transparent which data are actually used in a specific simulation, and the influence of model simplifications and estimations of unknown parameters on the simulation results can be examined.

In chapter 3, the needed input data for a reliable energy demand simulation are described, and the city-wide availability of these data is analysed. It turns out that virtual 3D city models, frequently available in the internationally standardized data format CityGML (CityGML 2012), are the most important input sources. Chapter 4 therefore gives a short overview on this data model and the availability of corresponding data, depicting that CityGML represents location and geometry of the building and its components (e.g. walls, roof, and ground slab), but lacks the representation of most other energy relevant building parameters. CityGML inherently supports a mechanism for application specific extensions (van den Brink et al. 2014) of the base standard called "Application Domain Extension" (ADE). This mechanism is actually used by an international consortium to specify the "Energy ADE" as standardized data model for energy relevant building data. The actual version 0.6.0 of this model (Nouvel et al. 2015 a, Nouvel et al. 2015 b) is introduced and discussed in chapter 5. Chapter 6 summarizes the paper, and gives an outlook to the next versions of the Energy ADE.

3 INPUT DATA FOR ENERGY SIMULATIONS ON BUILDING AND CITY LEVEL

In the following, the different types of input parameters needed to simulate the energetic performance of a single building are described.

3.1 Building geometry, location and orientation

Geometry, location and orientation of a building are important parameters influencing its energetic performance. The building's position determines the anticipated weather or climate conditions (see chapter 3.5) as well as additional effects of the neighbourhood like, e.g., shadowing. For incorporating effects of solar radiation, the orientation of the outer shell, especially of windows is essential.

An additional set of parameters is determined by the building geometry. The overall heating and cooling demand of a building is essentially determined by the occupied building volume. In many cases, the whole building is assumed to be thermally homogeneous ("one-zone model"). For more detailed simulations, it is necessary to regard multiple, (thermal) variably used regions ("thermal zones") within the building ("multi-zone model"). It is assumed that a thermal zone is isotherm, which means that heat exchange can only occur via its boundaries ("thermal boundaries"). These boundaries can be internal (between two adjacent zones) or external (between a zone and the outside world). In order to simulate the energy exchange, the volume of the zones as well as size, orientation and topology of the thermal boundaries must be known.

3.2 Building physics

The most important physical parameters determining the energetic behaviour of a building are the overall heat capacity of the building structure and the thermal transmittance of the outer shell. For taking into account heat losses and gains due to radiation, the optical parameters of the windows (reflectance, transmittance and emittance for different spectral regions) are needed as well. For multi-zone models, the same information is required for internal thermal boundaries.

3.3 Building occupants behaviour

Though the behaviour of the building's occupants significantly influences the energy demand, it is quite difficult to determine it in an objective way. In principle, at least the following effects must be considered:

- The temporally varying usage of the whole building or the different thermal zones. This can for instance be expressed by time-dependent schedules of the nominal temperature, ventilation rate, or the shading of windows.
- Energy consumption due to building systems different from heating and cooling, e.g. hot water production, cooking, usage of electrical appliances or lighting.
- Occupant dependent energy gains (internal gains).

3.4 Energy relevant building systems

For very detailed simulations, also the different energy conversion systems of a building need to be taken into account. The following effects influence the overall energy balance:

- Many systems are simultaneously energy producers and consumers. For example, a heat pump consumes electricity to produce thermal energy.
- Every energy transmission system has always an efficiency factor of less than 100%.

3.5 Weather and climate data

The meteorological conditions at the building position strongly influence the needed amount of heating and cooling energy. Most simulation systems use the following parameters: Air temperature, wind speed, humidity, direct and indirect solar radiation (Hensen & Lamberts 2011).

Depending on the type of simulation (static or dynamic), the meteorological parameters must be available as long term averages (e.g. monthly or yearly values), or as series of time-dependent values for one year. In the latter case, the time resolution typically is one hour. It is possible to use either "real" values based on measurements in a certain year in the past, or "typical" values, representing average climate conditions (Meteonorm 2016).

3.6 Data availability on city level

Table 1 shows in an overview the availability of the different input data categories and denotes the most important data sources for city-wide data. Best available are weather and climate data. National agencies like the Climate Data Center (CDC) of the German "Deutscher Wetterdienst" (DWD) provide several metrological parameters with high temporal resolution (CDC 2016). It is possible to get "real" measurements related to concrete time periods, as well as data sets for "Test Reference Years" (TRY) (BBR 2014). These are specially compiled data sets containing various meteorological parameters for every hour of a year. They represent average, but for a year typical weather conditions. In addition, time series representing an exceptionally cold winter half-year and an exceptionally warm summer half-year are available. Measurement and TRY data sets are available for a number of sites representing different German climate regions.

Aspect	Availability	Data source
Building geometry, location and orientation	+	3D city models
Building physics	-	Year of construction Building typology
Building occupants behaviour	-	Building function Statistical demographic data
Energy relevant building systems	--	Not available
Weather and climate data	++	Weather agencies like "Deutscher Wetterdienst"

Table 1: Data sources and availability of energy relevant building properties

The city-wide availability of geometry-related building data is also quite good. Central data source are virtual 3D city models, which in many German municipalities are area-wide available in the CityGML format. However, as it is further discussed in chapter 4, the actually existing CityGML models do not use the full functionality of the data model and do not fulfil all requirements of a detailed energy simulation.

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Editors: Manfred SCHRENK, Vasily V. POPOVICH, Peter ZEILE, Pietro ELISEI, Clemens BEYER

For all other relevant aspects of a building energy simulation, the city-wide availability is poor. Information concerning the physical characteristics of the building, the equipment of a building with energy consuming or producing systems, the number of occupants and their energy relevant behaviour is, if any, only available in exceptional cases. In some cases, procedures are known to estimate the needed information on base of available data. In particular, the heat transmission coefficients of the building facade and optical parameters of windows are often derived from the building's year of construction and its form typology. The occupants influence can (very roughly) be estimated from the building function, normally documented in the cadastre, and global demographic data taken from a census or microcensus.

4 THE CITYGML STANDARD FOR VIRTUAL 3D CITY MODELS

As discussed in chapter 3.6, virtual 3D city models in the CityGML format are an important source for energy simulations on district or city level. CityGML is an international data exchange standard of the Open Geospatial Consortium (OGC), based on Geography Markup Language version 3.1.1 (Cox 2004) for exchanging spatially related data. CityGML claims to represent all aspects of a city geometrically and semantically. Besides buildings, this also includes the terrain, traffic areas, infrastructure objects like bridges, tunnels or city furniture, and natural city objects like vegetation or water bodies. Furthermore, CityGML implements a methodology for application specific extensions called Application Domain Extension (ADE). An ADE, which is represented by one or more XML-schemata, not only allows to specify new classes in extension of existing ones, it is also possible to extent the attributes and relations of existing CityGML classes.

4.1 The CityGML Building module

This paper concentrates on buildings, because energy consumption of the traffic sector is not regarded and other kinds of city objects only indirectly influence the city-wide energy balance, e.g. by shadowing effects or influencing the micro climate. The CityGML module "Building" allows to represent buildings in 5 Levels of Detail (LoD), differing in the geometrical resolution and the semantic modelling depth (see Figure 1). In all LoD, a complex building may be separated in different building parts. Because the data models for buildings and building parts are identical, in the following the term "building" is used for both.

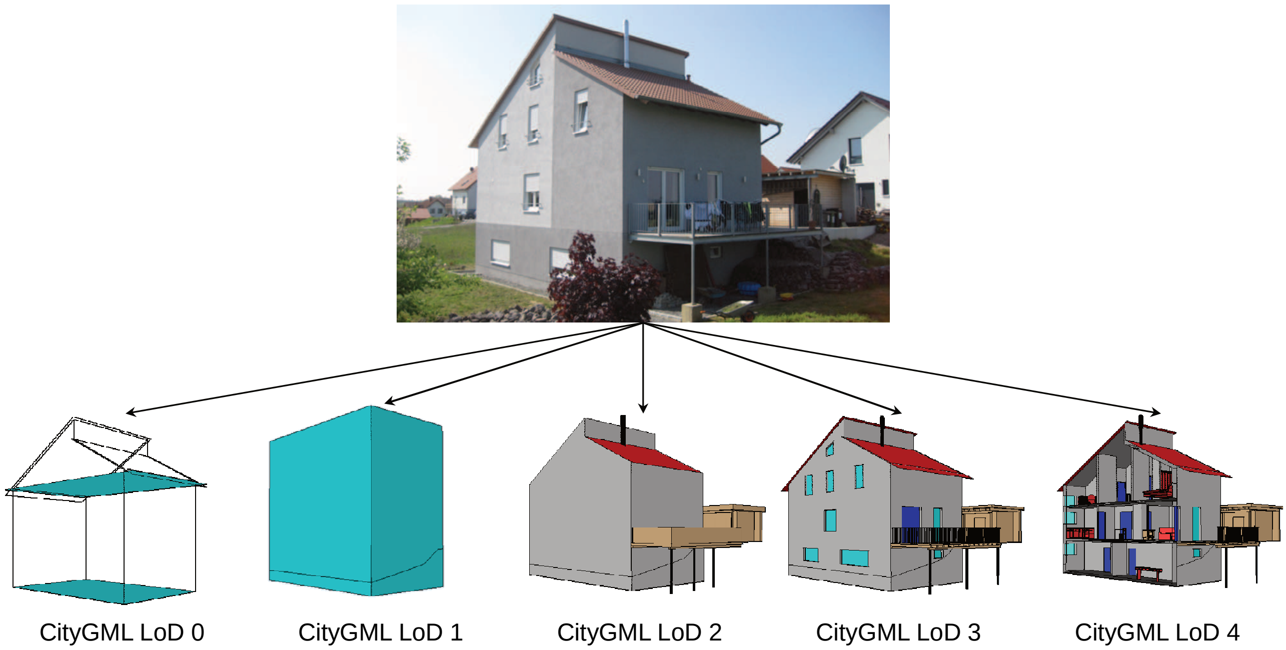

Figure 1: Representation of a building in 5 different Levels of Detail

Each building optionally has a number of attributes, allowing to specify its function, actual usage, year of construction, roof type, overall height, number and height of storeys. The five supported LoD of a building differ in quality and resolution of the geometric representation and the sematic structuring of the geometry. In LoD 0, the footprint or roof edge of the building are geometrically represented as horizontal surfaces. LoD 1 supports a fully 3D representation of a building as block model, where the building's footprint is vertically extruded to, e.g., the eaves or ridge height. In LoD 2 and higher LoD, the exterior shell of a building is not only represented geometrically, but can also be composed of semantic objects like wall-, roof- or ground surfaces. These "boundary surfaces" are geometrically represented as surfaces and carry no thickness or material information. Smaller features of the building significantly affecting its characteristics can be separately represented as "outer building installations".

LoD 2 realizes a geometrically generalized representation of the exterior shell, while LoD 3 calls for a geometrically exact representation. Furthermore, an explicit geometrical and semantical modelling of openings in the outer building shell (doors or windows) is possible from LoD3. As for the exterior boundary surfaces, it is not possible to attach energy relevant properties like a glazing ratio or optical parameters to openings. In LoD4, also the representation of interior rooms is possible. The volumetric geometry of a room can be subdivided into boundary surfaces (floor, interior wall and ceiling surfaces), and interior equipment (installations, furniture) of a room can also be modelled.

4.2 Availability of CityGML building models

Though CityGML principally supports 5 different LoD, city-wide available data mostly fall into the categories LoD1 and LoD2. The reason is that for these models an automatic generation based on existing cadastre data and (in the case of LoD2) airborne laser scanning or photogrammetric measurements of roof surfaces is possible. The generation of LoD3 and LoD4 models needs much more effort, and corresponding data are only available for some landmarks.

5 THE CITYGML ENERGY EXTENSION (CITYGML ENERGY ADE)

In this chapter, the CityGML extension supporting energy simulations is discussed in detail. Functionally, the following components can be identified in the data model:

The extension of CityGML base classes by energy relevant properties and relations to new energy related classes (see chapter 5.1).

- Classes to represent thermal zones and corresponding thermal boundaries (see chapter 5.1).
- Classes to represent physical materials and layered wall constructions (see chapter 5.2).
- Classes to represent the energy relevant behaviour of building occupants (see chapter 5.3).
- Classes to represent the building's energy demands and energy conversion systems (see chapter 5.4).

Furthermore, the Energy ADE implements some technical concepts, e.g. to represent schedules and time series, which are not discussed here.

5.1 General structure of the CityGML Energy ADE

Figure 2 depicts the general structure of the new data model, especially documenting the relations between the central classes. For better readability, the attributes of these classes are not shown. The different colours of the UML (Unified Modeling Language) elements in Figure 2 indicate the corresponding ADE module (see Table 2).

Four different CityGML classes have been extended with additional attributes:

- The extension of the CityGML base class (class _CityObject) enables that all derived classes can refer to energy demand information (class EnergyDemand, see chapter 5.4) and material information (class Construction, see chapter 5.2).
- The CityGML base class for buildings (class _AbstractBuilding) is extended by a number of energy related properties. Among others these include some specific building height values (ridge height, eaves height, average ceiling height), information on the conditioning of attic and basement, the building typology (e.g. single or multi family house), and information on refurbishment measures performed. The extension also allows relating a building with the new classes for energy conversion systems (class EnergyConversionSystem, see chapter 5.4) and occupant behaviour (class UsageZone, see chapter 5.3).

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Editors: Manfred SCHRENK, Vasily V. POPOVICH, Peter ZEILE, Pietro ELISEI, Clemens BEYER

- Refurbishment information is also added to the CityGML base class for boundary surfaces (class _BoundarySurface). Furthermore, time series for the global solar irradiance and the daylight illuminance can optionally be specifies for any boundary surface.
- The CityGML base class for doors and windows (class _Opening) is extended with refurbishment information and shading parameters.

For the modelling of thermal zones, three new classes have been defined. A building can refer to an arbitrary number of thermal zones (class ThermalZone). Each thermal zone is characterized by geometric parameters (gross volume, net volume, floor area), and physical parameters specifying its thermal capacity, infiltration rate and thermal bridges. The information whether the zone is heated and/or cooled is provided. Optionally, also the volumetric zone geometry and the list of rooms related with the zone can be represented.

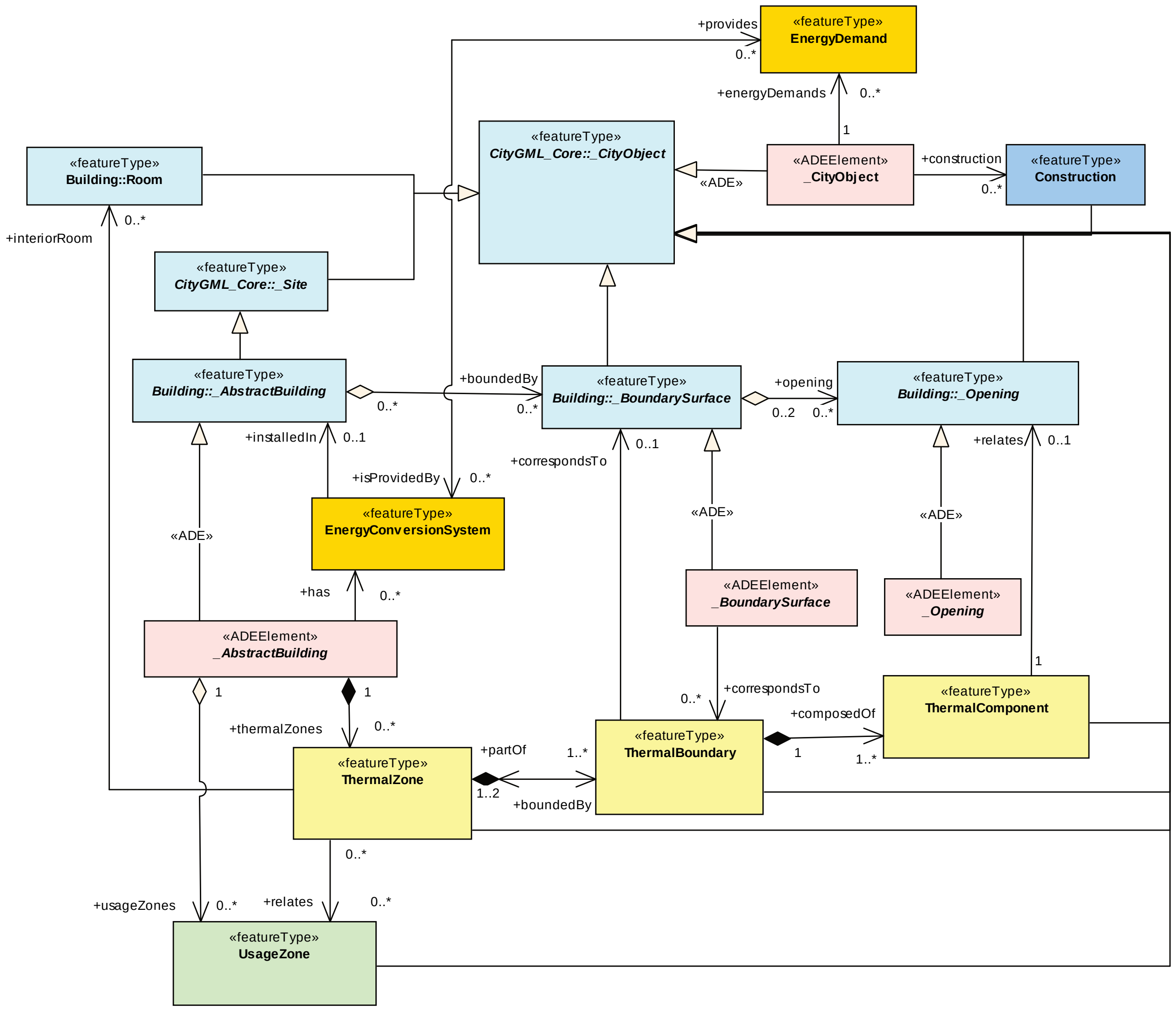

Figure 2: Energy ADE core model

	CityGML base classes
	Extension of CityGML base classes
	Thermal zoning
	Material
	Occupant behaviour
	Energy conversion systems

Table 2: Colour codes used in Figure 2 - Figure 5

It is mandatory to represent the boundaries of thermal zones by the class ThermalBoundary, which optionally can be related with a physical boundary surface. Attributes of ThermalBoundary are its orientation (azimuth and inclination angles), and the thermal boundary type. This type indicated whether the boundary represents an exterior wall, a roof, a shared wall between adjacent buildings, or some kind of interior thermal boundary. If a thermal boundary is composed of different components (e.g. solid wall parts and windows), these can individually be represented by the class ThermalComponent.

5.2 Materials

The new class Construction (see Figure 3) in the most general case describes the different material layers of a construction. If no layer information is available, the energetic performance of a building element can also be specified by a global thermal transmission coefficient (U-value) and a number of optical parameters. Each material layer (class Layer) can consist either of one homogeneous material, or a mixture of materials. The corresponding class LayerComponent carries a thickness value and is related to exactly one material. Actually, two different types of materials are considered. Solid materials (class SolidMaterial) are characterized by physical parameters like density, thermal conductivity and specific heat. Materials with negligible density and heat capacity (class Gas), are described by their thermal resistance (R-value).

If the layer order shall be applied in the reverse order (e.g. in case of interior thermal boundaries), the class ConstructionOrientation can be used.

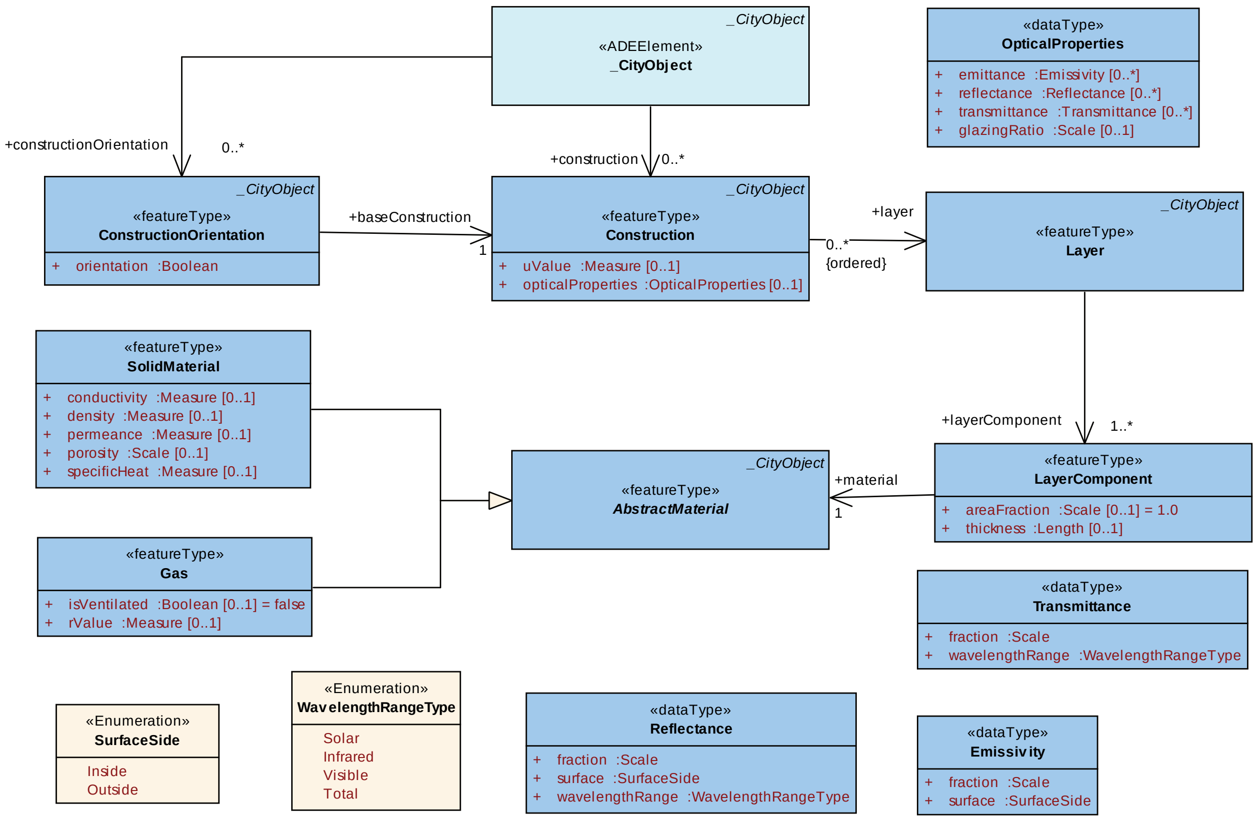

Figure 3: Energy ADE Material module

5.3 Building occupant behaviour

Figure 4 shows the classes to represent the occupants of a building and their behaviour, as far as it is relevant for an energy simulation. Central concept is to define regions of homogeneous usage (class UsageZone), which are referenced by the class ThermalZone. For each usage zone, arbitrary schedules for heating, cooling and ventilation may be prescribed, as well as the total internal energy gains due to the occupants. For more detailed simulations, the individual occupants of the usage zone and the corresponding households can be represented. The class Facilities allows considering the heat dissipation caused by hot water production, electrical appliances and lighting.

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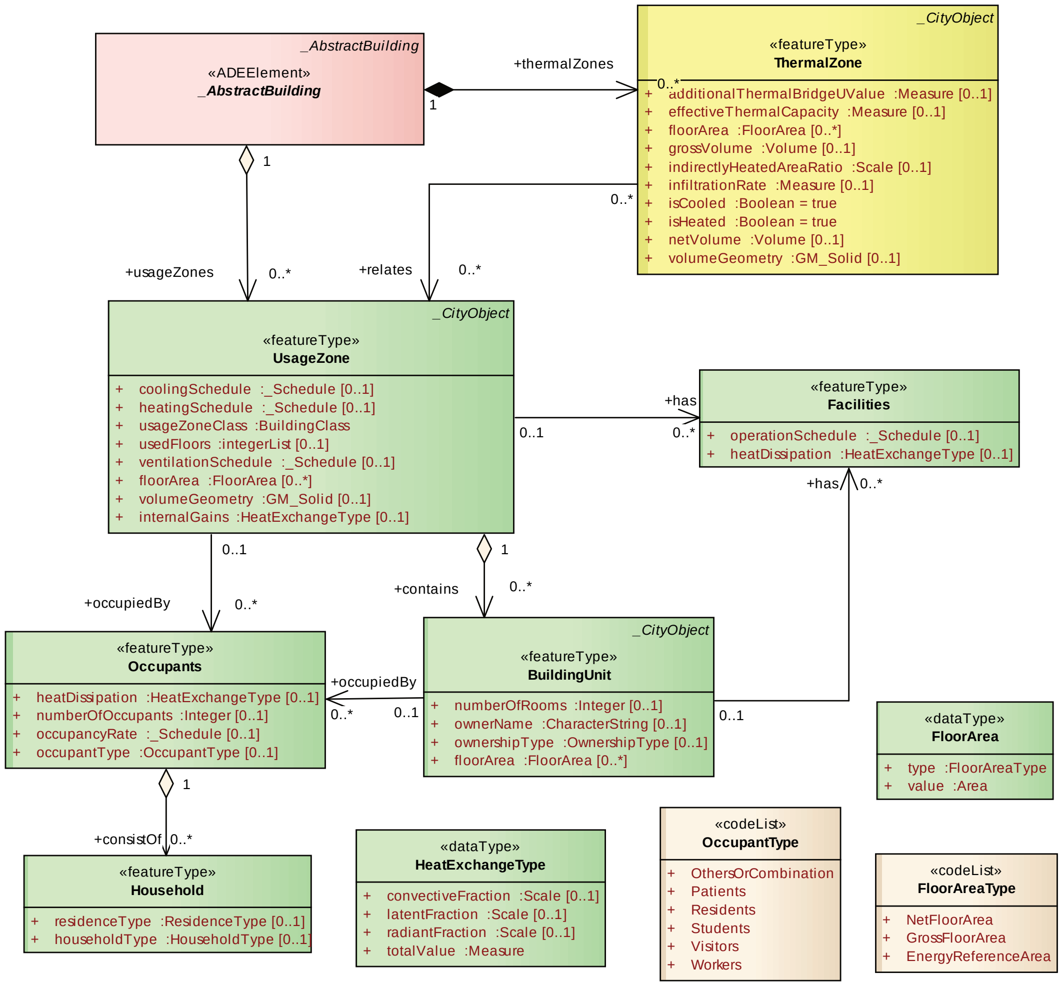

Figure 4: Energy ADE module "Occupants"

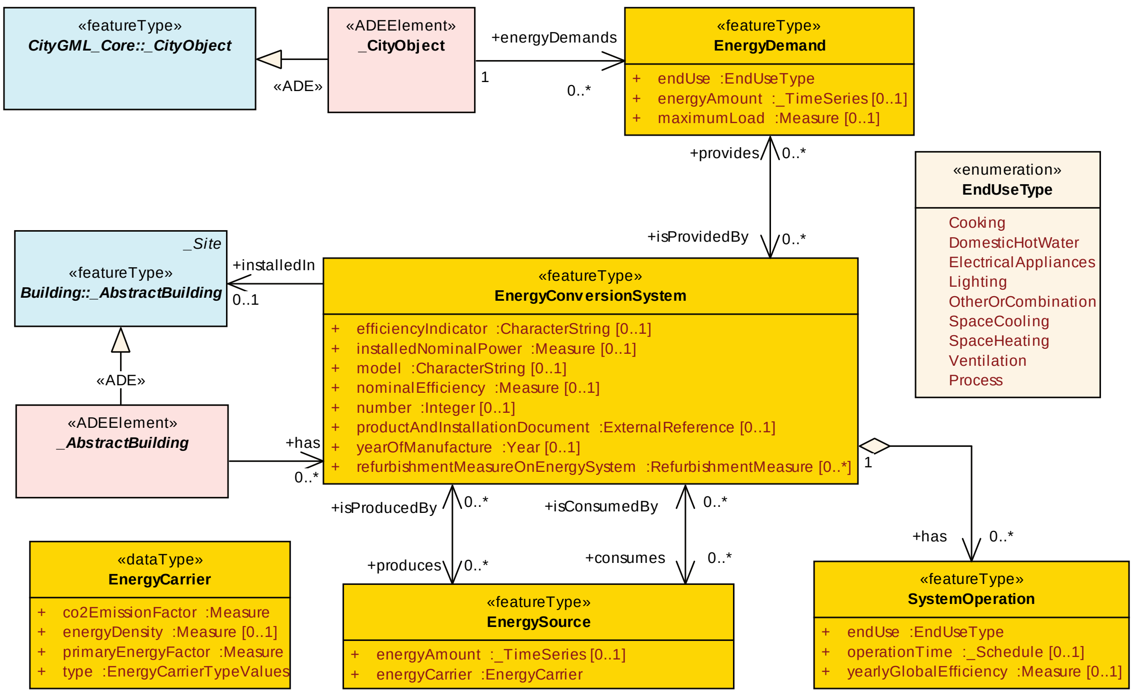

Figure 5: Energy ADE module "Energy system"

5.4 Energy conversion systems in buildings

In Figure 5 a very simplified UML model of the classes for the energy conversion systems of a building is depicted. The central class EnergyConversionSystem has properties for efficiency measures, for age, type and manufacturer of the system, and for refurbishment measures performed. Specific energy conversion systems like, e.g. boilers, heat pumps or district network substations are modelled by specific classes (not shown in Figure 5) derived from EnergyConversionSystem.

By using different energy sources (class EnergySource), it is possible to represent that a conversion system simultaneously produces and consumes energy. For each specific end use type (e.g. space heating, domestic hot water or cooking), it is possible to prescribe usage time schedules of the system. In combination with the properties of the energy carries (data type EnergyCarrier) this enables to calculate the total amount of consumed or produced energy and the CO2 footprint.

The data model furthermore supports modelling the energy demand related with a specific end use (class EnergyDemand). The corresponding time series may contain either measured energy amounts or simulation results. The CityGML extension mechanism enables to attach energy demands either to the whole building or to a sub-structure like, e.g. a room, a thermal zone or a usage zone.

6 SUMMARY AND CONCLUSION

For the holistic consideration of the energy performance of buildings it is not enough to focus on the building itself but, also to examine the neighbourhood on district or even on city level. Neighbourhood buildings can influence the energy consumption of a building, and the given or planned infrastructure can affect the selection of the building services and therefore the energy efficiency.

CityGML, as an established 3D city model, provides a good basis for such comprehensive considerations. At least in Germany, CityGML models (LoD1 and LoD2) are widely available from official agencies. Another big advantage of CityGML is the ADE mechanism, which allows the data model to be extended by own properties and features.

This ADE mechanism was used to extend CityGML by properties and features, which are relevant for energy simulations and estimations. After identifying the gaps of CityGML regarding energy simulation, a new UML based data model was created. For clarity reasons the model was structured into four parts: Core, Materials, Occupant Behaviour and Energy Systems. An overview of these parts is given in this paper.

Finally, after discussions within the Energy ADE development group, the version 0.6.0 of the extension has been released. For this version, the CityGML ADE schema including an online feature catalogue was automatically generated. Details of the CityGML Energy ADE can be found in the Github of the development group (https://github.com/cstb/citygml-energy) and the CityGML Wiki (http://www.citygmlwiki.org/index.php/CityGML_Energy_ADE).

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Web Data Extraction Systems versus Research Collaboration in Sustainable Planning for Housing: Smart Governance Takes It All

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1 ABSTRACT

To date, there are no clear insights in the spatial patterns and micro-dynamics of the housing market. The objective of this study is to collect real estate micro-data for the development of policy-support indicators on housing market dynamics at the local scale. These indicators can provide the requested insights in spatial patterns and micro-dynamics of the housing market. Because the required real estate data are not systematicly published as statistical data or open data, innovative forms of data collection are needed. This paper is based on a case study approach of the greater Leuven area (Belgium). The research question is what are suitable methods or strategies to collect data on micro-dynamics of the housing market. The methodology includes a technical approach for data collection, being Web data extraction, and a governance approach, being explorative interviews. A Web data extraction system collects and extracts unstructured or semi-structured data that are stored or published on Web sources. Most of the required data are publicly and readily available as Web data on real estate portal websites. Web data extraction at the scale of the case study succeeded in collecting the required micro-data, but a trial run at the regional scale encountered a number of practical and legal issues. Simultaneously with the Web data extraction, the dialogue with two real estate portal websites was initiated, using purposive sampling and explorative semi-structured interviews. The interviews were considered as the start of a transdisciplinary research collaboration process. Both companies indicated that the development of indicators about housing market dynamics was a good and relevant idea, yet a challenging task. The companies were familiar with Web data extraction systems, but considered it a suboptimal technique to collect real estate data for the development of housing dynamics indicators. They preferred an active collaboration instead of passive Web scraping. In the frame of a users' agreement, we received one company's dataset and calculated the indicators for the case study based on this dataset. The unique micro-data provided by the company proved to be the start of a collaborative planning approach between private partners, the academic world and the Flemish government. All three win from this collaboration on the long run. Smart governance can gain from smart technologies, but should not loose sight of active collaborations.

Keywords: housing dynamics, policy supporting research, research collaboration, smart governance, web data extraction system

2 INTRODUCTION

The complexity and multi-dimensionality of societal and environmental challenges, such as climate change and resource scarcity, challenge spatial planning towards more collaborative planning in which private and public actors converge towards a collective future (Aarts and Leeuwis 2010; Polk 2015). Spatial planning increasingly seeks to activate stakeholders for knowledge production and for the development of down-to-earth visions and policies.

One way to support such collaborative planning is the evolution towards 'Smart Cities'. The concept 'Smart Cities' refers to cities where digital technology and information is deployed for a more efficient use of resources. The use of digital technologies better equips cities to plan their future, taking into account new forms of governance, financing mechanisms and data exchange. The evolution towards Smart Cities goes together with the rise of an 'Open Data' culture. Data must be (1) available and accessible (e.g. at a reasonable price and in a handy and adjustable format or through download from the internet); (2) presented under conditions that allow the reuse and redistribution (including the merging with other datasets); and (3) data availability is universal, e.g. everyone must be able to use, reuse and redistribute the data (Bauer and Kaltenböck 2012; Khusro, Jabeen et al. 2014).

To make Smart Cities happen and work, we believe that research collaboration is a powerful approach. Transdisciplinary research projects for example aim at the creation of new knowledge on a common question through collaboration between research and non-research partners (Katz and Martin 1997; Tress, Tress et al. 2005). In this paper we use the European definition of transdisciplinarity that focuses on the involvement of non-academics in research (Darbellay 2015; Zscheischler and Rogga 2015). This involvement can range from including stakeholders in the research as advisors, informants and users; to actual transdisciplinary co-production where solutions to (urban) planning problems and visions for (urban) planning are co-created by different actor groups (including policy-makers, administration and business) (Albrechts 2013; Polk 2015).

Transdisciplinary research is gaining momentum in the realm of sustainable land use management and spatial planning. This seems part of a broader movement towards more collaborative planning, with approaches such as collaborative planning (Healey 1997; Healey 1998), fuzzy planning (De Roo and Porter 2007), adaptive co-management (Olsson, Folke et al. 2004), strategic planning and co-production (Healey 2004; Healey 2007; Albrechts 2013).

Almost parallel to this evolution towards more collaboration, a ‘sustainability-turn’ appeared in planning in reaction to the undesirable environmental and societal effects of continuous housing development (Berke 2002; Atkinson-Palombo 2010). Spatial efficiency popped up as a new concept in planning, and the increase of residential densities in both new-growth areas and existing neighborhoods through densification is considered a solution for the space consuming effects of urban sprawl (Gallent 2009; Flemish Government 2012).

Pursuing sustainable planning solely through densification programs will probably lead to strategic gaps. In-fill developments may indeed preserve valuable larger units of agricultural and natural open space from further urbanization. However, often abstraction is made of the importance of smaller open spaces – be it public, semi-private or private - for the environmental quality of life and support of ecosystem services in urban areas (Ståhle 2010; Oktay 2012; Dewaelheyns, Vanempten et al. 2014). So, space efficient strategies in planning should not only focus on urban densification through the development of new housing on (remaining) urban open spaces, but also through the intensification of the existing housing stock.

Housing is one of the main drivers of spatial development and transformation, besides employment and mobility (European Environment Agency 2006; European Environment Agency 2013). While land-use changes and urbanization processes proceeding spatial transformations are widely documented (Engelen, Lavalle et al. 2007), the underlying micro-dynamics of housing are less investigated. Current and future housing requirements reflect changing ambitions, expectations, values and wishes. Property prices for example are a sign of these accumulated desires of individual citizens to live and work in a particular location, and to commute between both (Gallent 2009). Any spatial efficiency strategy focusing on housing requires more quantitative and qualitative insights in the local dynamics of the housing market, and planning should pay greater attention to price signals and imbalances between supply and demand on the housing market (Barker 2004; Gallent 2009).

To date, there are no clear insights in the spatial micro-dynamics of the housing market. Nevertheless, policy-support indicators could measure them. The research objective of this study is the development of a proof-of-concept of two ‘open’ (e.g. freely available and accessible) policy-support indicators, speed of sale and listing price, that allow insights in the micro-dynamics of the housing market. For the development of these indicators, we focus on micro-data of real estate listings. The research question relates to the methodology: what are suitable methods or strategies to collect data on micro-dynamics of the housing market? We explored a quantitative and a qualitative approach for data collection, being web data extraction and a transdisciplinary research collaboration process initiated through explorative interviews. The proof-of-concept was developed for the case of the greater Leuven situated in Flanders (Belgium).

3 MATERIAL AND METHODS

3.1 Selected indicators

Two indicators are investigated: speed of sale and listing price. Speed of sale is defined as the duration that houses are listed for sale on the market (‘time-on-market’), with the time that a listing is published online as a proxy. Filippova and Fu (2011) found that properties in a booming market sold more quickly than properties sold in a declining market. In addition, a prolonged time-on-market reduces sale price. So, speed of sale seems to interact with house price (Clauretie and Thistle 2007; Johnson, Benefield et al. 2007). In addition, Miller & Sklarz (1987) confirmed that a greater degree of overpricing (listing price relative to value) results in longer marketing time and lower selling price. So, the indicator 'listing price' also provides valuable insights. It should be clear however that there is a difference between the expected (listing price) and realized price.

3.2 Case study Belgium and the greater Leuven

The study is situated in Flanders, the northern region of Belgium in Western Europe. In general, Flanders is currently one of the most densely populated regions in Europe with a population density of 462 inhabitants per km² in 2010.[1] It is known as a strongly urbanized and highly built-up region, that is characterized by urban sprawl, a dense road network (4.5km/km²), fragmentation, and ownership figures far above the European average (European Commission ; Antrop 2004; Bengs, Schmidt-Thmoé et al. 2006; Kasanko, Barredo et al. 2006; De Decker, Ryckewaert et al. 2010; Verbeek, Boussauw et al. 2014).

For the proof-of-concept of both indicators, the research focused specifically on the greater Leuven composed out of the municipalities Leuven and Herent. Leuven itself is a small regional city. It is known for amongst other things its university and related research and developments spin-offs. With 98,376 inhabitants in 2015, it is the 10th most populated city of Flanders.[2] In 2010, the greater Leuven had a population density of 1,686 inhabitants per km²,[3] and the population growth in the past 10 years (2005-2015) was almost 10%.

A combination of arguments makes the greater Leuven an interesting case study for the proof-of-concept of indicators on micro-dynamics of the housing market. First, the average housing price in the city of Leuven in 2010 was 2.5 times (+149 %) as expensive as in 2000. Moreover, the average housing prices further evolved from € 253.002 in 2010 to € 312,162 in 2014.[4] This average housing price in Leuven equals about 124% of the average price for a house in Flanders in 2014. Initial results of a study of Helgers and Buyst (2014) suggest that the price elasticity of supply in Flanders is very inelastic. An increase in price due to increased demand, leads barely to an increase in supply but rather to inflationary effects. This also has the effect that an increase in the demand mainly leads to rising prices.

Second, about 34% of the inhabitants of the city of Leuven stated in 2014 that they want to move within five years. Of these 34%, slightly more than 15% wanted to move to a different city or municipality. About 64% of the emigrants between 0-9 year and 25-39 years of Leuven moved to Herent in 2014. The reverse movement of Herent to Leuven, over 18%, happened mostly in the age group 20-24 years.

Third, 27% of the households in Leuven spend more than 30% of the total household expenses on housing.[5] Fourth, the owner occupies just fewer than 53% of the houses in het city of Leuven. For the suburb Herent, this figure is almost 80%. Finally, the greater Leuven is part of a region with a high potential for sustainable (re-)development of structurally underused detached housing (Bervoets, van de Weijer et al. 2015).

3.3 Used methods

Information on the 'speed of sale' and 'listing price' of properties listed for sale is not readily available in official censuses and databases in Flanders or Belgium. Nor does a housing pressure indicator exists in Belgium, his regions or municipalities. Nevertheless, Flemish and Belgian real estate agencies have large databases with these data. Therefore, we used two approaches to collect listings information from real estate portal websites. The first approach was a technical approach using a web data extraction system. The second approach was a collaborative approach in which research collaboration was initiated through explorative interviews.

[1] http://statbel.fgov.be/nl/statistieken/cijfers/bevolking/structuur/woonplaats/oppervlakte_dichtheid/

[2] http://statbel.fgov.be/nl/statistieken/cijfers/bevolking/structuur/woonplaats/groot/

[3] http://statbel.fgov.be/nl/modules/publications/statistiques/bevolking/Bevolking_nat_geslacht_opp_bevolkingsdichtheid.jsp

[4] https://www.immotheker.be/Immotheker3/Site_v3/Default.aspx?WPID=323&MIID=169&MSIID=186&L=N&Regio=Leuven&ChartType=0&Jaar=2014

[5] http://www.stadsmonitor.be/betaalbaarheid-van-het-wonen-woonquote

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3.3.1 Web data extraction

Real estate portal sites on the World Wide Web do publish most of the required information on speed of sale and listing price publicly and readily available. To be able to use these Web data, they need to be collected from the web and structured in a database using a "web data extraction" system. A web data extraction system makes use of a software application that collects and extracts unstructured or semi-structured data that are stored or published on Web sources (Laender, Ribeiro-Neto et al. 2002; Sarawagi 2008; Ferrara, De Meo et al. 2014). This data can then be further processed in a semi-automatic or fully automatic way: data can be converted into workable and structured data, merged and unified for further processing and saved for further use (Ferrara, De Meo et al. 2014). Database building is one of the known applications of web data extraction tasks, besides opinion mining and sentiment analysis, customer care and context-ware advertising (Ferrara, De Meo et al. 2014).

Among the available tools for web data extraction, we used the free desktop application 'import.io' (https://import.io/). It works well on websites based on templates or regular structures, and uses information that is provided by users in the form of labeled example pages to build a training set (Ferrara and Baumgartner 2011). Import.io offers several advantages. Because of its Graphical User Interface (GUI), simple extractions do not require users to code, so a non-programmer can use the tool. The desktop application does not require a local server since it uses an online server hosted by import.io. The programming codes behind the Web Extraction use a standard Application Programming Interface (API) structure in multiple formats, promoting the sharing of the code with other developers. In addition, failed updates of the extraction are notified. Finally, import.io allows to download the extracted data in four different formats: Excel, HTML, JavaScript Object Notation (JSON) and as comma-separated values (csv).

We used two web data extraction features of import.io: the Extractor and the Crawler. Both are semi-automatic tools that need to be guided by the user through a training session on a minimum of five Web pages. For template elements (e.g. data or information published at fixed places in the Website template) and well-structured web pages, a machine learning approach can be used. This approach requires the user to highlight the required pieces of information and to identify their datatype (further called highlighting). Data or information that has no fixed position in the Web page template or that is published on less structured webpages has to be addressed through the XML Path Language (XPath). XPath is a syntax for defining fragments of an XML document, and is part of the W3C's XSLT standard.[6] The XPath syntax uses path expressions to select nodes or node-sets in an XML document. The difference between the Extractor and the Crawler is the depth at which data will be extracted. An Extractor only extracts data from the indicated Webpage, while the Crawler goes to Webpages of the same website at a deeper hierarchical level.[7]

To decide which website(s) to extract, we composed a set of screening criteria based on website evaluation checklists from the universities of Berkely[8], Leicester[9], Maryland[10] and Wisconsin[11]. The composed criteria included a suitable goal and content of the webpage (being the publication of real estate listings) and the availability of the required information (type of property; market; listing price; address; date since when the house is listed or speed of sale). Also, it should be clear who is the owner of the website; the website needs to be maintained and updated frequently; it should be user-friendly; and its relevance has to be clear (e.g. website of a local real estate agent versus a real estate portal site that offers listings of different real estate agents and listing providers).

We did a preliminary web data extraction test for the case of greater Leuven. After checking seven major real estate portal websites that offer real estate listings, we decided to focus on one real estate portal website that offered information on the 'listing date', e.g. date since when a property was listed. We used the import.io Extractor to extract the required information from a listings overview page of the considered website. Since the required data were well structured or published as fixed elements on the webpage, the Extractor was

[6] For the specifications see: http://www.w3.org/TR/xpath/
[7] http://support.import.io/knowledgebase/
[8] www.lib.berkeley.edu/TeachingLib/Guides/Internet/EvalForm.pdf
[9] http://www2.le.ac.uk/offices/ld/resources/study/eval-web
[10] www.lib.umd.edu/tl/guides/evaluating-checklist
[11] http://www.education.wisc.edu/docs/WebDispenser/soe-documents/aics-lesson3-webpagecredibilitychecklist.pdf?sfvrsn=2.

trained through highlighting. For this prototype extraction round, the number of pages was limited to less than 10 pages; and page selection was random.

We did a second trial run for the case of Flanders to test (1) if web scraping could be used to collect the required information at a larger scale and (2) if we could use the import.io Crawler to collect additional information from the pages of individual listings (like lot size, Energy Performance Certificate (EPC) value and building year). The website used for the first trial run blocked crawling, so we focused on two new websites that offer complementary information. One site also offers the required information on the date of listing, while the second site provides additional information on the type of sale (including private owner and auction). The Crawler was trained by highlighting for structured data and by XPath syntax for non-structured data (Table 1).

	Fixed elements: training by highlighting	Variable elements: training through XPath syntax
Website 1	*Type:* house, apartment *Market:* for sale, for rent *Listing price* *Address* (sometimes limited to the municipality) *Listed for sale since*: date *Lot size*	*Energy Performance Certificate (EPC)* .//*[.="EPC value"]/following-sibling::div *Building year* .//*[.="Building year"]/following-sibling::div *Housing type* .//*[.="Building placement"]/following-sibling::div *Price history* .//*[@class="table price-history"]
Website 2	*Type_market:* house, apartment; for sale, for rent, sales by auction *Listing price* *Address* *Municipality* *Seller:* agency, by auction, by the owner	*Energy Performance Certificate (EPC)* //*[.="Energieverbruik"]/following-sibling::td *Building year* //*[.="Bouwjaar"]/following-sibling::td *Subtype:* house, villa, bel-étage: //*[.="Subtype property"]/following-sibling::td *Number of façades:* proxy for housing type (detached, semi-detached, terraced) //*[.="Aantal gevels"]/following-sibling::td *Lot size* //*[.="Oppervlakte terrein"]/following-sibling::td

Table 1 Web data extraction by training of the application Import.io through highlighting and XPath syntax of the two extracted websites

3.3.2 Initiating transdisciplinary research collaboration

A transdisciplinary research collaboration is the second approach we explored for the development of policy-supporting indicators on the micro-dynamics of the housing market. The involved partners were university researchers on geosciences and –technology, the spatial planning policy department of the Flemish government, and private businesses active on the real estate market. This collaboration focused on the sharing of 'system knowledge'. System knowledge is knowledge on the current state of given system and its ability to change (Hirsch Hadorn, Bradley et al. 2006; Brandt, Ernst et al. 2013). As such, the research collaboration is situated at the 'consultation' level, but aims at initiating a process that can evolve towards the level of 'collaboration' where participants are partners in a policy project and jointly decide about issues with policy makers, (Pretty 1994; Leeuwis 2000; Aarts and Leeuwis 2010; Lang, Wiek et al. 2012; Brandt, Ernst et al. 2013).

Simultaneously with the web data extraction, the dialogue between stakeholders was started through explorative interviews. The interviews served three goals: (1) initiate the transdisciplinary research collaboration through a dialogue between stakeholders; (2) raise understanding, e.g. gain insights in the context of the housing market; and (3) explore the development of housing dynamics indicators, e.g. (i) whether there is a need of an indicator on dynamics in the housing market, and (ii) possibilities for the development of such indicator in terms of the availability of data, experiences from within the real estate market etc. Related to the latter goal, there were four research questions: is the housing pressure indicator a relevant indicator; when is a sale slow or fast; is web data extraction a suitable, reliable, efficient, feasible way to collect the required data to calculate the indicator; and are there other or better ways available or developable to collect the required data.

We used semi-structured interviews and purposive sampling, i.e. respondents from which we expected to receive as much information as possible (Maxwell 1997; Patton 2002; Guarte and Barrios 2006; Teddlie and Yu 2007; Creswell 2008). Qualitative research does not aim at collecting data from a random selection of a large number of data points to obtain statistical information about the opinions of an entire population. Instead, the aim is to choose a small number of respondents that will give in-depth data (Koontz 2003;

Messely 2014). The seven major real estate portal websites in Flanders were contacted as well as the associations of notary and real estate agents. Only two real estate portal websites agreed to cooperate. Both interviews lasted about 45 minutes. The interviews were transcribed ad verbatim using the online tool "otranscribe"[12].

The qualitative data were analyzed according to the grounded theory approach, organizing the interpretation of raw data into a theoretical explanatory scheme (Strauss and Corbin 1998). We used the open and axial coding phases of inductive coding. In the open coding phase, the data were broken down in discrete objects such as ideas, phenomena and feelings, and given a name. These objects are further called concepts. Since this is an exploratory study all objects were included. These concepts were then further analyzed and aggregated into distinct categories. In the axial coding phase we re-assembled the concepts and categories by identifying links and cross-cuts (Rogge, Dessein et al. 2011; Kerselaers, Rogge et al. 2013; Messely, Rogge et al. 2013). This gained a more profound and comprehensive understanding of the data.

3.4 Micro-data of real estate listings and data cleaning

The proof-of-concepts are based on a 10 year database of listings provided by a major real estate portal website after the explorative interview. This company scrapes small(er) independent real estate agents websites across Belgium and has more than 110,000 listings on the Web. The standardization of practice and procedures within the company insures a high enough level of accuracy of the data. The presented analysis specifically focuses on market dynamics in the year 2011. Data exchange required two rounds, since the researchers needed a first understanding of the database to be able to formulate the concrete variables needed for analysis. We received the data in a .csv format file of 2.5 GB. A selection was made of the case municipalities (Leuven and Herent) and required variables using Qlikview[13] and exported to .csv format.

Data clean up consisted of two main processes, being the selection of relevant and sufficiently documented records (houses and apartments for sale, municipalities of Leuven and Herent), and the transformation of data to usable formats (listing price, housing numbers, dates, geographic coordinates, etc.). We used the open source data cleaning tool "OpenRefine"[14] (Verborgh and De Wilde 2013). Only the required variables were kept, with data on listing price, speed of sale, address, type of market (rental and buyers), and context variables.

First, we made a selection for the greater Leuven which resulted in a set of 20,179 records out of more than 3 million. As we want to study houses and apartments for sale, rental properties and commercial buildings, building plots and garages were left out, as well as student rooms, holiday houses and 'other'. This resulted in a selection of 6,766 records. Second, we cleaned up the data skipping unrealistic or blank values for some key variables such as listing price, date first for sale (result: 5,419 records). Addresses were also not always correctly spelled, this was corrected using the text faceting tool of OpenRefine.

Third, not all listings with an address in Leuven or Herent were geographically located in Leuven or Herent. These were removed from the database by a spatial join between the dataset of the listings and a shapefile of municipalities in a Geographical Information System (GIS). A number of 103 records appeared to be geographically located outside Leuven and Herent, and were removed from the dataset. As a result, 5.271 records remained.

We focused on the year 2011 for the calculation of the proof-of-concepts. This is the most recent year in which census data is available concerning the existing building stock, population characteristics etc., what would allow comparison with official census data. Finally, spatial analyses were performed on a dataset of 390 records using Geographical Information System (GIS) techniques (Figure 1).

3.5 Calculating the indicators

The proof-of-concept indicators 'speed of sale' and 'listing price' were calculated for the year 2011. Speed of sale was calculated as the difference in number of days between the first and last date of publication on the portal website. Some processing was needed to calculate this speed of sale. The appropriate variables were "creatie_datum" (date of creation), "is_gearchiveerd" (listing is archived or not), "r_datum" (date of

[12] http://otranscribe.com/
[13] http://global.qlik.com
[14] http://openrefine.org

archiving), “laatstewijziging_datum” (date of last change), and the sequence of “Pub1 start”, “Pub1 stop”, “Pub2 start”, “Pub2 stop”, “Pub3 start”, “Pub3 stop” etc. (start and end date of the publication period). For example, there seems to be some inconsistencies in the dates of archiving (e.g. when a real estate agent archives a listing) and the end date of the last publication period. This is due to the fact that a real estate agent him- or herself decides and assigns when a listing is archived. For the proof-of-concept, we used “Pub1 start” and “Pub1 stop”.

The calculating of the indicator ‘listing price’ was straightforward. The database provided both the initial asking price and the corrected asking price. Since the corrected asking price is seldom completed, the initial asking price was used. This was compared with the average selling price tracked by Belgian censuses. For the greater Leuven, the average listing price was additionally compared with the average realized price[15] for the entire dataset (2005-2014) to check the consistency in pricing difference between the expected and the realized price over the past 10 years. Pricing difference (%) was calculated as [(realized price – listing prize) / listing prize *100].

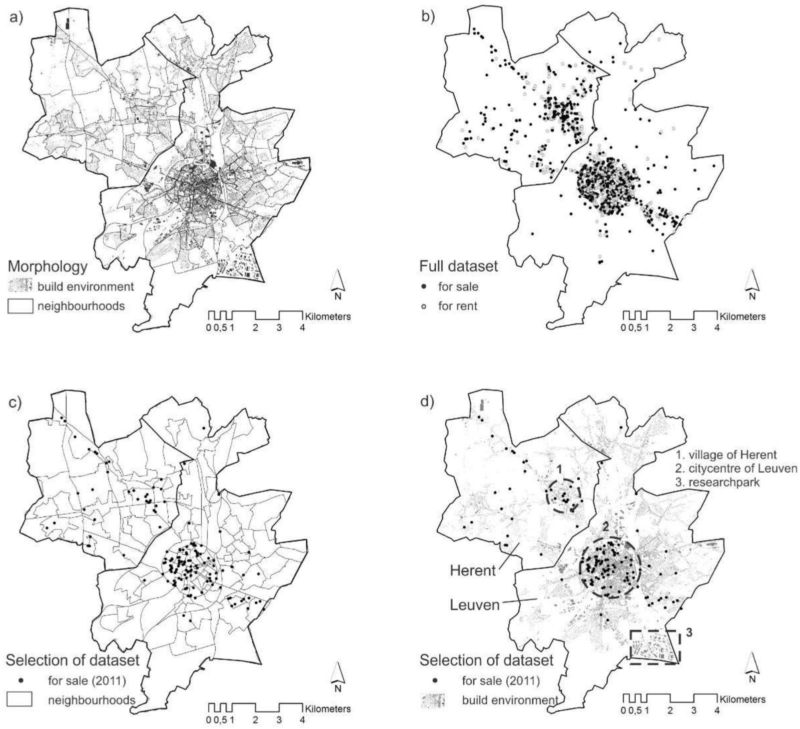

Figure 1 Characterization of the case study of the greater Leuven. Morphology (a) indicates the neighborhoods and built environment. The full dataset (b) gives an overview of all the listings, while the selected dataset (c) focuses on houses and apartments for sale for the year 2011. Map (d) indicates the three main urban cores being the city center of Leuven, the village of Herent and the research park of Haasrode in relation to the selected listings.

4 RESULTS

4.1 The use of web data extraction

At the scale of the greater Leuven, the web data extraction system proved a valuable method for exploring ideas and concepts for new indicators. This is especially the case when data is not readily available, as is the case for micro real estate data.

The web data extraction trial run at the scale of Flanders however encountered a number of practical and legal issues. Practical issues included an extensive duration of 44 hours for extracting one website. The legal issues are related to the grey legal zone in which web data extraction is situated. In Flanders, the act of web data extraction itself is not illegal. Yet, the terms of use of the screened real estate websites all disallowed on the one hand to use information published on the site by third parties and on the other hand to copy and/or store published information in databases. Some real estate websites could allow it on the precondition of a

[15] Calculations based upon data from Stabel.be: http://statbel.fgov.be/nl/statistieken/cijfers/economie/bouw_industrie/vastgoed/gemiddelde_prijs_woonhuis/ retrieved on 2/1/2016.

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written authority; others literally prohibited web scraping. Besides the individual terms of use, the intellectual property rights and the database right (like European Union Directive No. 96/9/EC of 11 March 1996; and UK Copyright and Rights in Databases Regulations 1997) apply. Due to these technical and legal issues, web data extraction is not considered an optimal technique to collect the required data for purposes beyond the exploring of a concept for an indicator.

4.2 Insights in the real estate market from two explorative interviews

The two explorative interviews provided preliminary insights in three main issues: (1) housing market indicators and organization of the housing market; (2) characteristics of the interviewed real estate portal sites; and (3) possibilities of data collection through web scraping and cooperation.

4.2.1 Housing market indicators and organization of the housing market

In general, both companies indicated that the development of indicators about housing market dynamics was a very good and relevant idea, yet a challenging task. The respondents referred to their existing price estimation indicators, and suggested four additional possible indicators: the share of listings published online compared to the total supply of listings; the share of listings that goes offline without being sold; the selling price; and the influence of insulation of the property on the price.

“[the development of an indicator about housing market dynamics is] a very good idea. We are very interested in that and tried to develop such indicators ourselves. Of course, that is not always possible because we are in a commercial dynamic. Sometimes we need to make choices. But it has always been the goal of our company to bring this kind of information to the private buyer.” Company A

About the validity of indicators that are calculated based on real estate listings, the respondents stressed that (1) the indicator ‘speed of sale’ only indicates how fast a property is from the market, not how fast it is sold, and that (2) a share of the listings goes offline without actually being sold. This has to be taken into account when interpreting the indicator ‘speed of sale’ based on the duration that a listing was online. Benchmarking whether a property is slow or fast from the market can be done based on their data. The respondents also stated that ‘blind spots’ will remain, for example no data is available on the share and transactions of private sales, e.g. sales that happen “under the shower of the local soccer clubs”. To check the validity, the respondents suggested involving the notaries, since they have data on actual sales and selling prices. Nevertheless, they also announced that this would be a challenging task.

The respondents claimed the real estate sector to be a difficult and complex sector. Also, there is an important role for power over data flows. Respondents believed that the government should take an official position concerning this, since they consider it a necessity for private buyers to know as much as possible about the properties that are for sale. So, concerning the organization of the housing market both companies stressed the need for more transparency on the housing market in Flanders.

4.2.2 Characteristics of the interviewed real estate portal sites

Both companies have a similar dream, being the persuasion of a transparent housing market where the end users are put first. They also put forward the development of their corporate real estate database. The business models of both companies differ however. Where one company works partly according to the general routine of buying listings from software providers that are completed with listings from free publications and available government data, the other company collects listings itself through own software and through web data extraction (called ‘web scraping’) of small initiatives and real estate agents.

“Our ambition is to offer the end-user the most complete housing supply. It (e.g. the API) is also a platform that we are developing specifically for the end-user. We really try to maintain this point of view. […] Our business model functions completely different. Basic functionalities are for free. We generate income through cooperation with the real estate agent. To make life easier for the real estate agent, to have better integrations, and services” Company B

“The past years, many people started [with initiatives to open up the real estate sector], from different stakeholders. Anyway, we want to support each initiative, because we too have a big dream to open up all of that [e.g. data] for everyone” Company A

Concerning the exchange of data, there is an ambition to provide data for free, with respect for the license restrictions of software providers. One company is currently developing an API for providing free data as a way to solve some commercial problems, since it would allow them to collect data as well. In general, both companies referred to the need for a better organization of the exchange of data, on the one hand between the three regions Flanders, Brussels and Walloon region; and on the other hand between the real estate sector and the government (for example about the Energy Performance Certificate (EPC)).

4.2.3 Possibilities of data collection through web scraping and cooperation

Both companies were familiar with web data extraction systems (e.g. web scraping) and considered it a suboptimal technique to collect real estate data for the development of housing dynamics indicators. They mentioned two reasons for this, being the inefficient workflow of translating data to html to data; and the fact that only current listings are published online and that a long period of scraping is needed to collect time series data, e.g. labor-intensive. Moreover, the technique of web scraping was considered computer intensive, placing a load on the servers of the real estate portal websites. Legal issues encompassed the obligatory protection of the listings bought from software providers. For the company using web scraping as a business strategy, indexing of the website is not allowed and their website is protected against scraping. The company takes the position that the website of a real estate agent is a publication channel, but they respect it if an agent doesn't want to be scraped. Both companies stated that collaboration [with them] is a better option than web scraping.

"We don't prefer it [web scraping], because it is a very suboptimal way to transfer data. We translate our data to html, made for browsers, and then you translate through html this information into data again. Many data gets lost and is very computer intensive. We have to generate all those web pages at our server side, you have to collect all the data and process it. There are just better ways to collect data." Company B

"Web scraping, I don't think it is realistic for you to develop it yourself. I think it is much more interesting to collaborate with us." Company A

So, both companies preferred an active collaboration instead of passive web scraping in the frame of the development of indicators about housing market pressure. A range of concerns and preconditions was mentioned, related to the fact that they are commercial companies. The goals of the indicators are important criteria, although it was also mentioned that it is difficult to tell now where the development of these indicators will end. If there are commercial goals attached to it, it would be a problem to cooperate. But if the developed indicators will be available for everyone, it is okay. There are concerns about advantages for competing companies, and everybody who joins needs to collaborate under equal conditions. The companies' data can be used to develop a proof-of-concept. Specifically concerning the exchange of data, one company would provide their complete database, while the other company would first run a trial query. Once the proof-of-concept of the indicators is developed, a new consultation is requested to further discuss future cooperation.

4.3 Transdisciplinary research collaboration: from stakeholder engagement towards future co-production

The explorative interviews provided a basis for the determination of a shared goal. Both companies share our challenge on developing open (e.g. freely accessible) indicators on micro-dynamics of the housing market. The ambition of both companies is to pursue a transparent housing market where the end users are put first, so our challenge is part of their 'dream'. They also share our success, as they gain when we succeed in our challenge. Finally, they also feel responsible to work on this shared challenge, based on commercial motivations. The recognition of a shared goal opened up the way for co-creation of the project. A users' license was formulated and signed by one company and the research partner.

The process of an ongoing longtime collaboration between the real estate portal site and the Flemish government is now being developed. The formal transfer of the cooperation from the academic research group to the government was covered in a transfer meeting. A mutual engagement for exploring future collaboration between the company and the governmental party was pronounced. A win-win was identified for both parties. For the company, involvement in housing policy support research and insights in their own data were mentioned. Communication about the results and publication of the indicators could happen

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jointly. Also access to and/or involvement in developing additional information was considered a mutual gain.

For the government, collaboration with the private company allows to gain detailed insights in the housing market processes through data that is not available elsewhere. This would allow the effective development of indicators for the real estate market, i.e. speed of sale, housing pressure, listing and sale prices, attractiveness of neighborhoods, and friction inoccupation of houses.

Both parties formulated specific points of interest. For the company, the reason for collaborating in the frame of this explorative study was the clear endpoint of the project in the near future. This ensured them that the collaboration would be manageable. This relates to the fact that they are a commercial business. Discussed preconditions for the governmental party included the possibility to put the company's database at the disposal of third parties in case of outsourcing (part) the analyses. Also the criteria of scientific integrity should be acknowledged and agreed upon for the collaboration.

4.4 Proof-of-concepts of the indicators

Based on the micro real estate data from the database provided by a major real estate portal, we calculated the proof-of-concepts for the indicators speed of sale and listing price.

4.4.1 Speed of sale

For the greater Leuven, the indicator 'speed of sale' provides detailed insights at the micro-level (Figure 2 and Figure 3). For listings submitted in 2011, we see that the two largest groups are those listings sold within two weeks, and those sold within three months (both 19%). Based on the data, almost half of the listings (47%) can be assumed to be sold within three months (Figure 3). Most of the listings are situated in de city center; the listings the most peripheral tend to be longer on the market. The listing price of those premises are lower than the inner city premises.

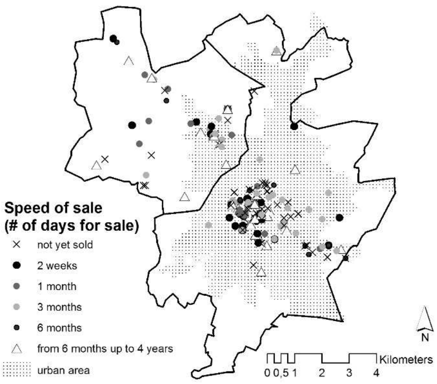

Figure 2 Map of the proof-of-concept indicator 'speed of sale' for the greater Leuven. The map is based on data received from one real estate portal site.

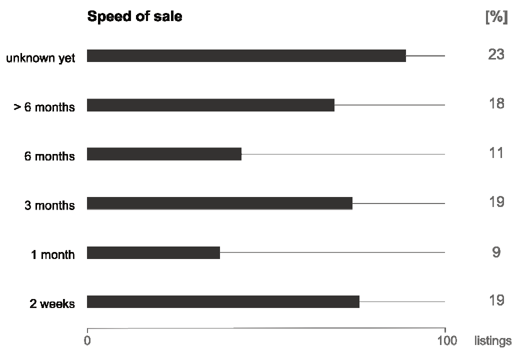

Figure 3 Distribution of listings for the year 2011 per arbitrary time category of speed of sale. The graph is based on data received from one real estate portal site.

4.4.2 Listing price

The indicator 'speed of sale' also provides detailed insights at the micro-level for the greater Leuven. It allows geographical differentiation, for example by regrouping by neighborhoods, municipalities, real estate markets, etc. (Figure 4). For the time series 2005-2014, comparisons were made between the listing prices from the database and the realized prices as reported by Statistics Belgium[16] (Figure 5). Stressing the exploratory nature of our study, this first exercise clarifies for a limited time period (2005-2014) that listing prices for houses and apartments are more volatile than the realized price for the case of greater Leuven, for both houses as for apartments. Analyzing further the pricing difference (Figure 6), volatility appears bigger for apartments than for houses.

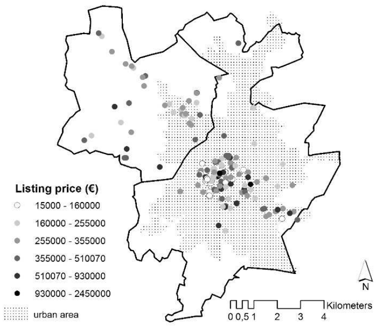

Figure 4 (left) Map of the proof-of-concept indicator 'listing price' for the greater Leuven. The map is based on data received from one real estate portal site. Figure 5 (right) Evolution of the listing prices of houses and apartments, based on the dataset, versus there realized prices from Statistics Belgium over the period 2005-2014.

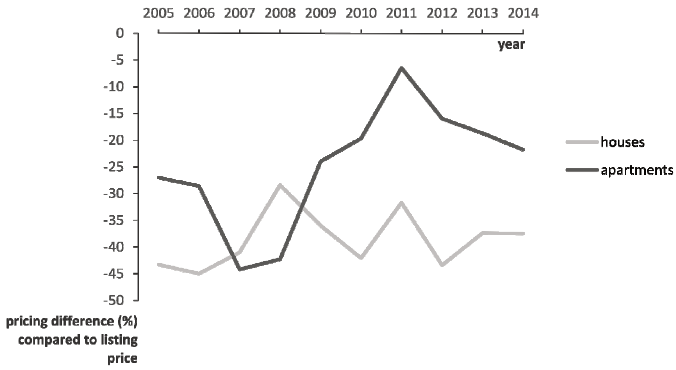

Figure 6 The difference in price (%) between listing price and realized price compared to the listing price is volatile, especially for apartments, for the time period 2005-2014.

5 DISCUSSION

5.1 About the proof-of-concepts and gaining insights in micro-dynamics of the housing market in the greater Leuven

Since the proof-of-concepts are calculated for the year 2011 and for one case study only, actual interpretations of the data and comparisons with other cities or benchmarks are not possible. The results of the proof-of-concepts did nevertheless allow to gain insights in possible analyses based on the two indicators, like the comparison with other datasets. Calculating these indicators for all municipalities in Flanders or Belgium and for different years will allow to map dynamics of the housing market in time and space.

Concerning the proof-of-concept of the indicator 'speed of sale', it would be interesting to link the listings with information on the real estate agent. Does size of the real estate agency matters? Spatial analyses at neighborhood level allow insights in neighborhoods with a fast and a tame market. In collaboration with real estate companies, bench marks for a fast or slow speed of sale can be determined. We also wonder if there is an effect of the execution term of the selling deed, which is set at three months in Belgium.

The proof-of-concept for the 'listing price' indicator allows to calculate the average listing price per neighborhood, and evaluate of this average price is above or below the average listing price for the municipality, region, Flanders or Belgium. Concerning the pricing differences between the listing price and

[16] http://statbel.fgov.be/nl/statistieken/cijfers/economie/bouw_industrie/vastgoed/gemiddelde_prijs_woonhuis/ retrieved on 2/1/2016

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realized price, it is interesting to find out if the differences for Leuven (ranging until 45%) also appear elsewhere in Belgium. Further research at a larger scale of Belgium could verify the volatility of pricing differences for apartments. It would also be interesting to analyze the effect of the speed of sale on these pricing differences.

The goal was the development of policy-support indicators for spatial planning. The proof-of-concepts clarified that the indicators can explicit housing market dynamics in space and time at a detailed scale level. This will allow to evaluate in which neighborhoods the housing market is very dynamic and where it is dull, so where it would be opportune to stimulate or limit the housing supply. Are we planning at the right places? What if vibrant housing market dynamics appear there where we are not looking? The importance of monitoring over longer time series is related to the persistence of the observed dynamics. Housing dynamics can change rather fast, where spatial planning is characterized by a certain level of slowness. Monitoring indicators such as speed of sale and listing price allows to identify regions with a systematic higher or lower dynamic. This inspires and supports interferences on the longer run.

5.2 About distilling indicators for housing dynamics through micro-data of real estate listings

There are several reasons to untangle the spatial structures and dynamics through micro-data of real estate listings. First, distilling indicators for housing dynamics by means of micro-data is novel for Belgium. Since real estate data are not systematic published as statistical data or open data, access to these data can give insight in the spatial patterns of the housing market. We were able to elaborate on detailed real estate data per premise. This gave the means to analyze data on any geographical scale, so not to be bound by the usual statistical or administrative borders. Additional, time-series since 2005 allow the analysis of dynamics through time and through space.

Second, the real-estate data makes it possible to study profoundly the mechanisms in the housing market dynamics and its spatial patterns in retrospect of policy goals such as spatial efficiency within a sustainable planning.

Third, the unique data by courtesy of a private partner is a start of a collaborative planning approach between private partners, the academic world and the Flemish government. All three win from this collaboration on the long run. The private partner will have broader insights in the functioning of the real estate market by the developed indicators. The academic partner can benefit from new research on the topic of housing dynamics and elaborating indicators. The public partner can gain insights in spatial patters and dynamic to which it can steer upon as a function of desired spatial policy. Housing markets function locally, so a tailored spatial policy-framework is needed to intervene or monitor spatial development. A long lasting collaboration between the three stakeholders on the field of urban planning and on housing is also new to planning in Belgium.

5.3 About working with the database of private companies

The review and pre-processing of the company's database provided points of attention for future collaborations. The exchange of data highlighted the importance of suitable formats and standards for database export. The joint development of a protocol or model for database export could increase the efficiency of data exchange. The review and clean-up of the data revealed a number of human errors, despite the review and clean-up by the company. In addition, the metadata files with brief information on a part of the variables provided by the company appeared insufficient for the researchers to gain a full understanding of the meaning of (certain) variables and their interrelations. To handle issues with unclear variables when calculating indicators and for the definition of benchmarks, a close collaboration with the company's employees is needed.

If the research collaboration continues, a data exchange procedure should be designed. We see two possible approaches: Extract Transform and Load (ETL) and Linked Data (LD). The first approach, Extract Transform and Load (ETL), is a database management process that includes the extraction of data from different data sources, the transformation of data for storing it in a suitable format or structure, and the loading of the transformed data in the final database. Such ETL systems are developed to integrate data from multiple applications or sources. In this case, it would be data from different real estate companies. All these 'parent' databases are typically developed and supported by different software packages, using different structures and formats.

Using ETL for the data exchange between real estate companies and the government requires the development of a database export query for each company. The initial development will need some effort in the beginning, but once operational it can be maintained with a minimal effort. Next, a transformation protocol needs to be developed, e.g. which variable from companies x, y and z refer to which variable in the final database of the government; transformation of the coordinates to a suitable format and coordination system, etc. When working with database export queries, the transformation of the data can be done by either of the parties. Finally, the transformed data is loaded into the database of the government. Given the commercial identity of real estate companies, the government could provide the technical development of the database export queries and transformation protocols.

The second approach concerns the Semantic Web and the use of Linked Data. In the semantic web, computers are capable of understanding the exact meaning of data (Berners-Lee 2000), by the linking of data and internet applications through web services (Folmer and Verdonk). Linked Data is a method for the publication of data in such a standardized and structured way that the data becomes linkable. Linked Data is considered one of the promising solutions for the integration of large volumes of data that are available online in a variety of proprietary and non-proprietary formats. The Semantic Web can help to overcome the hindrance of a fragmented supply of data (in terms of formats, publishers, etc.) by enabling the analysis, exploration and discovery of unexpected connections and relations. This way, better insights in and understanding of complex social, geographic, cultural and economic processes can be gained (Ballatore, Bertolotto et al. 2014).

5.4 About opportunities for transdisciplinary co-production in sustainable planning and housing policy

Transdisciplinary research collaboration between policy, academics and private companies is new in the context of housing policy. This study has put a first step towards involving private companies in the research collaboration of spatial policy makers and academics. Initial collaborations however appeared delicate, in terms of the building trust and balancing between commercial, academic and policy concerns.

At this stage, collaboration was limited to the consultation level. For each party involved, such collaboration appeared to offer opportunities and wins which are hardly attainable alone. This was an incentive to engage for a further exploration of future collaboration between policy and private companies. Involving stakeholders into scientific domain as advisors, informants and users moves research activities analytically and concretely into transdisciplinary co-production (Polk 2015).

There is a need for more common and collective strategies, not only in the planning but also in the management of space (Tress and Tress 2003; Dewaelheyns 2014; Dewaelheyns, Kerselaers et al. 2016). The development of new policies by governments in cooperation with private companies and citizens is considered an important way to improve the quality of government plans. Involving people in decision making allows them to learn and understand the range of problems and solutions, which can result in greater public support for the end result (Aarts and Leeuwis 2010).

The role of governments in such new governance processes shifts from being a strictly imposing authority (e.g. instrumental perspective) towards a facilitating authority, creating optimal conditions for societal projects (e.g. participation and eventually network perspective) (Aarts and Lokhorst 2012). Governments move away from organizing and managing top-down and bottom-up processes, towards anticipation and making use of self-organizing ability and initiatives of people (Aarts and Lokhorst 2012). Aarts and Leeuwis (2010) explicitly stress this need for a ‘network perspective’ on governance, since people are active agents who interact with each other and organize themselves to get things done. This changes the way a government interacts with society to get things done. To be able to anticipate on the self-organizational ability of people, Aarts and Lokhorst (2012) suggest that governments must be alert and constantly gathering information about developments in society. This requires a pro-active attitude in contacting societal actors and opening negotiations with them (Aarts and Lokhorst 2012), which has proven fruitful in this explorative study. Such network model allows governments to better situate themselves amidst the dynamics of power and processes of self-organization.

5.5 About joined monitoring

To balance the internal and external complexity of spatial developments, quantitative analyses via monitoring systems are best combined with specific qualitative evaluations. The definition of key performance indicators and their coupling with development projects allows to check and demonstrate how planned developments contribute to an improvement of the local quality of life and to the realization of the Flemish policy ambition of spatial efficiency.

Transparency of spatial policy cannot be limited to the mere consultation of indicators. The learning-by-doing processes and transdisciplinary research collaborations demand more attention for mutual communication. This requires new instruments that allow citizens, companies, organizations, etc. to share information, accompanied by clear agreements on how to handle the shared information. The sharing of information by publishing spatial indicators in new formats that are freely accessible at the Internet (such as Linked Data) increases the utility of available information outside the own ICT-environment. This is not only the case for governments, but also for private companies as indicated by our research. This allows to discover correlations between data of diverse sources, inviting new insights in spatial issues of companies, organizations and citizens.

6 CONCLUSIONS

Data on the supply and demand side of the housing market is not always (readily) available. We explored possible strategies to develop two policy-support indicators on local housing market dynamics for the buyers' market. These indicators were "speed of sale" and "listing price".

We focused on two methods, being the technical and quantitative approach of web data extraction systems, and the participatory qualitative approach of research collaboration and co-production. The web data extraction system proved a valuable method for exploring new ideas and concepts for new indicators. This is especially the case when data is not readily available. Yet, when moving to an operational phase, web data extraction systems are not the best suited method to collect large amounts of data at high temporal frequencies. In addition, legal issues are to be respected: all evaluated portal sites prohibited the storage of the information published on their website in databases of third parties, being exactly the goal of web data extraction systems.

The qualitative approach of research collaboration and co-production was explored via interviews with two companies publishing real estate listings online. The use of explorative interviews appeared a good entry to dialogue with stakeholders. It became clear that both companies shared our goal and responsibility. These are two preconditions for further collaboration, regardless of the intensity of collaboration (consultancy, collaboration and self-mobilization). The interviews also allowed to gain preliminary insights in the housing market which proved valuable along the process. The development of new policies by governments in cooperation with private companies and citizens is considered an important way to improve the quality of government plans. Points of attention for the exchange of data between a private company and research comprise the joint development of a protocol or model for database export and close collaboration with the company in the form of a feedback panel (conceptually and technically).

Being able to explore micro data obtained through the research collaboration is an advantage. First, access is provided to an original dataset of all listings for the whole of the country, including historical data of a 10 years' range. This prevents extensive and technically complex searches to be carried out via web scraping of the Internet. Second, a dialogue with the private partner can provide interesting and first hand insights regarding the functioning of the housing market. Third, data on the level of single listings give a range of potential opportunities to analyze spatial patters and dynamics as from regional to local levels as to neighborhoods. As our case study shows, differences in pricing and vacancy rate can be found throughout the neighborhoods and the urban and suburban municipalities.

The proof-of-concept indicators on 'speed of sale' and 'listing price' could be further tested on fixed geographical areas such as administrative divisions, policy based boundaries (e.g. urban areas, zoning plans), or (segmented) housing markets. Based upon time series, dynamics throughout history could be made visual in space. In the future, we intend to broaden up the indicators to the whole of Flanders or Belgium and benchmark them in time. A further differentiation is possible due to the different submarkets (buyers' market, rental market, development of newly build homes). This will enable us to benchmark the results of the greater Leuven with other urban metropolitan zones.

To conclude, our study proves that smart governance can gain from smart technologies, but should not lose sight of active collaborations.

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Why Geospatial Linked Open Data for Smart Mobility?

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1 ABSTRACT

While the concept of Smart Cities is gaining momentum around the world and government data are increasingly available and accessible on the World Wide Web, key issues remain about Open Data and data standards for smart cities. A better integration and interoperabilty of data through the World Wide Web is only possible when everyone agrees on the standards for data representation and sharing. Linked Open Data positions itself as a solution for such standardization, being a method of publishing structured data using standard Web technologies. This facilitates the interlinking between datasets, makes them readable by computers, and easily accesible on the World Wide Web. We illustrate this through the example of an evolution from a traditional Content Management System with a geoportal, to a semantic based aproach. The Traffic Safety Monitor was developed in the period of 2012-2015 to monitor the road safety and to support policy development on road safety in Flanders (the northern part of Belgium). The system is built as a Content Management System (CMS), with publication tools to present geospatial indicators on road safety (e.g. the number of accidents with cars and the number of positive alcohol tests) as Web maps using stardardized Open Geospatial Consortium Webservices. The Traffic Safety Monitor is currently further developed towards a Mobility Monitor. Here, the focus is on the development of a business process model for the semantic exchange and publication of spatial data using Linked Open Data principles targeting indicators of sustainable and smart mobility. In the future, the usability of cycling Infrastructure for vehicles such as mobility scooters, bicycle trailers etc. can be assessed using Linked Open Data. The data and metadata is published in Linked open data format, opening the door for their reuse by a wide range of (smart) applications.

Keywords: Flanders, Open Data, Smart Cities, smart mobility, Spatial Linked Data

2 SMART MOBILITY IN SMART CITIES

Cities are facing ecological and economical challenges due to the incerasing influx of population. In 2010, about 75% of European Union population was located in urban areas (Caragliu et al. 2011). The concept of Smart Cities evolved as an approach to tackle the challenges (such as global warming, congested traffic, and health of an aging population) that arose due to overcrowding of the cities. Smart Cities made cities more liveable by increasing the overall quality of life through digital technologies and efficient use of the resources (Bastiaan Baccarne et al. 2014; Janssen et al. 2011; Deakin & Al Waer 2011). The use of digital technologies or technological push helps cities to plan their future by allowing cities and citizens to take into account new forms of governance, financing mechanisms and data exchange (Angelidou 2015) .The 'Smart Cities' concept quickly became a popular way to describe 'the city of the future'.

As defined by Caragliu, Del Bo, & Nijkamp (2011) in page 70 , a city is smart when " investments in capital (human and social) and traditional (transport) and modern (ICT) communication infrastructure fuel the sustainable economic growth and high quality of life achieved through wise management of available natural resources and participatory governanace". The smart city concept has six key dimensions, divided over two categories: ecological/greener (smart environment, smart economy/energy, smart mobility) and quality of life/liveable (smart people, smart governance, smart living) (Caragliu et al. 2011; Bastiaan Baccarne et al. 2014). This paper focuses only on smart mobility dimension for smart cities.

Belgium is known for traffic problems in growing cities. Besides traffic jams, road safety is a pressing question. One way to take up the challenge of lowering the number of traffic accidents and deathly victims is the evolution towards 'Smart Mobility'. It is important to ensure road safety next to a reduction of traffic congestion. In addition, the compliance with sustainable clean energy goal is also equally important when global warming is the raising concern. Smart Mobiltiy is not an isolated dimension, but part of the ecosystem of smart cities (Bastiaan Baccarne et al. 2014). The economy, use of smart technologies, citizens involvement etc is needed to understand the necessities of the citizens. Examples are the use of advanced technologies such as smart phone applications to facilitate citizens in their commuting, empowering or involving citizens by governments to take smart decisions while commuting (promoting use of cycles, by improving cycling networks and infrastructure). Thus, to move towards smart mobility, data openness and data integration are two major aspects.

Here, 'Open Data' implies that data must be (1) available and accessible (e.g. at a reasonable price and in a handy and adjustable format; through download from the internet); (2) presented under conditions that allow the reuse and redistribution (including the merging with the other datasets); and that data availability is universal, e.g. everyone must be able to use, re-use and redistribute the data (Bauer and Kaltenböck, 2012; Khusro et al., 2014). During the past years a policy framework to provide government data as 'Open Data' was developed in Flanders. More data will be available on the web in the coming years. The web is a popular medium when it comes to the sharing of information and data. To realize the maximum benefits of the open data, there is a need of common understanding on how to process data available on the web. Data from different domains come in different formats and they must be reconciled in order to integrate. A better integration and interoperability of data through the web is only possible when everyone agrees on the standards for data representation and sharing (Fox 2013; Heather & Bizer 2011; Khusro et al. 2014). Linked Open Data (LOD) is one such method for publishing structured data using standard web technologies.

2.1 The Traffic Safety Monitor

The Traffic Safety Monitor (www.verkeersveiligheidsmonitor.be) was developed by SADL (Spatial Application Division Leuven) during 2010-2015 to monitor and support the policy development on road safety in Flanders (the northern part of Belgium) (Tirry and Steenberghen, 2013a). The aim was to support the accessibility, the quality and the interoperability of indicators for road safety. Examples of spatial indicators on road safety are: the number of accidents with cars, number of deaths due to accidents, the number of positive alcohol tests etc.

The Traffic Safety Monitor (Figure 1) was deployed as geospatial Content Management System (CMS) based on Drupal. The viewing (WMS[1]) and downloading capabilities (WFS[2]) using standard Open Geo Consortium (OGC) web services were implemented with the integration of Open Layers, Geoserver and PostGIS. Because of privacy concerns, WFS service was available only to registered users at the time. The focus was also on providing an extensive metadata with the target that anyone should be able to recalculate the indicators themselves. A standard metadata template stores the non-spatial information such as creator, temporal information (date of publishing/updating), reference, data quality along with spatial metadata like Spatial coverage (Flanders), Spatial representation (vector/grid), Spatial Reference System (ESPG code). Both geospatial indicators as maps and metadata are made available to the users of the Traffic Safety Monitor

From 2016 onwards, the Traffic Safety Monitor is being further developd as the Mobility Monitor. Here, the aim is to bring together data from five core themes related to mobility that are important at the regional and local level:[3] accessibility, road safety, reachability, liveability and environment. Some indicators are: particulate matter maps, dagebrous points in the roads abd accidents with cyclist. The maps will be converted into GeoLinked data and made available for download both via WFS and as RDF.

[1] A Web Map Service (WMS) is a standard protocol for serving georeferenced map images over the Internet that are generated by a map server using data from a GIS database.

[2] Web Feature Service (WFS) provides an interface allowing requests for geographical features across the web using platform-independent calls.

[3] http://ec.europa.eu/transport/themes/urban/doc/ump/com(2013)913-annex_en.pdf>
http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+REPORT+A8-2015-0246+0+DOC+XML+V0//EN

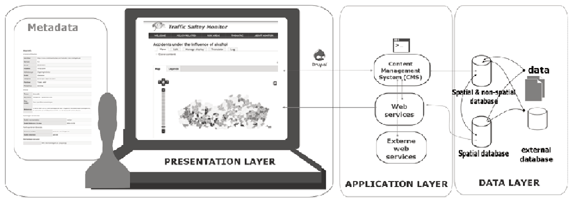


Figure 1: Logical Model of Traffic Safety Monitor Flanders

2.2 Research objectives

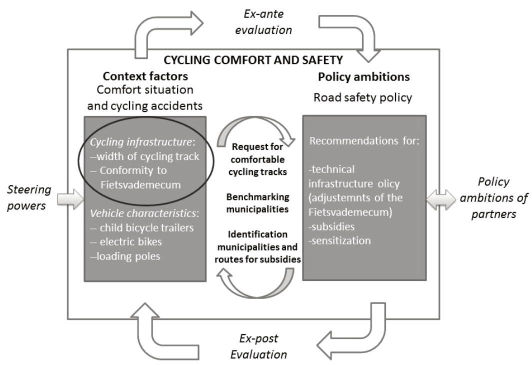
The conversion of the data into LOD format involves a series of standards and technologies. Several authors proposed life-cycles or tehnologies for Linked Data conversion (Auer et al. 2012; Zaveri et al. 2012; Lopez-Pellicer et al. 2011; Heather & Bizer 2011). However, a need for simplified but detailed operational steps of the LOD conversion process was felt while applying the principles of LOD in the frame of the Traffic Safety Monitor. Thus, the focus lied at the development of a business process model for the semantic exchange of spatial data. The main objective is to incerase the interoperability[4] among data from different domains/sources.

After a brief outline of the use case ‘Cycling infrastructure in Flanders as Geospatial LOD’, the concepts and methods used for the adaptation to the new technology of Geospatial LOD is given. The paper focuses on the standardised roadmap for the creation of geospatial Linked Open Data presented in the ‘Results’ section. The key finding and challenges encountered are discussed further. Finallly, we draw conclusions about the role of the LOD in the scope of smart mobility.

3 USE CASE: CYCLING INFRASTRUCTURE IN FLANDERS AS GEOSPATIAL LOD

The transformation of mobility in a smart direction requires an alternative sustainable means of transport to private vehicle such as cycling (Garau et al. 2016). The evaluation of the urban mobility can be done with indicators of mobility (Garau et al. 2015). The 2013 annual report on Road Safety in Flanders by Carpentier et al. (2014) indicates that cyclists make up 20% of the total number of traffic victims. Also, cyclists are the largest group of deathly victims within the built-up area (29%). In their report, the authors demand attention for the improvement of infrastructure, such as the separation of cycling tracks from the road and cycle highways (Carpentier et al., 2014). Figures from the European Transport Safety Council (ETSC) indicate 9.5 cycling deaths per million inhabitants, a figure far above the European average of 4.2 cycling deaths (Adminaite et al., 2015).

To provide a basis for the Traffic Safety Monitor, Tirry and Steenberghen (2013a) developed a general policy-oriented conceptual framework for monitoring. This conceptual framework was specified for the use case “cycling infrastructure as Geospatial LOD (Figure 2). To better map the impact of the type and condition of cycling infrastructure on accidents, there is a need for qualitative and semantic interoperable data. Therefore, we focused on the publication of “cycling infrastructure data” as Linked Data, starting with a semantic exchange model of the metadata for the accidents and cycling comfort data (Tirry and Steenberghen, 2013b). The case study is the publication of the “cycling infrastructure map” as Geospatial Linked Opend Data. The usability of the cycling infrastructure to the mobility scooters, bicycle trailers and links to the other external vehicular characteristics such as loading poles can be accessed in the future.



4 “capability to communicate, execute programs, or transfer data among various functional units in a manner that requires the user to have little or no knowledge of the unique characteristics of those units” (OpenGIS, 1996).

Figure 2: A conceptual framework for monitoring applied to cycling comfort. This study focuses on the publication of "cycling infrastructure data" as Linked Data. Based on the generic monitoring framework by Tirry and Steenberghen (2013a).

3.1 Data

We used the "cycling infrastructure data" that represents the Supra-local Functional Cycling Route network (Bovenlokaal Functioneel Fietsroutenetwerk - BFF). This network is under development by the Flemish Policy to ensure a safe journey by bike for house, school and work movements. To develop and realize the BFF, the Flemish Government structurally collaborates with the provinces. The Agreement 'Support of the Supra-local cycling policy' ('Ondersteuning van het bovenlokaal fietsbeleid') between the Flemish Government and the provinces states that the provinces are responsible for the design and management of the BFF. Provinces are also responsible for the inventory of cycling infrastructure along non-regional roads that are part of the BFF. A complete inventory of the BFF is required to control the conformity[5] of the BFF. These inventory data are stored in a geographical information system (cyclingGIS – fietsGIS) which is coordinated by the Flemish Government, Department of Mobility and Public Construction Works and currently under development by the company Geosolutions. The cycling infrastructure data is received in 'shapefile' format which is uploaded to a PostGIS database.

3.2 Methods

3.2.1 BPMN

BPMN is a standard for process modelling, defined by the Object Management Group (OMG). The graphical notation that is created to provide a unified language of worldwide acceptance for the specification of business processes (Silver, 2009). The use of Business Process Modeling Notation (BPMN) process allows the stadardisation of the workflow, with an ability of automatization/semi-automisation of the process. The process modeling allows to analyze, design and diagram a business process flow. We used the Bizagi Modeler[6], an open software that enables to visually diagram, model and document business processes in industry-standard BPMN.

3.2.2 Ontologies

The term "Ontology" origins from the domain of philosophy and refers to the philosophical investigation of an existence. In the context of Semantic Web, the most commonly used definition comes from Studer et al. (1998): "An ontology is a formal explicit specification of a shared conceptualization of a domain of interest". The different elements of this definition are defined as follows (Studer et al., 2007):

- Formal: Data is machine-processable and can be interpreted in a well-defined way.
- Explicit: all concepts must be explicitly defined to make them machine-interpretable. Some concepts make sense for humans, but not for machines.
- Shared: There is a consensus about the conceptualization.
- Domain specification: The focus lies on knowledge about a particular domain.

Thus, ontologies facilitate communication between people on one hand and heterogeneous and widely spread application systems on the other by providing shared common understanding of a domain (Pinto & Martins 2004; Verborgh 2014))

Vocabulary: Vocabulary is the set of terms (classes and property names) that could be used in a domain. Ontology specifies how these vocabulary terms can be used. An ontology defines what is the class (TopographicObject), what is the subclass (road), and the properties these class/subclass can have, like "has address", "has-location" etc. (Hart and Dolbear, 2013). Taxonomy: A controlled vocabulary that has been structured into a hierarchy. A taxonomy is often "is a kind of" relationship (Hart & Dolbear 2013; Noy & McGuinness 2001).

Protégé 5.0 (developed by Standford Center for Biomedical Informatics Research), a free and open source software is used for creating the ontologies in our case. It provides a platform to construct domain models

[5] For guidelines concerning conformity of the cycling infrastructure, we refer to Vademecum Fietsvoorzieningen, available at: http://www.mobielvlaanderen.be/vademecums/vademecumfiets01.php

[6] http://www.bizagi.com/

and knowledge based application ontologies. For an in-depth guide to building ontology in Protégé, we refer to Horridge (2011).

3.2.3 Linked Open Data

In the recent years, LOD is seen as an emerging technology that helps both humans and computers with an unambiguous understanding of data and their processing. LOD guides to achieve the vision of the Semantic Web. The Semantic Web, first mentioned by Tim Berners-Lee (2000), allows data to be shared and reused across different platforms thanks to the use of standards and a set of principles. The term 'Semantics' mean that there is an agreement on the meaning of an object or entity. For example, if we talk about an entity or object named 'road', it should have an explicit definition that everyone understands in the same way, no matter where you live or from which culture you are. The Semantic Web is a vision on technology in which computers are capable of understanding the exact meaning of data. This makes machines intelligent so they can process and link the datasets and LOD is a method to attain this vision of Semantic Web. LOD data builds upon the standard web technologies, like Hypertext Transfer Protocol (HTTP) and Uniform Resource Identifier (URI).

Berners-Lee (2000) four design principles of Linked Open Data are :i) Use Uniform Resource Identifiers (URIs) to name the data entities; ii) Use Hypertext Transfer Protocol (HTTP) URIs , so the information can be looked up in the web and description of the particular entities can be retrieved ("dereferenced"); iii) Provide a useful information using open standards like the Resource Description Framework (RDF), SPARQL Protocol and RDF Query Language (SPARQL to encode the information and query them. iii) Provide links to related URIs (other information), so people can discover more. The use of these design principles ensures that data of different sources can be connected and queried (Bizer et al., 2009). These principles are summarized in a "5 star" deployment scheme[7] (Figure 3). This 5 Star Linked Data system is cumulative, meaning that each additional star presumes that the data meets the criteria of the previous step(s).

☆ Data is available on the Web, in whatever format.
☆☆ Data is available as machine-readable structured data, (i.e., not a scanned image).
☆☆☆ Data is available in a non-proprietary format, (i.e, CSV, not Microsoft Excel).
☆☆☆☆ Data is published using open standards from the W3C (RDF and SPARQL).
☆☆☆☆☆ Data is all of the above and links to other Linked (Open) Data.

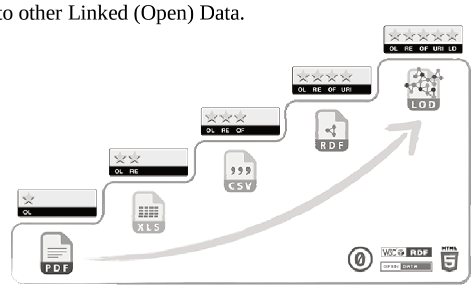


Figure 3 The "5 stars" deployment scheme of Linked Data by Berners-Lee. Source: http://5stardata.info/en/

3.2.3.1 Geospatial Linked Open Data

Geospatial data is recently becoming available as LOD (Koubarakis & Kyzirakos 2012; Batte & Kolas 2012). It differs from other data since the representation of real world entities and their topological relationship should be defined explicitly. There is need for understanding of some general concept of Geographic Information System (GIS), so is discussed breifly further. Any entity in the real world such as traffic lights, road, city is called a 'feature', and each feature has a location x (latitude) and y (longitude). These features are represnted using mainly three types of geometries: traffic lights can be represented a point geometry, roads can be represented as a line geometry and city as a polygon geometry There is always some kind of a spatial realtionship among the features of the real world. The roads can intersect with the boundary of the city, the road contains traffic lights. The topological relationships (equals, disjoint, touches, inside, covered by, contains etc) has been defined by Simle Features Geometry, Egenhofer and RCC8 (Batte & Kolas 2012; Patroumpas 2014). Consequently, in LOD, RDF vocabularies and SPARQL queries meant for

[7] http://5stardata.info/en/

non spatial data are not capable to handle the spatial data. GeoSPARQL[8] is an extension to SPARQL for dealing with geospatial data. As we are dealing with the spatial data, we use GEOSPARQL for both representation and querying.

GeoSPARQL states a standard way to express topological relationships, i.e. spatial properties between topographic features, and to query them. The OGC Simple Feature model represents a spatial object as an OGC feature (Figure 4). There are three key classes for such representation in the GeoSPARQL ontology (Batte and Kolas, 2012; Perry and Herring, 2012):

Feature: an entity in real world with some spatial location; i.e. a municipality;

Geometry: A representation of a spatial location; i.e. a set of coordinates; Any geometric shape: point, line or polygon

Datatype for geometry: Geometry can be represented using Well-Known Text (WKT) or Geographic Markup Language (GML). WKT is the most commonly used, as defined by the Simple Feature Model International Organization for Standardization (ISO) 19125-1. The WKT format (or serialization[9]) for points, lines and polygons looks as follows:

Point: Point (x, y)

Line: Linestring(x1,y1 , x2 y2 …….xn,yn)

Polygon: ((x1,y1 , x2 y2 …….xn,yn), (a1,b1 , a2 b2 …….an, bn)

Spatial object: A superclass of both Features and Geometries. The class geo:Geometry is a top class which is a superclass of all geometry classes.

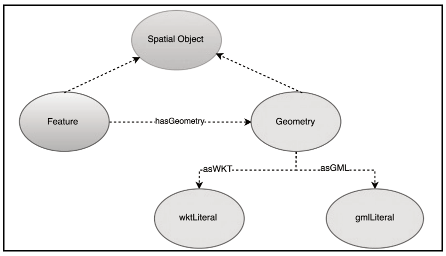


Figure 4:GeoSPARQL ontology. Source: Koubarakis and Kyzirakos (2012)

In addition to ontologies, GeoSPARQL also has reasoning capabilities. This includes a standard way to express topological relationships (spatial properties between topographic features) and to query them. This makes it possible for example to check whether two roads intersects or not. GeoSPARQL provides a set of standard functions for spatial calculations such as. geof:sfDistance (to find distance between two geometric points), geof:sfBuffer (to find for example bus stops located within 200m) (Perry & Herring 2013; Perry & Herring 2012; Batte & Kolas 2012). Thus, providing a platform to do simple spatial queries. However, is still in development to include the functionalities as in GIS tools.

3.2.4 Conversion Tool Selection

There are several tools available for the conversion to LOD depending on the format of data (csv, Realtional Database, shapefile etc.). This study focused on automatic conversion using a tool that has geospatial capabilities as manual conversion is cumbersome or almost not possible when there are more than 1000 rows. The conversion of the raw data in RDB to RDF can be done with several software tools, namely: Geometry2RDF, SPARQLify, TripleGeo and GeoTriples. Here, we list and compare only those softwares with spatial capabilities (Table 1).

[8] http://www.opengeospatial.org/standards/geosparql
[9] The proces of transformation of RDF into data format for publication on the web

Tools	Direct Maping [10]	R2RML[11]	RML[12]	Automatic Mapping Generation	GeoSPARQL Compliance	RDMS	ESRI Shape file
Sparqlify[13]	-	-	-	-	-	√	-
Geometry2RD[14]F	√	-	-	√	√	√	√
TriplesGeo[15]	√	-	-	-	(√)	√	√
GeoTriples[16]	-	√	√	√	√	√	√

Table 1: Comparison of different conversion tools (Kyzirakos, 2015)

After a comparison of the available tools, GeoTriples was chosen as it has the most extensive capabilities supporting geospatial data which makes use of R2RML mapping. GeoTriples is a semi-automated tool that allows the publication of geospatial information as RDF using GeoSPARQL vocabularies. It is not tightly coupled however to a specific vocabulary, so user-defined vocabularies can be used as well (Kyzirakos et al., 2014). The mapping generator can use tailored scripts called mapping for conversion into the RDF data model.GeoTriples supports four types of data sources for direct mapping: Database (Relational Database such as PostGIS); Shapefile (ESRI shapefile); RML (R2RML mapping file) and also KML[17] (Keyhole Markup Language). Then, GeoTriples uses these mappings to generate the RDF output, also called RDF graph or RDF triple, in different standard formats such as N-Triple (default), Turtle and RDF/XML.

4 RESULTS

We provide a standardized workflow created in BPMN for publishing of the cycling infrastructure data as Geospatial Linked Open Data (Figure 5). The simplified and comprehensive method behind this workflow is mainly based on best practices from the W3C Linked Data Cookbook[18], the LINKVIT project[19], and the work by Hart and Dolbear (2013). The process of Linked Data publication is divided in four phases (Figure 5) and are discussed below.

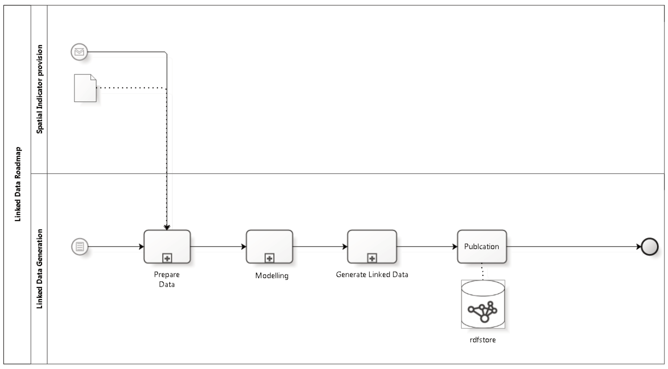
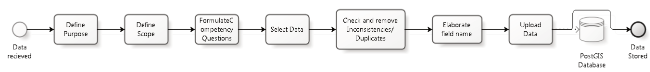


Figure 5: Business process model in for the publication of cycling infrastructure as Linked Open Data. The model is developed using Business Process Modeling Notation (BPMN)

4.1 Phase 1: Prepare data



[10] Direct mapping from relational data to RDF (http://www.w3.org/TR/rdb-direct-mapping/)
[11] A language for expressing customized mappings from relational database to RDF datasets (http://www.w3.org/TR/r2rml/)
[12] An extension of R2RML (http://semweb.mmlab.be/rml/spec.html)
[13] http://sparqlify.org/wiki/Sparqlification_mapping_language
[14] Geometry2RDF is the plugin within Geokettle (a powerful and metadata-driven Spatial Extract Transformation Load tool
[15] https://github.com/GeoKnow/TripleGeo
[16] https://github.com/LinkedEOData/GeoTriples
[17] An OGC standard file format used to display geographic data in mapping applications like google maps. http://www.opengeospatial.org/standards/kml/
[18] http://www.w3.org/2011/gld/wiki/Linked_Data_Cookbook
[19] http://www.linkvit.eu/en/

Figure 6:BPMN scheme of Phase 1 'prepare data' of the standardized workflow for publishing Linked Data

The first phase of data preparation is given in Figure 6. The initial tasks are to define the purpose of data (What is the current/future use?), to set the scope (What is important?) and to formulate competency questions (What queries can be done ?).

Here, the main reason for publication of the cycling infrastructure as the Geospatil Linked Open Data is to stimulate open innovation by providing the data and opportunity to link these data to other datasets. For example, events could be published along the cycling road such as charging stations for electric bikes; and the compatibility could be checked between infrastructure and vehicles using it; which parts of the BFF are already suitable for child bicycle trailers.

Defining the scope helps to decide what should and shouldn't be included for the conversion; The scope of the case here, is to provide open access to the characteristics and suitability of the cycling infrastructure. Any idea about the kind of questions that should be answered correctly by the RDFS ontology and accompanying data also helps to select the suitable and necessary data. It is advised to have as many competency questions as necessary to cover all queries that are expected to be asked by the users of the Linked Data. Some examples in our case are: Which bicycle lanes are conform with Vademecum guidelines? , What is the breadth of the cycling track at a certain location?, What is the nearest cycle track from a work location ? The scope helps to determine what fields are needed. The cycling infrastructure dataset has an extensive inventory with 42 attributes defining cycling infrastructure characteristics, type, built-up material, etc. The selection of 15 attributes are made in the beginning that are interesting, useful and can answer the competency questions formulated above.

The next steps to be taken are: to clean the data by removing inconsistencies and duplicates, elaborate on the field names (field names that are ambiguous and perhaps shortened due to limitations on string length of used database technology). There are different tools available for performing the above mentioned tasks. These tools range from a general purpose spreadsheet (like MS Excel) [20] to dedicated data cleansing tools (like Open Refine[21]). After cleaning for the inconsistencies, at the end of the Phase 1 process we can upload the shapefile into a PostGIS table.

4.2 Phase 2: Modelling

This modelling phase is often the most complex and crucial part of the Linked Data design (Figure 7).

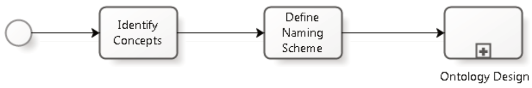


Figure 7: BPMN scheme of Phase 2 'modeling' of the standardized workflow for publishing Linked Data

4.2.1 Identify concepts

The database is documented for the development of a conceptual model of the data by defining concepts and their relationships and properties. The process normally starts with a rough sketch to express how the concepts are related to each other and to real world things. For example: we can relate the cycling infrastructure and its attribute length by forming simple sentence: "Cycling Infrastructure has a length" and "Length is measured in cm". After the documentation of the attributes (Table 2) and rough analysis, the following concepts were identified and summarized in a detailed scheme.

- Cycling infrastructure: A geographical area that is part of a road network. It is defined by the line geometry specially meant for bicycles.
- Inventory: All the measurements related to cycling infrastructure such as length, breadth, type and breadth of the separation strip between cycle track and adjacent road.
- Characteristics: The characteristics of the cycle track including material, cycling direction, morphology etc., given in certain units of measurement.

[20] http://schoolofdata.org/handbook/recipes/cleaning-data-with-spreadsheets/
[21] https://github.com/OpenRefine/OpenRefine/wiki/Getting-Started

- Quality Assessment: The conformity test that measures the compliancy with the Vademecum Fietsvoorzieningen .

Field Name	Field Full Name	Type	Unit	Example	Comments for RDFS Ontology
Ws_oidn	Roadregister_ObjectIdentification_ number	number		603099	Official ID from the road register
Materiaal	Material	string		asphalt	Building material of the Cycling Infrastructure
Breedte	Breadth	number	cm	100	Breadth of cycling infrastructure. Value = min:0 – max 500cm

Table 2 Example of documentation of database for identifying concepts

4.2.2 Define Naming Scheme

The first principle of Linked (Open) Data tells us to “Use Uniform Resource Identifiers (URIs) to name (identify) things” (Berners-Lee, 2000). A scheme is defined for assigning persistent URIs to the dataset. The European Interoperability Solutions for European Public Administrations (ISA) initiative[22] has published ten rules [23] for using persistent URIs [24]. Following these guidelines, the following structure is used:

{domain}{type}/{dataset|ontology}/{concept}/{reference} where

{ domain }	An internet domain (URL) controlled by data owner where the data will be published and the URIs can be dereferenced. Here, the domain is ‘verkeersveiligheids.be’
{type}	Type is ‘id’ of the URI is an identifier of an object (individual/instance); ‘resource’ if it refers to the metadata about an object; ‘vocab’ if it refers to the definition of a concept in an ontology.
{dataset|ontology}	This is either the short name of the dataset, or the short name of the ontology.In our case, we use the name ‘CyclingInfrastructure’ for the dataset, and ‘CyclingInfrastructureOntology’ for the ontology.
{concept}	This is the name of the concept referred to by the object that is identified by the URI.
{reference}	A unique number or code that identifies the object within the namespace. This reference can be both a name or a number, as long as it is unique and not too long. Concepts in an ontology are referenced by their name. Therefore, the {reference} is left empty. Instead a slash (/), the hashtag (#) is used to separate the {concept} from the rest of the URI. Both ‘/’ and ‘#’ has its own advantage and limitations. In our case, ‘#’ is used as it best fits our data.

The resulting persistant URIs are:

For ontology:

< http://www.verkeersveiligheidsmonitor.be/vocab/2015/CyclingInfrastructureOntology.owl# >

For data corresponding to the cycling infrastructure:

< http://www.verkeersveiligheidsmonitor.be/data/CyclingInfrastructure# >

4.2.3 Ontology Design

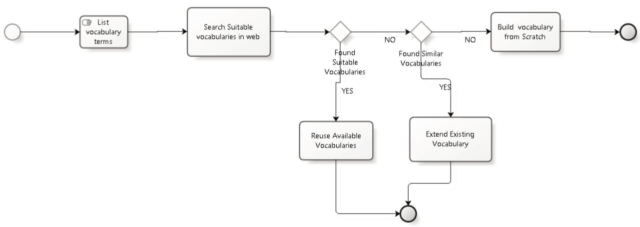


Figure 8 BPMN scheme of the subprocess ‘Ontology design’, part of the standardized workflow for publishing Linked Data

After the identification of concepts, properties and relations, then defining the naming scheme, we move up to the ontology design. Ontology design is in fact a subprocess with own start and end events (Figure 8). One of the first recommended steps towards building an ontology is to determine the domain and scope of the ontology to be developed, and to write down a list of terms to be represented in the ontology, called vocabulary (Noy and McGuinness, 2001; Studer et al., 1998). Terms of this vocabulary represent specific types of things. The definitions of the terms provided by the vocabularies using formal language/standards (RDFS or OWL), bring clear semantics (meaningful data) to descriptions and links (Alani, 2006).

[22] http://ec.europa.eu/isa/index_en.htm
[23] https://joinup.ec.europa.eu/community/semic/document/10-rules-persistent-uris
[24]https://joinup.ec.europa.eu/sites/default/files/c0/7d/10/D7.1.3%20-%20Study%20on%20persistent%20URIs.pdf

After listing the terms, an ontology design process continuous with the search for reusable existing vocabularies. LOV was used as a search engine to sarch for existing vocabularies. There are several web repositories for searching such existing ontologies, like Linked Open Vocabularies (LOV), Swoogle and Watson etc. The LOV repository has a comprehensive view of available RDF schemas and vocabularies. Its interface makes it easy to search and provides additional information, like metadata of vocabularies, classification by vocabulary spaces and interlinks to other vocabularies (Community, 2013).

It is possible that the matching vocabularies do not exist in these repositories. Then, suitable vocabularies could be built by extending existing vocabularies, or new vocabulary could be built from scratch (Noy and McGuinness, 2001) depending on the situation. The decision making process whether to build ontologies yourself is modelled in BPMN (Figure 8) and is based on literature (Corcho et al., 2003; Noy and McGuinness, 2001; Studer et al., 2007).

Though LOD principles recommends you to reuse ontologies when possible. After the extensive search, the decision was to create own basic ontology for the dataset in addition to using some existing ontologies and vocabularies (Table 3) . There was indeed a requirement to develop ontologies for the terms that did not exist yet in the repositories. The advantage of developing your own ontology is that the meaning is closely matched to your data structure. Also, you do not require knowledge of other external ontologies and publication time is faster. The only disadvantage might be that the data becomes less accessible as data users/consumers are less familiar with the ontologies developed by you.

Classes	CyclleLaneCharacteristics, CycleLaneInventory, QualityAssessment etc
Properties	hasQualityAssessment, hasCyclingDirection, hasServiceType etc
Imported properties	rdf[25]:comment, rdf:label, ogc:hasGeometry, ogc[26]:Geometry, ogc_asWKT etc

Table 3: Some of the classes and properties for cycling infrastructure ontologies

The ontology describing the cycling infrastructure inventory and characteristics of the selected attributes are shown in Figure 9. The format used for saving the ontology files is RDF/XML.

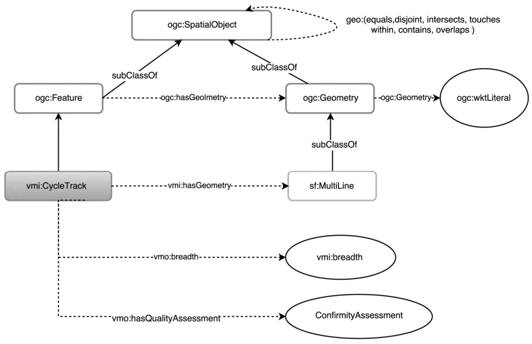


Figure 9:Ontology model for the cycling infrastructure Data

4.3 Phase 3: Linked Data Generation/RDF creation

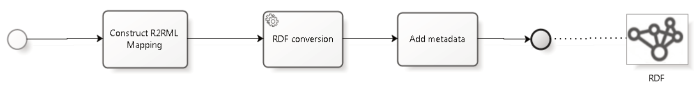


Figure 10: BPMN scheme of Phase 4, modeling, of the standardized workflow for publishing Linked Data

The next phase consists of the generation of Linked Data from a Relational Database (Figure 10). The conversion of a Relational Database (RDB) , or term 'mapping' in our case, is defined in a simplistic way:

- A subject corresponds to a column in the table with an unique id (primary key) concatenated with the namespace URI of a resource.
- Each column name of an RDB table is a RDF predicate.

[25] *'Rdf' is a prefix used for the namespace of RDF standard*
[26] *'ogc' is a prefix for the namespace of GeoSPARQL standard*

- Each RDB table cell value is an object.

4.3.1 R2RML Mapping

The RDB to RDF Mapping Language (R2RML) is a W3C standard for creating customized mapping from relational data to RDF following both structure and target vocabulary given by user (Kyzirakos et al., 2014; Sequeda et al., 2012). The R2RML mapping makes the data retrieved from an input database explicit and better comprehensible than information coded in another proprietary language, in addition to making it easier to reuse for other tables (Hart and Dolbear, 2013).

TriplesMap: A mapping rule for R2RML is referred as TriplesMap (Figure 11). It has three components: i) Logical Source, ii) Subject Map, and iii) one or more Predicate-Object Maps.

Logical Source

A Logical Source refers to a table of the PostGIS database we want to map(rr:logicalTable). It can be that can a SQL view[27] or a valid SQL select query that you are going to convert to RDF. Example:

rr:logicalTable [rr:tableName “cyclingInfr”]

Note: ‘rr’ is a prefix for the namespace of r2rml standard ‘http://www.w3.org/ns/r2rml#’ / ‘cyclingInfr’ is the name of the SQL view table in the PostGIS database

Subject Map

Subject Maps generates a URI from the combination of a column in a logical table (mostly Primary Key relation) with a namespace (Section 4.2.2). A subject map consists of an URI pattern (rr:template) that defines a subject or URI template for each row; a class (rr:class) corresponding to the ontology class for that table. Example: We want to give unique identifier for each geometry and also defin the class Geometry using GeoSPARQL vocabulary.

rr:subjectMap [rr:class ogc:Geometry; rr:template 'www.verkeersveiligheidsmonitor.be/resource/cyclinginfrastructure/Geometry/{“gid"}';];

Predicate Object Map

In Predicate-Objet Map (rr:predicateObjectMap), the attributes of tables (columns) are mapped using suitable ontology properties using Predicate Object Maps. A TripleMap can have one or more rr:predicateObjectMap. This map is further divided into two division:

A Predicate Map specifies the property relationship between a subject and an object.

An Object Map specifies the object column and datatype properties for a value corresponding to that column.

Example: The column “asWKT” which contain the information of the latitude and longitude of the cycling infrastructure is defined using predicate ‘asWKT’ and datatype ‘wktLiteral’ of GeoSPARQL vocabulary.

rr:predicateObjectMap [rr:predicate ogc:asWKT;

rr:objectMap [rr:datatype ogc:wktLiteral;rr:column '"asWKT"';];];

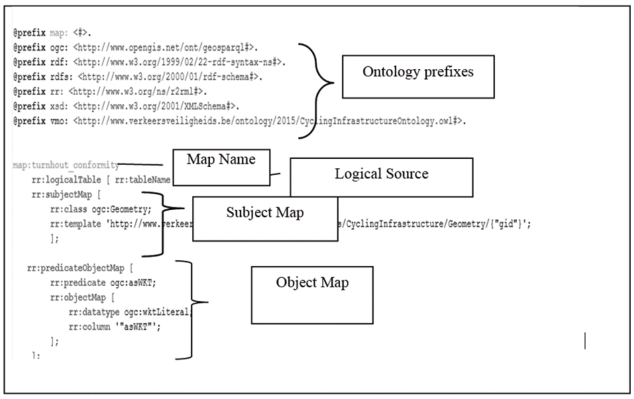


Figure 11: R2RML Mapping: Example of a triplesmap

[27] Postgis view table created from SQL query with only selected attributes

4.3.2 RDF conversion

After the completion of the R2RML mapping process, the next step is to use GeoTriples for generating RDF output. As discussed earlier in Section 3.2.4, GeoTriples was chosen as it has the most extensive capabilities supporting geospatial data which makes use of R2RML mapping. We decided to work with semi-scripted conversion techniques, i.e., using own script. Command Line was used rather than GUI as the errors in script could me accessed and was convenient while running the script multiple times. The '.rml' file created during the previous process (Construct R2RML Mapping) for the automatic to RDF triples. The file is saves as N-triples with '.nt ' extenstion.

4.3.3 Add metadata

The addition of metadata (Semantic Metadata in this case) is crucial for the assessment of data quality (Vrandecic and García-castro, 2013). Metadata provides information about the data itself such as origin, data production; temporal dimension (until when is data valid for use), provenance[28] and for which theme/applications the data can be used. Introducing data with such self-description allows users to make decisions about whether to re-use data while considering reliability and usability.

In April 2015, GeoDCAT-AP [29] an extension of DCAT-AP for geospatial datasets, data series and services has been initiaated by Joint Research Centre(JRC) of the European Commission (EC) (Patroumpas et al. 2015). The metadata specifications will also contains the vocabularies for transport networks (Veeckman et al. 2016). At the time of reseach such development has not been made. Thus, the basic metadata (description, publisher, modification date, creation date, creator and vocabulary used for the dataset) is documented using Dublin core (http://purl.org/dc/terms/) and Data Catalog Vocabulary (http://www.w3.org/ns/dcat#) (See below). However, in future GeoDCAT-AP will be used for documenting metadata.

```
@prefix dcterms: <http://purl.org/dc/terms/>.

@prefix dcat: <http://www.w3.org/ns/dcat#> .

#---------Data Set METADATA-----------------------------------------------------------

vmi:dataset-001 a dcat:Dataset;

                                        dcterms:title "Cycling Infrastructure of Turnhout "@en ;

dcat:keyword "Cycling Infrastructure", "Quality Assessment", "Measurements" ;

dcterms:description "Cycling Infrastructure Dataset for Turnhout, type BFF"@en ;

                                        dcterms:created "2015-11-06"^^xsd:date ;

                                        dcterms:modified "2015-11-06"^^xsd:date ;

                dcterms:identifier
<http://www.verkeersveiligheidsmonitor.be/cms/indicator/CyclingInfrastructure> ;

dcterms:publisher "Policy Support Center Flemish Government for Traffic Safety Monitoring";

                                        dcterms:language <http://id.loc.gov/vocabulary/iso639-1/en> .
```

4.4 Phase 4: Linked Data Publication

In this phase, the dataset is uploaded to the triplestore. There are different stores available for publishing the dataset, both as research prototypes and commercial stores . Based on the inventory of available publication tools for supporting Geospatial Semantics, we can state that the choices for suitable publication tool in the frame of the Traffic Safety Monitor are limited. Because most triplestores only support the publication of two dimensional point data and do not support GeoSPARQL ontologies and function. The geometry of cycling infrastructure is represented as Multilines (combination of several lines). Thus, limiting the choice of available tools. Only Parliament[30] and Strabon[31] appear to provide the most extensive functionalities concerning geospatial data (Bereta et al., 2013, Kyzirakos et al., 2012. Yet, Strabon is not compatible with GeoSPARQL and currently not under active development). As Parliament supports (i) the functionalities of

[28] Provence refers to the process of development of data
[29] https://joinup.ec.europa.eu/asset/dcat_application_profile/asset_release/geodcat-ap-v10
[30] http://parliament.semwebcentral.org/
[31] http://www.strabon.di.uoa.gr/

GeoSPARQL and (ii) all geometry types (point, line, polyline, polygon), and because it is an open source software, we use Parliament as a triplestore for publishing and querying Linked Data in the semantics exchange model of the Traffic Safety Monitor (Koubarakis et al., 2012, Batte and Kolas, 2012; Kolas et al., 2009). We refer to Batte and Kolas (2012) for an overview of the topological functionalities supported by Parliament. The strengths and weaknesses of Parliament are summarized in (Table 4).

Parliament	
Strengths	*Weaknesses*
Implementation of GeoSPARQL standard	Research prototype
Creation of Spatial index	Still not fully stable
Actively under development	

Table 4: Strengths and weaknesses of Parliament

The .ttl (turtle) and .nt (N-Triples) files generated in the previous sections are uploaded in this store. Parliament is only installed in localhost. As discussed earlier, the software is still in a development phase and is still too unstable to go into production. Then, the files can be uploaded into a default RDF graph. Parliament works with creating indexes of two types, Temporal and Spatial, which enables it to have faster query performance and better space usage (Batte and Kolas, 2012; Kolas et al., 2009). Therefore, it is important to check whether the index has been created or not.Now, Parliament is ready for query. The output of the query can be made available in several RDF data formats (RDF/XML, .rdf, GeoJSON[32]) so that data users have a choice and can select the method that best suits their purposes.

4.4.1 GeoSPARQL queries

After generating the Linked Data, the next step was to run the spatial queries to see the performance of the Parliament triple stores. As the queries on Linked open data are complex, we provide first an example of simple query then GeoSPARQL query.

Query 1: Find the cycling infrastructure with breadth more than 150 and conform with the Conformity test of the Vademecum Fietsvoorzieningen.[33]

```
1.  PREFIX ogc: <http://www.opengis.net/ont/geosparql#>
2.  PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
3.  PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>

4.  PREFIX vmo: <http://www.verkeersveiligheidsmonitor.be/vocab/2015/CyclingInfrastructureOntology.owl#>

5.  SELECT  ?breadth ?conformity ?geom

6.  WHERE {

7.  ?s  vmo:hasQualityAssessment ?conformity;
8.           vmo:breadth ?breadth;
9.     ogc:hasGeometry/ogc:asWKT ?geom.

10. FILTER (?breadth >=150 &&  lcase(str(?conformity))="fietsinfrastructuur conform")

11. }
```

Lines 1 - 4 provide the prefixes for the namespaces of ontologies used to describe the data.
Line 5 specifies the selection of variables we want to return as result. In this case these are the variables breadth of cycling infrastructure, result of conformity test and the geometry (multiline segments).
Lines 6 - 9 specify the relationships for selecting the triples. The pattern is :
?subject ?predicate ?object
Line 10 specifies the condition for filtering the data. Here, these conditions are 'breadth is greater than 150 cm' and is 'breadth is conform to the Vademecum guidelines'.

Query 2: GeoSPARQL: Find the cyclingInfrastructure within 200m of Point of Interest (POI) in Turnhout

[32] http://geojson.org/

[33] The Vademecum Fietsvoorzieningen is available at: http://www.mobielvlaanderen.be/vademecums/vademecumfiets01.php

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Editors: Manfred SCHRENK, Vasily V. POPOVICH, Peter ZEILE, Pietro ELISEI, Clemens BEYER

```
1.  PREFIX ogc: <http://www.opengis.net/ont/geosparql#>
2.  PREFIX geof: <http://www.opengis.net/def/function/geosparql/>
3.  PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
4.  PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
5.  PREFIX units: <http://www.opengis.net/def/uom/OGC/1.0/>
6.  PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
7.  PREFIX vmo: <http://www.verkeersveiligheidsmonitor.be/vocab/2015/CyclingInfrastructureOntology.owl#>
8.  PREFIX gn: <http://www.geonames.org/ontology#>
9.  PREFIX wgs84_pos:<http://www.w3.org/2003/01/geo/wgs84_pos#>
10. PREFIX spatial:<http://jena.apache.org/spatial#>

    11. SELECT ?cycle_wkt_s

    12. WHERE {

#conversion of lat long of katholieke-hogeschool-kempen-turnhout-gezondheidszorg to wkt
    13. ?feature a gn:Feature ;
            a.  wgs84_pos:lat ?lat ;
            b.  wgs84_pos:long ?long .

    14. BIND(spatial:toWKTPoint(?lat,?long) as ?wkt) .

#buffer point 200 m
    15. BIND(geof:buffer(?wkt, 200, units:metre) as ?buffer) .

#find cycle tracks within Turnhout
    16. ?cycletrack a vmo:CycleTrack;
                        1.  ogc:hasGeometry ?cyclegeo.

#find cycle tracks within buffer
    17. ?cyclegeo geof:sf_within[a ogc:Geometry;ogc:asWKT ?s_buff];
                  i.  ogc:asWKT ?cycle_wkt_s.
    18. }
```

Lines 1 - 10 provide the prefixes for the namespaces of ontologies used to describe the data.
Line 11 specifies the selection of variables we want to return as result. Here, these variables are the cycling infrastructure geometries with 200 m buffer distance
Lines 13 - 14 represent the conversion of latitude and longitude of Point of Interest (POI), being here katholieke-hogeschool-kempen-turnhout-gezondheidszorg to a WKT variable using a Spatial function (spatial:toWKTPoint).
Line 15 uses the GEOSPARQL function geof:buffer to create a buffer around the POI.
Lines 16 - 18 present the selection of the cycling infrastructure with the buffer by using GEOSPARQL function geof:sf_within.

5 DISCUSSION

5.1 Challenges in LOD

During the recent years, there has been a significant increase in the availability of large amounts of open, distributed and structured semantic data on the web. At the same time, there have been important advances in semantic search (Baines and Lightfoot, 2009; Lopez et al., 2013). Linked (Open) Data fundamentally advocates the interoperability and reuse of data. However, there are considerable challenges, drawbacks and possible hurdles in realizing the full potential of Linked Data (Bechhofer et al., 2013; Lopez et al., 2010). Linked Data principles are built on a stack of several standards and technologies. The learning process is long owing to complexity of the Semantic Web for researchers and developers. The end-users can benefit from Linked Open Data only if there are user-friendly interface solutions that conceal the complexity underneath. Also, the process of finding and querying the distributed semantic open data are difficult and not optimal (Bechhofer et al., 2013; Lopez et al., 2010). Also, to ensure the reusability of the open data, metadata is crucially important as it provides information about provenance, quality, credit and methodology. The issue of trust could be minimized only if the user can view and explore metadata. The assessment of data quality is yet another issue to be solved. There is no automated method to know if the links are logically consistent. Also the misuse of Linked data or misrepresentation of information within Linked data may direct semantic search engines or Semantic Web applications to a spammer's data or website (Hart and Dolbear, 2013).

5.2 Lesson Leaned in the context of Geospatial LOD

In the traffic safety monitor, the linked open data case was implemented to standardize metadata and spatial indicators to give more insight about the traffic safety. The focus lied at the development of a business process for the semantic exchange of spatial data and metadata using linked open data principles. This business process allows describing spatial indicators in a structured way as well as unlocking and presenting them in a coherent way to ensure exchangeability of indicators through semantic operability. The same BPMN workflow can be used for conversion of any other spatial data. The improvisation of the process and semi-automatisation some process is forseen in future. The publication tool 'Parliament' triple store succesfully carried out the simple geoprocessing functions such as buffer and intersects. This should be considered as the strength of the store as it implements the GeoSPARQL standards. The workflow still does not include the interlinking and enriching part of the process.

The geospatial semantic web can offer more intelligence to spatial reasoning and increase the benefit of LOD with geospatial information. It still is at initial stage of development however, facing several challenges in the implementation. The first challenge encountered while developing the workflow is finding stable software. Most of the software packages that are available for free are still a prototype version. Consequently, they are not stable enough to put into production. Performance issues with such software tools include problems of crashing while running queries. A second issue with the geospatial semantic web is that different types of software tend to use their own vocabularies for representing geometries. This makes it more difficult to understand and use them. Although, LOD advocates the reuse of ontologies, the new vocabularies are still being developed. Sometimes it is understandable as Geospatial LOD is not extensive enough to cover all the vocabularies in different domain. However, even the basic vocabularies for representing point geometries is varies for different softwares. Even GeoSPARQL, an W3C recommendation, is supported only by a few softwares. This makes it difficult to achieve the vision of the semantic web where everybody is speaking the same language. The support for map visualization and spatial analysis tools for end users is a third issue. The visualization of linked geospatial data in most case is currently very primitive (for example, restricted to point geometry). Some tools are map4rdf, mappify are still under development.

The installation of different softwares for each phase like mapping tool, converting software, publishing software and visualization software made a conversion and consumption of LOD a cumbersome process. The need for an integrated platform for gespatial data was realized. The GeoLinked data project had develped such platform 'GeoKnow generator workbench' (Garcia-rojas et al. 2014). The tool did not yet support GeoSPARQL and had only point geometry visualization. The GeoSpatial field has still long way to go to develop stable and harmonized solution for Geospatial LOD.

5.3 Coming back to smart mobility : the road ahead

Smart cities concept seems to be divided into two major themes: used of wide range of smart applications (ICT driven) and cititzens and government making sustainable livelihood and environmental choices (citizen driven) (Beniamino Murgante & Borruso 2015). The common grounds here are open data, cross-sector interoperability and user driven application (Bork et al. 2015; Bastiaan Baccarne et al. 2014). In terms of smart mobility the alternative sustainable modes to the private vehicles such as cycling is a needed approach (Garau et al. 2015; Garau et al. 2016). For intercommunication, sharing and processing of the data it is emminent that everybody is speaking the same language. Linked Open Data priciples provides the set of standards for the harmonisation. Linked open data can aid in achieving smart mobility by combining the data from the different sources giving new insights to the situation (Janssen et al. 2011; Kyzirakos et al. 2014; Kyzirakos et al. 2012; Khusro et al. 2014).

In the evolution towards the 'Mobility monitor' from the 'Traffic safety montitor, the cycling infrastructure data will be available for downloading using OGC standardised web services WFS. The data will be available as RDF. The future research further explore the suitability of cycling tracks for mobility scooters, bicycle trailers etc. In the context of indicator development focus is on linking the cycling infrastructure data to other interesting external datasets. The other spatial indicators related to accessibility, road safety, reachability, liveability and environment will be available to public as Geospatial LOD. The aim here is to promote the use of Geospatial LOD and provied an opportunity to connect to the extenal sources, in turn opening the door to the innovation and ad-hoc applications. We give one example of such application as the potential of Geospatial LOD. In our case, the research started with the conversion of the cycling infrastructure to LOD. The focus here is the saftey of citizen while cycling. Along with the infrastructure, another aspect of bikers safety is reducing the number of deadly/non-injurious accidents. The death with accident involving cyclist are officially registered but it is equally interesting to know from citizens point of view which cycling tracks are considered dangerous. These type of accidents though not registered in the accident database of the government but could be gathered via 'crowd sourcing'. Citizen might be intereseted to know about the deadly points in the road and be warned beforehand. Here, LOD is crucial for ensuring interoperability of the data coming from the heteregenous sources. The smart mobile application an help to do the predictive analysis and provide the possible safest cycling routes.

6 CONCLUSION

We are confronted with the challenge of the reducing the traffic jams, accidents and ensuring the safety of the citizens while commuting. In Belgium, cyclists are the major component of the traffic and often considered vulneratble traffic victims. In terms of smart mobility, the clean energy and reducing the traffic cyclists can play major roles. Here, Linked (Open) Data certainly holds a promising future. Also, it helps to

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overcome expensive costs of data harmonization and processing. The fundamental principle of Linked Data is to make data open and available on the web, maximizing its use, reuse and innovation.

However, Geospatial LOD is still at intial phase, most of the software supporting only two point geometries. Also, the software tools to support link discovery and data reuse are relatively immature since the technologies are on the frontline of development. Another aspect is that Linked Open Data is a combination of stack of technologies. There is a need to install specific software for mapping, creating ontology, storing and client side application. To promote the use of LOD as general, there is a need for an integrated platform with stable release. In our experience, it becomes a long learning process if there is necessity to understand and install and use several process. And, the issue of semantics still remains if everybody is working in own silos and developing. Another important expect is reuse of the data. The end-users are expected to benefit the most of Linked Data via user friendly web applications, since query developments are a barrier for people with less technical expertise. The technologies being relatively new has still some hurdles to overcome.

In this study, we formulated a standardized business process model for converting “cycling infrastructure data” to simplify the Geospatial LOD conversion process. The BPMN process need to be extended to include interlinking and enriching phase of Geospatial LOD in the future. In the evolution towards the Mobility monitor, the focus lies in liniking to external dastasets such as environmental and vehicular data to gain maximum insight. The research aims at promoting smart mobility applications and decisions. The objective is to promote both Open Data via WMS/WFS (5) and 5 stars of Tim Berneers Lee Geospatial Linked Open Data.

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🏆 *reviewed paper*

Zusammenhänge zwischen der Basisinnovation der Informations- und Kommunikationstechnologien und der räumlich-funktionalen Entwicklung der europäischen Stadt

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1 ABSTRACT

Zu Beginn der gesellschaftlichen Etablierung der Informations- und Kommunikationstechnologien in den 1990er Jahren wurde die gänzliche Trennung von realem und virtuellem Raum sowie die Auflösung der gebauten Stadt befürchtet. Es folgte eine Phase der intensiven Betrachtung und Auseinandersetzung mit den Entwicklungen. In den Jahren nach der Jahrtausendwende wandelte sich dieses Verständnis hin zu einem Wechselverhältnis: Teile lösen sich auf, andere bedingen sich gegenseitig. Grundlegend scheinen sich reale und virtuelle Welte zu überlagern und miteinander zu verschmelzen. Welche Auswirkungen die Digitalisierung auf den Stadtraum tatsächlich genommen hat, ist bisher jedoch weitgehend stiefmütterlich untersucht worden.

Dieses Paper beschäftigt sich mit den bisherigen Auseinandersetzungen zum Thema der baulich-räumlichen Auswirkungen der Digitalisierung auf die Europäische Stadt. In einer Querschau wird der Stand der Forschung analysiert. So werden neben konkreten Forschungslücken auch Hinweise auf mögliche Untersuchungsparameter und -methoden herausgearbeitet, um im weiteren Vorgehen selbstständig kausale Bezüge zwischen Digitalisierung und Stadtraumentwicklung aufzeigen zu können.

Keywords: IKT, Basisinnovationen, Digitalisierung, Europäische Stadt, Informations- und Kommunikationstechnologie

2 HINTERGRUND DES PAPERS

Vor dem Hintergrund der rasanten Entwicklungsgeschwindigkeit der Informations- und Kommunikationstechnologien (folgend: IuK-Technologien), die in den vergangenen 30 Jahren Einzug in alle gesellschaftlichen und ökonomischen Bereiche gehalten haben, scheint es nur wenige Elemente zu geben, die sich einer umfänglichen Transformation entziehen konnten. Auf den ersten Blick sieht es so aus, als würde die Europäische Stadt zu einem solchen transformationsresistenten Bereich gehören. Dabei unterliegt diese in ihrer Nutzung und Gestalt seit jeher einem steten Anpassungsprozess. Die Europäische Stadt begründet sich aus dem Wechselspiel von gebautem und gelebtem Raum (LEFEBVRE 1970: 129), vom Nebeneinander öffentlicher und privater Einflüsse und Kompetenzen (BENEVOLO u. SCHILLER 1999: 223), sozialer, funktionaler und ästhetischer Dimensionen (HASSENPFLUG 2002: 51-52) sowie räumlicher Nähe, Dichte und Komplexität (HOFFMANN-AXTHELM 1993: 222).

Dieses Paper ist Teil eines Promotionsvorhabens an der Brandenburgischen Technischen Universität Cottbus-Senftenberg mit dem Titel „Das (Raum)Modell der Europäischen Stadt im digitalen Zeitalter". Darin werden die Zusammenhänge zwischen der Basisinnovation der IuK-Technologien und der stadträumlichen Entwicklung unter besonderer Berücksichtigung der Leitfunktion Handel untersucht. Ziel dieses Vorhabens ist es zum einen, die Bedeutung der Betrachtung raumrelevanter Auswirkungen der Digitalisierung für die weitere wissenschaftliche Auseinandersetzung herauszuarbeiten und zum anderen die Darlegung konkreter, kausaler Bezüge respektive Folgen dieser am Beispiel des Handels zu analysieren.

3 DIGITALER WANDEL DURCH INFORMATIONS- UND KOMMUNIKATIONSTECHNOLOGIEN

Der Begriff der Digitalisierung steht stellvertretend für einen Transformationsprozess. Im ursprünglich technischen Kontext noch als Beschreibung der Transformation analoger Daten in digitale Formate. Im Sinne der »digitalen Revolution« wird damit der grundlegende Bedeutungswandel gesellschaftlicher und ökonomischer Bedingungen und Zusammenhängen durch IuK-Technologien beschrieben. Aus denen zugleich vielfältige Aus- und Wechselwirkungen mit allen Lebens- und Arbeitsbereichen resultieren. (Vgl. WIEGANDT et al. 2011: I; KAMMER u. JANIK 2014: 5)

Die Digitalisierung, angetrieben von der Basisinnovation der IuK-Technologien im Sinne des fünften Kondratieffzyklus (NEFIODOW 2014), ist dabei nicht der erste Auslöser für eine Transformation solchen Umfangs. Untersuchungen der vorangegangenen Basisinnovationen zeigen, dass all diese, von der

Dampfmaschine und der Eisenbahn über Elektrotechnik bis zum Automobil, als Triebkraft der wirtschaftlichen Entwicklungen ähnlich umfangreiche Auswirkungen zur Folge hatten.

Bei näherer Betrachtung haben diese einen deutlich sichtbaren Einfluss auf die räumliche Entwicklung der Europäischen Stadt genommen. (Vgl. BÄRTSCHI 1983; MUTSCHLER 2014) Auch die Stadtplanung als raumdefinierende und -organisierende Disziplin reagierte darauf, beispielsweise mit gewandelten Leitbildern. (BENEVOLO 1993: 229-231; STURM 2000: 7-8)

Es drängt sich die Schlussfolgerung auf, dass auch die IuK-Technologien raumrelevante Auswirkungen auf die Stadt haben. Die Frage, die sich daran anschließt lautet: Welche baulich-räumlichen Auswirkungen hat die Digitalisierung auf die Europäische Stadt? Vor dem geschilderten Hintergrund und der aufgeworfenen Frage beschäftigt sich das vorliegende Paper in einer Querschau mit den bisherigen Auseinandersetzungen.

4 BASISINNOVATIONEN ALS TRIEBKRÄFTE DER STADTENTWICKLUNG

Kondratieffzyklen, vordergründig als ökonomische Phänomene bekannt, sind ihrem ursprünglichen Sinn nach als „Reorganisationsprozess von Wirtschaft und Gesellschaft“ (NEFIODOW 2014: 3) zu verstehen. Sie geben über mehrere Jahrzehnte die Richtung des Wirtschaftswachstums vor und sind in nahezu allen gesellschaftlichen Bereichen bestimmend. (HEDTKE 1990: 90; NEFIODOW 2014: 3) Als Auslöser der Zyklen sah der russische Wirtschaftswissenschaftler und Ökonom Nikolai Kondratieff Basisinnovationen. Diese definierte er als bahnbrechende Innovationen, die eine Leitfunktion für die Wirtschaft einnehmen und weitere Industrien als Folgen nach sich ziehen. (NEFIODOW 2014: 3-4)

Solche Basisinnovationen waren es, die den wirtschaftlichen Wandel in der Produktion von der Agrar- und Landwirtschaft, hin zur Industrie und Dienstleistung angetrieben haben. Mit der Erfindung der Digitaltechnik wurde die Herausbildung eines neuen Produktionssektors begünstigt. (PILLER 2006: 31-32) Dieser, auch quartärer Sektor genannt, zeichnet sich dadurch aus, dass materielle Güter, wie sie den primären, sekundären und tertiären Sektor bestimmen, gegenüber den immateriellen Gütern an Bedeutung verlieren. (Vgl. Abb.1) Im Umkehrschluss gewinnen die immateriellen Güter wie Daten, Informationen und Ideen an Bedeutung. (REDLICH u. WULFSBERG 2011: 31-32) Dieser ökonomische Transformationsprozess ist zugleich Auslöser für die Entwicklung hin zur Informations- bzw. Wissensgesellschaft. (STREICH 2011: 24) Während in der Dienstleistungsgesellschaft der Servicegedanke allumfassend vorherrschte, zeichnet sich die Wissensgesellschaft durch »Wissensarbeit«, der „[…] Instrumentalisierung von Informationen und Kommunikation“ (SPUR u. EßER 2013: V) aus.

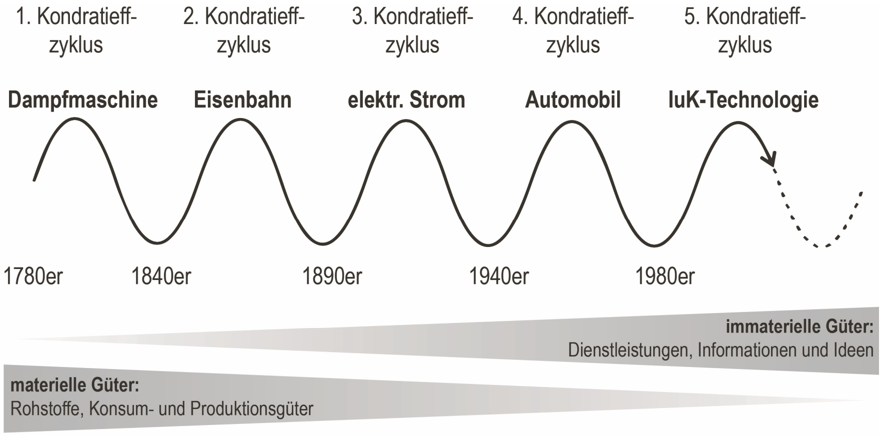

Abb. 1: Kondratieffzyklen und Basisinnovationen (eigene Darstellung)

Die beschriebenen gesellschaftlichen und wirtschaftlichen Transformationsprozesse der vorangegangenen Basisinnovationen zeigten sich bisher auch durch verschiedene Ausprägungen im Stadtbild, die im Folgenden stark vereinfacht dargestellt werden:

Die Dampfmaschine, sinnbildlich Merkmal der Industrialisierung, brachte als Wegbereiter der Textilindustrie Fabriken, Schornsteinanlagen und neue Wohnquartiere im Stadtraum hervor. Die Entwicklungen hin zu maschinellen Fertigungs- und Produktionsweisen, führte zu einem Boom der Städte als Lebens- und Arbeitsraum, einhergehend mit massiver Landflucht. (BENEVOLO 1993: 184-186) Auf Grund der neuen, parallelen Strukturen von Arbeit, Wirtschaft und Wohnen in der Stadt, wurden Ansätze einer strikten Funktionstrennung (Charta von Athen), abgeleitet aus Hygiene- und Gesundheitsansprüchen, planerisch forciert. (STURM 2000: 7)

Mit der Weiterentwicklung der Technologien hin zum Massentransportmittel Eisenbahn erlangte die räumliche Dimension der Städte eine neue Ebene, die sich zunehmend in die Region ausbreitete. Es entstand ein weiteres Erschließungsnetz im Raum. Schienenwege, z. T. großflächige Infrastrukturen und monumentale Bauwerke, wie Bahnhöfe, Haltepunkte und Werkstätten, prägen die Europäische Stadt bis heute. (BENEVOLO 1993: 192-193)

Mit dem elektrischen Strom folgte im Weiteren die Stahl- und Chemieproduktion. Die Massenfertigung von Gütern wurde revolutioniert. In Folge dessen sind neben erweiterten Transportinfrastrukturen auch große Fabrik- und Fertigungshallen zum Stadtbild hinzugekommen. Die Elektrifizierung der Stadt machte diese zudem auch bei Nacht nutz- und erlebbar, der persönliche Aktionsradius erweiterte sich erheblich. Die weiterhin wachsende Stadtbevölkerung machte die Kanalisation der Stadt zur Wasser- und Abwasserversorgung erforderlich. Die Planungen von Haussmann ab 1853 zur Stadterweiterung, Straßenraumentwicklung und Kanalisationsplanung in Paris (BENEVOLO 1993: 196-210) sowie der Hobrecht-Plan (1862) in Berlin (BENEVOLO 1993: 214) machen exemplarisch die wechselseitige Beziehung zwischen Stadt- und Infrastrukturplanung sowie gesellschaftlicher und technischer Entwicklung deutlich.

Zudem wuchs die persönliche Mobilität durch die Erfindung und den schrittweisen, massentauglichen Einsatz des Automobils (1886 Carl Benz). Das Automobil, noch heute wichtiger Wirtschaftsfaktor der Industrienationen, machte neue Straßen- und Wegenetze sowie neue Ordnungssysteme in der Stadt erforderlich. Das Auto als individuelles Transportmittel und die dazugehörigen Verkehrsinfrastrukturen erlaubten aber auch eine zunehmende Trennung von Arbeiten und Wohnen. Das städtische Umland wurde als Wohnraum immer attraktiver.

Allen Basisinnovationen ist gemein, dass sie eine Vielzahl an Folgeinnovationen und -einrichtungen nach sich zogen, die ebenfalls raumwirksame Bedeutung haben. Deutlich wird unter diesem Gesichtspunkt jedoch auch, warum eine eindeutige Zuordnung von Innovationen und baulich-räumlichen Auswirkungen nur schwer auf direktem Wege möglich ist. Es ergeben sich Kausalketten bzw. Folgen die aufeinander aufbauen.

5 PHASEN IN DER AUSEINANDERSETZUNG MIT DIGITALISIERUNG UND STADTRAUM

Der 1941 von Konrad Zuse entwickelte, erste programmierbare Computer ‚Z3‘, kann als Meilenstein des fünften Kondratieffzyklus bezeichnet werden. Mit Beginn der 1960er Jahre etablierte sich der Einsatz von Computern in einzelnen Forschungseinrichtungen und Großkonzernen. Erst im darauffolgenden Jahrzehnt wurde die Entwicklung und Verbreitung spezifischer und anwenderorientierter Software im Unternehmensbereich gängige Praxis. Mit der Verbreitung des PC (Personal Computer) zu Beginn der 1980er Jahre im unternehmerischen Umfeld setzte sich der Einsatz von Computertechnik zunehmend auch im Privaten durch. Ab Mitte der 1990er Jahre weitete sich die bis dahin stattgefundene technische Entwicklung durch die Verbreitung des Internets als Daten- und Kommunikationsbasis aus und führte sowohl im unternehmerischen, als auch im gesellschaftlichen Umfeld zu einem grundlegenden Wandel. (CASTELLS 2001: 5) Ab 2010 wurde die Nutzung des Internets zunehmend mobiler. Handheld Geräte wie Smartphones und Tablets (mobile devices) ermöglichen einen zeitlich und räumlich freien Umgang mit dem neuen Medium. (BRENNER u. WITTE 2011: 9-10)

Die rasante Transformationsgeschwindigkeit, ausgelöst durch die fortwährende Entwicklung der IuK-Technologien, hat dazu beigetragen, dass wissenschaftliche Untersuchungen in Hinblick auf die stadträumliche Entwicklung, aufbauend auf empirischen Daten, bisher nicht ausreichend stattgefunden haben. (CASTELLS 2005: 11; WIEGANDT et al. 2011: II)

Die bisherige wissenschaftliche Auseiandesetzung mit der Thematik lässt sich in drei Phasen gliedern (Vgl. Abb.2):

1990er Jahre: Auflösung des Raums - Euphorie des Neuen

2000er Jahre: Erste Welle der Ernüchterung – Komplexitätsbetrachtung

2010er Jahre: Fokussierte Einzelthemenbetrachtung – Rückkehr und Zukunft der Stadt.

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Ziel dieser phasenweisen Betrachtung ist es, eine Übersicht hinsichtlich der jeweiligen Reflexionen auf die baulich-räumlichen Auswirkungen zu erlangen. Weiterhin werden auf diese Weise Themen gesammelt, die im weiteren Verlauf der Arbeit als Indikatoren für die Untersuchung der Zusammenhänge zwischen

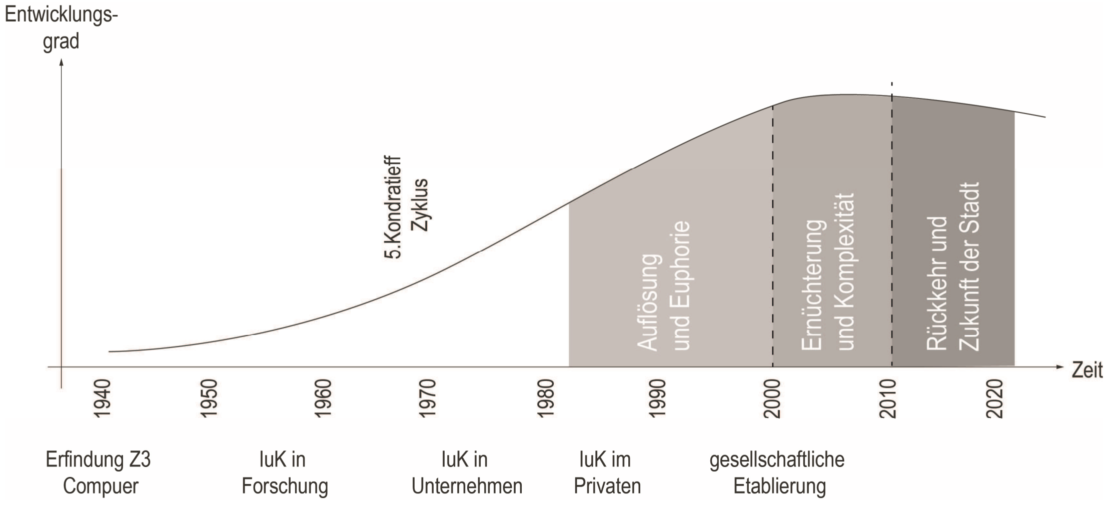

Abb. 2: Phasen in der wissenschaftlichen Auseinadersetzung zu IuK-Technologien und den baulich-räumlichen Erwartungen (eigene Darstellung)

5.1 1990er-Jahre: Auflösung des Raums - Euphorie des Neuen

In den verschiedensten Fachdisziplinen sind in den 1990er Jahren mit der Entwicklung und gesellschaftlichen Etablierung der IuK-Technologien Zukunftsvorstellungen erwachsen, die massive Auswirkungen für den Stadtraum, bis hin zu dessen Auflösung schlussfolgerten. Mindestens eine Überformung des Stadtraums durch die neuen Kommunikationsnetze schien unausweichlich. Parallel zu dieser Befürchtung, entstand auch eine Euphorie für das fundamental Neue. Veränderungen in allen Bereichen wurden prognostiziert: Von der gesellschaftlichen und körperlichen Freiheit wurde geträumt und ein eklatantes Wirtschaftswachstum erwartet. (BUDKE et al. 2004: 10) Der euphorische Gedanke von der „Vernetzung der Welt" (RÖTZER 2006: 39), der sinnbildlich für das Streben nach neuen und offenen Strukturen, nach Freiheit und Auflösung von Grenzen stand, kann vor dem zeithistorischen Kontext des Kalten Krieges auch als gesellschaftlicher Spiegel verstanden werden. Der Wunsch nach Austausch und Kommunikation war prägend für die Zeit. Mit der Computertechnik und dem Internet ergaben sich ungeahnte Möglichkeiten diesen Begehrlichkeiten näher zu kommen.

5.1.1 Auflösung des Raums und seiner Funktionen

Die räumliche Konzentration und Dichte, historisch gewachsene Merkmale der Europäischen Stadt, erfuhren bereits mit der Etablierung von Telefon und Auto eine allmähliche Aufweichung. Mit dem Aufkommen der Computertechnik und dem zunehmenden Einsatz des Internet in Wirtschaft und Gesellschaft, erlangte die Befürchtung zur Auflösung der Stadt eine neue Dimension. Florian RÖTZER (1995) sprach in diesem Zusammenhang vom Erodieren der Städte, die neben dem Raumverlust zugleich mit einem Funktionsverlust zu kämpfen haben werden. Mit dem Verlust der Funktionen stellt er auch die Vermutung an, dass Städte lediglich Orte der Erinnerung vergangener Zeiten sein werden: „Die historischen Städte werden bestenfalls zu Museen, hinter deren Fassaden High-Tech und Event-Kommerz regieren, zu Orten der »Erlebnisgesellschaft«, die immer beliebiger werden und mehr und mehr in Konkurrenz zu Freizeitparks und Shopping Mall stehen." (RÖTZER 1995: 38)

5.1.2 Kommunikation

Der Architekturhistoriker Helmut BÖHME (2000) beschrieb diesen Trend des räumlichen Umbruchs als eine Verschiebung der Abhängigkeiten von Stadt und Kommunikation: „Dieser neue Stadtraum ist nur noch gehalten durch eine Dimension von elektronischer Kommunikation […]" (BÖHME 2000: 14). In der Betrachtung der historisch gewachsenen Beziehung von Stadt und Gesellschaft, in der die Kommunikation eine Schlüsselrolle einnahm, stellte er weitergehend fest, „Die Kommunikation braucht keinen städtischen Ort mehr." (BÖHME 2000: 16)

5.1.3 Virtueller Raum

Wie BÖHME ging auch der Soziologe und Stadtforscher Hartmut HÄUßERMANN (2000) in seinen Betrachtungen davon aus, dass die Europäische Stadt, die bis dahin prägend für das Verständnis von Raum und Gesellschaft war, nicht mehr erforderlich sein wird. Die virtuelle Stadt würde an ihre Stelle treten: „Die alte europäische Vorstellung, dass Urbanität an einen Ort gebunden ist und dass dichte Kommunikationsbeziehungen ein Kennzeichen dafür seien, ist von den Propheten des digitalen Zeitalters bereits verabschiedet worden. […] Der virtuellen Stadt im Internet gehört demnach die Zukunft." (HÄUßERMANN 2000: 64)

5.1.4 Stadtgestalt und Anpassungsfähigkeit

Diese erste Phase der (gesellschaftlichen) Computerära war geprägt vom Gedanken einer zunehmenden Trennung von Körper und Raum. Es drängte sich die Frage auf, welche Gestalt die Stadt unter den neuen Vorzeichen in Zukunft haben werde. Braucht man noch Licht, Luft und Sonne zum Wohnen oder öffentliche Orte der Kommunikation und des Austauschs, wenn der virtuelle Raum doch all jene Funktionen einer Stadt übernehmen wird? (RÖTZER 1995: 43) HÄUßERMANN konstatierte „Die Stadt ist in dieser herkömmlichen Gestalt nicht mehr notwendig." (HÄUßERMANN 2000: 67)

Die Frage nach der Stadtgestalt ging einher mit der Frage der Anpassungsfähigkeit an neue Gegebenheiten. RÖTZER nahm dieser Frage die Antwort voraus, indem er reflektierte, dass die Gestalt einer Stadt seit jeher etwas grundlegend, dauerhaft Konsistentes ist. Städtische Wandlungsprozesse, so das Dilemma, unterliegen zeitlich gesehen ganzen Epochen. (RÖTZER 1995: 13-14) Die Verbreitung und Aneignung der neuen Technologien führte zur Weiter- und Neuentwicklung von Anwendungen und Nutzungen. Es findet eine stetige Rückkopplung und Erweiterung statt, wodurch eine rasante Beschleunigung des technologischen Wandels zu beobachten ist. IuK-Technologien erobern immer größere Reichweiten und erweitern somit ihre Einflusssphären. (CASTELLS 2001: 6)

Aufbauend auf dem Gedankengang der Geschwindigkeit beschrieb BÖHME (2000) diesen Transformationsprozess durch IuK-Technologien als Verschwinden von Stadt, Raum und Ort. Er begründete diesen Ansatz mit den neuen Möglichkeiten der Distanzüberwindung, welche die Kommunikationstechnik mit sich bringt indem er erkennt, dass die telekommunikative Stadt nicht wie die Alte raumverdichtet, sondern zeitverdichtet ist. (BÖHME 2000: 14)

Diese erste Phase in der Auseinandersetzung mit Digitalisierung und Stadtraum war geprägt von der Furcht der Auflösung des materiellen Raumes und der Euphorie der scheinbar neuen Möglichkeiten. Entdichtung und Dezentralisierung schienen unausweichliche Effekte für die Stadtentwicklung zu sein. Insbesondere den neuartigen Kommunikationsmöglichkeiten wurde eine Schlüsselrolle in der Entwicklung zugeordnet. Wissen als Ressource konnte seither in Sekundenbruchteilen transportiert werden. Raum und Zeit schienen sich in Auflösung zu befinden. Die Stadt als gebautes Element schien ihre Daseinsberechtigung zu verlieren: „Die Stadt war der Ort, an dem die Industriegesellschaft entstanden ist, aber die postindustrielle Gesellschaft kann gut auf die Stadt verzichten." (HÄUßERMANN 2000: 67)

5.2 2000er-Jahre: Erste Welle der Ernüchterung – Komplexitätsbetrachtung

Die Phase des Jahrtausendwechsels war geprägt von einer Skepsis und Ernüchterung gegenüber der Technik und deren möglichen raumrelevanten Auswirkungen. Im Rückblick auf die vergangenen Jahre deutete sich allmählich an, welche der prophezeiten Folgen durch die Digitalisierung tatsächlich eintraten. William MITCHELL (1996), Architekturprofessor am Massachusetts Institute of Technology, reflektierte diesbezüglich nüchtern, dass es bereits in vergangenen Zeiten umfangreiche Transformationsprozesse durch Innovationen gegeben hat: „It's an old script replayed with new actors. Silicon is the new steel, and the Internet is the new railroad." (MITCHELL 1996: 16)

Das Meinungsbild wandelte sich zur Haltung, dass die Stadt nicht per se obsolet werde, sondern eine Überformung erfahren wird: „Physical settings and virtual venues will function interdependently, and will mostly complement each other within transformed patterns of urban life rather than substitute within existing ones." (MITCHELL 1999: 155) Auch RÖTZER kehrte sich von der Prophezeihung der Auflösung des Raumes ab. Er sah die Gefahr eher darin, dass „[…] die Bedeutung des verdichteten städtischen Raums in vielerlei Hinsicht schrumpft." (RÖTZER 2006: 40)

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Sinnbildlich für die Distanzierung von der ersten Phase, der Auflösung bis zur Euphorie, steht auch der Wortwandel. Der Begriff der »digitalen Revolution«, wie er in der Anfangszeit geprägt wurde, erfuhr zunehmend in wissenschaftlichen und gesellschaftlichen Kreisen eine Abkehr. (BUDKE et al. 2004: 10) IuK-Technologien galten nicht mehr grundlegend als revolutionäre Neuheit, sie etablierten sich zunehmend in allen Lebensbereichen.

In der Folge dieser Ernüchterung rückten systematische Betrachtungen der Wechselwirkungen in den Fokus. Eine Gründungswelle von Netzwerken, Kommissionen, Arbeitsgruppen und Tagungen zum Thema der Digitalisierung war das Ergebnis. (BUDKE et al. 2004: 10) Zudem wurden neuartige Untersuchungsmethoden erprobt. Unter dem Stichwort der »Internetkartographie« wurde versucht, den bis dahin scheinbar unsichtbaren Folgen der Digitalisierung ein Gesicht zu geben. So wurden durch die grafische Abbildung von Hardwarestrukturen, Datenaufkommen, IP-Adressen und Zugangsmöglichkeiten, erste Bilder zum Zusammenhang von Technik und Raum erzeugt. (HINZE 2004)

In dieser Phase erlebten auch die Smart-City-Gedanken[1] einen Boom, die z.T. als eine ganz neue Form der Stadt betrachtet werden. Zu Beginn ein unternehmensgetriebener Ansatz, der erst im Laufe der Entwicklung auch in der wissenschaftlichen Auseinandersetzung eine Position einnahm. Symptomatisch für diesen Ansatz ist der Gedanke der vollkommenen Durchdringung der IuK-Technologien in allen gesellschaftlichen, wirtschaftlichen und städtischen Bereichen. Die Ziele dahinter variieren von der Abkehr von fossilen Energieträgern bis hin zu einem neuen Marketingbegriff, der wirtschaftlichen Aufschwung und Vorteile im Standortwettbewerb bringen soll. (JAKUBOWSKI 2014: 10) Abgesehen von gänzlichen Stadtneubauten, wie beispielsweise bei der südkoreanischen Stadt Songdo, handelt es sich bei Smart City Ansätzen häufig um eine Überformung bestehender Strukturen durch digitale Netze.

5.3 2010er-Jahre: Fokussierte Einzelthemenbetrachtung – Rückkehr und Zukunft der Stadt

Die Phase der systematischen Betrachtung setzt sich bis heute fort, jedoch mit einer Schwerpunktverlagerung hin zu tiefgründigen Auseinandersetzungen mit einzelnen Themenstellungen. Verschiedene Fachbereiche beschäftigen sich zunehmend mit den Einflüssen der Digitalisierung auf das jeweilige Themenfeld. Ein raumaffines Beispiel ist die Ausbildung im Bereich Architektur. Die RWTH Aachen bildete im Studienprojekt »Tertiär, grau«, die angehenden Architekten im Bereich Gebäudelehre im speziellen Kontext der Digitalisierung aus. Die Studierenden beschäftigten sich mit den Bauwerken der Infrastruktur des 21. Jahrhunderts, vor allem mit Blick auf technisch-funktionale Aspekte. (BERNHARDT 2011) Wie sehen Gebäude aus, in denen Serverräume immer größer werden, klassische Büros hingegen tendenziell eher verschwinden?

Eine Art Kräftemessen bzw. eine Machtverschiebung findet derzeit zwischen realem und virtuellem Raum statt. RÖTZER (2006), der seine Aussagen der frühen Phasen selbst korrigiert, stellt fest: „Das Zusammenspiel von wirklichen und virtuellen Räumlichkeiten, des leibhaften und des virtuellen Körpers, ist zu einer der neuen Herausforderungen […] geworden.“ (RÖTZER 2006: 46) Die utopischen Gedanken der Anfangszeit wurden in Teilen bereits heute in die Realität umgesetzt: Der Kühlschrank, der sich durch Lieferdienste selbst befüllt. Oder die Utopie vom selbstfahrenden Auto, welches heute bereits mit einer Vielzahl an Fahrassistenten ausgerüstet ist, um unterstützend einzugreifen. Rein technisch betrachtet gibt es bereits eine Vielzahl neuer Möglichkeiten, die z.T. ihre gesellschaftliche Reife noch nicht erreicht haben. Im Gegensatz dazu, rückblickend auf die ersten Jahre der Interneteuphorie, sind die Gedanken der Enträumlichung endgültig gescheitert. Journalist und Architekturkritiker Hanno RAUTERBERG (2012) erkennt in den aktuellen Mustern sogar einen gegensätzlichen Trend in der »Digitalmoderne«: Je losgelöster der Mensch leben und arbeiten kann, umso stärker wird das Verlangen nach räumlicher Rückkopplung. Eine Widerbelebung des Städtischen ist die Folge. (RAUTERBERG 2012: 14) Das »neue« „[…] Verlangen nach Stadt, nach ihrer Intensität und Dichte zu wachsen […]“ (RAUTERBERG 2013: 9) ist die Gegenbewegung

[1] Da es keine allgemeingültig anerkannte Definition des Begriffes gibt, wird sich im Folgenden auf den Ansatz der Wiener Stadtwerke bezogen, der zu den häufig verwendeten gehört: „Smart City bezeichnet eine Stadt, in der systematisch Informations- und Kommunikationstechnologien sowie ressourcenschonende Technologien eingesetzt werden, um den Weg hin zu einer postfossilen Gesellschaft zu beschreiten, den Verbrauch von Ressourcen zu verringern, die Lebensqualität der Bürgerinnen und Bürger und die Wettbewerbsfähigkeit der ansässigen Wirtschaft dauerhaft zu erhöhen, – mithin die Zukunftsfähigkeit der Stadt zu verbessern.“ (WS 2011: 6)

zur Prophezeiung der raumlosen, digitalen Stadt. „Die Menschen müssen nicht, aber sie treffen sich trotzdem immer noch gerne im realen öffentlichen Raum.“ (BBSR 2015).

Der Philosoph Luciano FLORIDI (2015) hält die Frage nach online oder offline sogar für überflüssig. Nach seiner Vermutung „[…] sind wir wahrscheinlich die letzte Generation, die noch einen deutlichen Unterschied zwischen Online- und Offline-Umgebungen erfährt.“ (FLORIDI 2015: 129) Die Generation Z, all jene zwischen 1995 und 2010 Geborenen, werden den Unterschied zwischen realem und virtuellem Raum in diesem Umfang nicht mehr wahrnehmen.

6 ERKENNTNISSE AUS DER BETRACHTUNG

Die Auseinandersetzung mit den Auswirkungen der Digitalisierung findet auf Grund der Komplexität des Themas und der rasanten Entwicklungsgeschwindigkeit zuweilen mit einer thematischen Fokussierung statt. So werden Themen wie Gesellschaft und Kommunikation, Wirtschaft und Unternehmensstrukturen, Nutzung und Verhalten im öffentlichen Raum, Verkehr und Mobilität oder auch der Einzelhandel sehr konkret in der wissenschaftlichen Auseinandersetzung hinsichtlich der Veränderungen durch die Digitalisierung überprüft.

Aus dem Blickwinkel der stadträumlichen Entwicklung, brachte die Betrachtung der Etablierung der IuK-Technologien in Wirtschaft und Gesellschaft als zentrales Ergebnis einen Mangel an empiriegestützter Forschung hervor. Es gibt aktuell wenige Ergebnisse, die eine fundierte Aussage über die erkennbaren, respektive zu erwartenden Folgen der Digitalisierung für die baulich-räumlichen und funktionalen Entwicklungen der Europäischen Stadt treffen.

In der Aufarbeitung der verschiedenen Phasen der Auseinandersetzung von IuK-Technologien im stadträumlichen Kontext wurde deutlich, dass eine Vielzahl an Faktoren aus unterschiedlichsten Richtungen die Entwicklungen beeinflussen. Eine interdisziplinäre Forschung ist daher zwingend notwendig. Themenfelder, die in diesem Zusammenhang, zumindest in Ansätzen, berücksichtigt werden müssen, sind: Innovationsforschung, Wirtschafts- und Investitionsgeschichte, Architektur- und Stadtbaugeschichte, Geographie, Sozial- und Gesellschaftswissenschaften sowie Kunstgeschichte und Philosophie. Ziel dieser interdisziplinären Untersuchung muss es sein, in der Breite der Themenfelder die verbindenden Perspektiven und Elemente zu identifizieren, um ein Aussage über deren Wechselwirkungen treffen zu können.

Aus den vorgestellten Gedankengängen zu Basisinnovationen und deren baulich-räumlichen Auswirkungen wird für die weitere Bearbeitung der Thematik folgende Ausgangsthese aufgestellt: Alle bisherigen Basisinnovationen haben baulich-räumliche Auswirkungen auf die Stadt genommen. Es ist davon auszugehen, dass auch die IuK-Technologien einen solchen Einfluss haben oder noch entwickeln werden.

Die Frage nach Ursache und Wirkung wird dabei eine zentrale Bedeutung in der Auseinandersetzung einnehmen. Es gilt in den folgenden Arbeitsschritten ein Forschungsdesign zu entwickeln, dass auf Wirkungsbeobachtung und -Analyse basiert und in der Lage ist, Kausalbeziehungen aufzuzeigen. Für das methodische Vorgehen wird sich dabei an den Herangehensweisen der Akteurs-Netzwerk-Theorie und der Technikfolgenabschätzung orientiert.

Anders als in den Betrachtungen der vorangegangenen Basisinnovationen kommt mit der IuK-Technologie zudem ein Raumverständnis, das des virtuellen Raumes, als neues Element hinzu. Der bisherige Raumbegriff erfährt dadurch eine Erweiterung. Inwieweit sich daraus auch Änderungen im Verständnis des Typs der Europäischen Stadt ergeben, soll in der weiteren Bearbeitung ermittelt werden.

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A Critical Deconstruction of the Concept of Transit Oriented Development (TOD)

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1 ABSTRACT

The concept of Transit-Oriented Development, or TOD, has generated much interest in Europe over the last decade. Because the term "TOD" originated in the United States, this model is often assumed to be a recent import from North American cities. This paper examines how planning policies in three European capital city-regions – Amsterdam, Stockholm and Vienna – have been shaped by the ideas and principles underlying TOD since the Second World War. All three case studies are located in countries with mature systems of spatial planning: the Netherlands (Western Europe), Sweden (Northern Europe), and Austria (Central Europe). The paper illustrates that TOD, albeit called by other names or not named at all in policy, has been an intrinsic principle of planning in Austria, the Netherlands, and Sweden and in their respective capitals for decades. Far from being a recent North American invention, TOD has its roots in Europe and dates back many decades. Clearly, the enthusiasm with which TOD in its recent embodiment has been received in the US and Canada has done much to highlight and promote the concept over recent decades in Europe.

Keywords: Stockholm , Amsterdam, Europe, Transit-Oriented Development, Vienna

2 INTRODUCTION

The concept of Transit-Oriented Development, or TOD, has generated much interest in Europe over the last decade due to a combination of factors including technological innovations in transit, privatization reforms in rail transit, new goals of sustainable urban development, and the shifting spatial dynamics of contemporary society (Bertolini et al. 2012). Some of the pioneering work to define and codify TOD was presented in 'The Next American Metropolis' by Peter Calthorpe in 1993, where he proposed a series of conceptual design schemes and diagrams that have come to epitomize TOD (Calthorpe 1993). Because the term "TOD" originated in the United States, this model is often assumed to be a recent import from North American cities. However, TOD is based on much older ideas of rail-based urban development that took place in many European cities during the 19th and 20th centuries (Newman and Kenworthy 1996). Arguably, the modern reincarnation of TOD is more focused on urban aesthetics (Pojani and Stead 2015). Other tenets, such as accessibility, density, and mixed-use have remained more or less unchanged.

2.1 Research Question

This paper examines how planning policies in three European capital city regions – Amsterdam, Stockholm and Vienna – have been shaped by the ideas and principles underlying TOD. All three case studies are located in countries with mature systems of spatial planning: the Netherlands (Western Europe), Sweden (Northern Europe), and Austria (Central Europe). To be clear, the study does not provide an analysis of direct references to TOD in planning policies in these city regions. Instead, it examines the extent to which planning policies from the middle of the 20th century to the present have reflected TOD principles. The main focus in this analysis is on train-based (i.e. "nodal") TOD as opposed to tram-based or "corridor" TOD. Much of the analysis is based on secondary sources (i.e. articles, books, and planning reports) written in English. This study was conducted as part of the project "CASUAL – Co-creating Attractive Urban Areas and Lifestyles", led by the Nordic Centre for Spatial Development (Nordregio) and funded by the Urban Europe Joint Programming Initiative. The present paper constitutes a synthesis of some key findings of the study. The full study will be available later in 2016.

2.2 Research Method

The paper presents an overview of the development of spatial planning in the Netherlands, Sweden, and Austria since WWII, with an eye to highlighting policies that could be considered to be, or might affect, TOD. The paper then considers the implications of the development of these policies in terms of TOD planning and practice in the respective capital city-regions: Amsterdam, Stockholm, and Vienna. The history of TOD is discussed using the "culturized planning model" as an analytical lens to explain the evolution of planning policies and processes. This model, as the name suggests, is concerned with planning culture, and builds on earlier paradigms, including path dependence, path shaping, globalization, Europeanization, policy diffusion, and families of nations (see Knieling and Othengrafen 2015; Pflieger et al. 2009; Stead et al. 2015).

3 THEORETICAL FRAMEWORK: THE "CULTURIZED PLANNING MODEL"

Unlike other professional activities such as civil engineering or computer programming, planning varies greatly depending on the place in which it is practiced. Culture shapes the way in which planning systems are devised and constructed, as well as the way in which planning operates and performs. It affects both formal and informal rules, methods, and procedures. Differences in planning culture are reflected in a diversity of planning instruments, planning practices, and professional ethos (see Friedmann 2005; Sanyal 2005; Stead et al. 2015).

Building on their earlier work, Knieling and Othengrafen (2015) put forward the "culturized planning model" as an aid to analyzing the impacts of cultural contexts on planning policies and processes. This framework considers both manifest and latent aspects of culture. The underlying assumption is that "planning culture" encompasses collective thinking modes and behavioral patterns, stemming from shared professional codes as well as more general societal values. The culturized planning model consists of three analytical levels: (a) planning artifacts; (b) planning environment; and (c) societal environment (Fig. 1). Clearly, the levels are not discrete: there are interactions within levels and between levels.

Adopting the culturized planning model as a frame for analysis, this paper considers how planning policies have been shaped by principles of TOD in three case study city regions: Amsterdam, Stockholm and Vienna. The analysis and discussion is framed by the three levels contained in Fig. 1 (i.e. societal environment, planning environment and planning artifacts) and the elements contained in each level. In the interest of simplicity and flow, no attempt is made to divide each section into subheadings based on the different levels and their constituent elements. Instead, the most important occurrences of these levels are highlighted as they arise in the text.

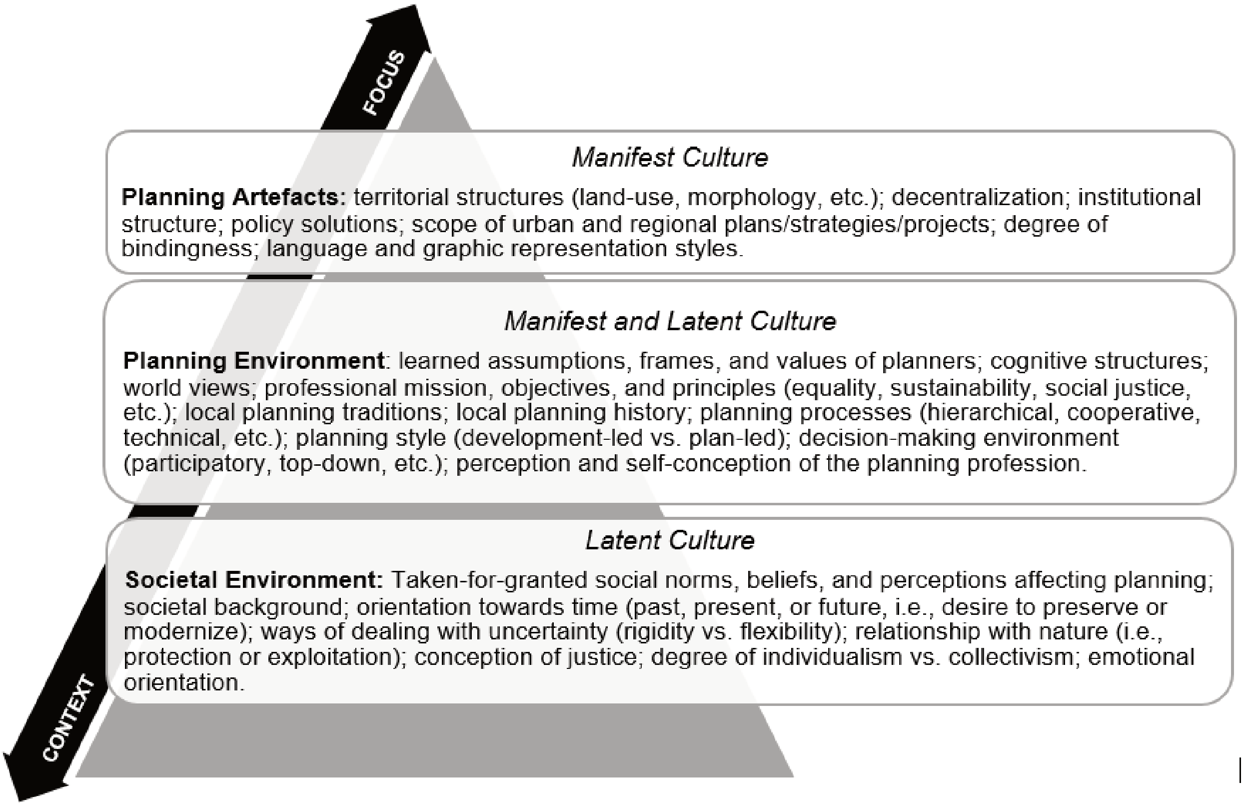

Fig. 1: The culturized planning model (based on Knieling and Othengrafen 2015).

4 KEY FINDINGS

All three case studies are located in countries with mature systems of spatial planning, which represent a specific region of Europe: the Netherlands (Western Europe), Sweden (Northern Europe), and Austria (Central Europe). TOD, albeit called by other names or not named at all in policy, has been an intrinsic principle of planning in these places since WWII.

4.1 Amsterdam

Amsterdam has a dense multi-modal public transport system based on metro, tram, bus, and bicycle. Its metropolitan region is an exemplar of relatively successful, albeit complex, development control which has attracted interest from planners around the world. In the post-war period, the city expanded out from its historic fan-shape. Major efforts were poured into creating urban "lobes," as well as new satellite towns, which followed TOD concepts (planning artifacts). Although a highly knowledgeable "TOD lobby" is evident, it has failed to reach a wider audience and frame the TOD concept for the planning community (planning environment). Local planners are searching for (a) ideas related to the design of areas in the immediate proximity of train stations, especially in terms of aesthetics, mixed uses, 24-hour uses, and accessibility, and (b) financial tools that would make TOD viable without substantial investment from the public sector (Fig. 2). The recent economic crisis has been particularly problematic for the City of Amsterdam which finds itself with a large amount of land in its ownership which is not located in TOD zones. Before being able to develop TOD sites, the city needs to find a way of disposing of its current stock of land. While train station areas are seen as convenient work places, families and individuals do not perceive them as high-status living environments. Because bicycle use is widespread, the standard distance for non-motorized travel to train stations is much higher than in TOD zones in other countries. Despite these difficulties, many Dutch planners are still positive about the future of TOD in the Amsterdam region and view it as an efficient urban and regional development strategy.

Fig. 2: Amsterdam's Zuidas district, a TOD site centred around Amsterdam South Station (Source: Dutch Office Fund).

4.2 Stockholm

While planning at the regional scale is generally weak in Sweden, Stockholm is arguably a leading example of coordinated rail transit and urban development (planning artifact). In the post-war period, the city was transformed from a monocentric city to a polycentric transit-dependent metropolis. Although the term TOD has not been used, TOD has been a guiding concept of Stockholm's (and other Swedish regions') regional development for many decades (planning environment). While no longer the cornerstone of planning, TOD is still present in planning visions for the future (Fig. 3). However, the automobile lobby has also gained

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ground. Individual development projects have come to dominate the development scene. Their siting often appears to be accidental rather than based on careful planning and coordination with public transport. Various new projects have been built along regional motorways and offer ample parking. This laissez-faire approach has blurred the previously sharply defined borders of the inner city. TOD is seen as one of several complementary tools which could potentially be adopted but by no means the leading one.

Fig. 3: Hammarby Sjöstad, a TOD-influenced brownfield redevelopment area, houses 20,000 inhabitants and constitutes a mix of TOD and green urbanism (Source: La-Citta-Vita on Flickr).

4.3 Vienna

In the first few post-war decades, urban planning in Vienna was heavily preoccupied with reconstruction of the building stock destroyed in the war. Large housing estates were also developed on vacant land south and east of the city, the dimensions of which were reminiscent of Eastern European socialist estates. They were based on TOD principles in the sense that public transport was provided. At the time, Vienna was an exemplar of a top-down, corporatist form of social-democratic urban governance, based on rigid master-planning (planning environment). The city expanded in a circular fashion along its historical radial structure (planning artifact). In the 1970s and 1980s, Vienna experienced a wave of urban renewal to counter urban deterioration, which was becoming visible in the cityscape of the centre, but urban renewal took a gentler form than the demolition and rebuilding works occurring elsewhere.

Fig. 4: Vienna's Seestadt Aspern, a TOD site still under development, is planned to house 20,000 residents (Source: Liebherr-Werk Bischofshofen GmbH).

During the 1980s, social-democracy began to establish new forms of urban governance in line with the neo-liberal political restructuring of other European countries (planning environment). Municipal socialism began to transform into municipal capitalism. In contrast with the publicly-funded TODs of the past, new urban development projects were planned as public-private partnerships. From the 1980s onwards, Vienna's TOD focus shifted to inner city areas. Part of the shift was driven by the desire of city leaders to promote Vienna's image as an internationally competitive city and a gateway between Eastern and Western Europe, and motivate the private sector to implement this vision. Contemporary TODs are an expression of a new form of planning comprising new urban policies and entrepreneurial governance (Fig. 4). While marking a break with traditional corporatism, they represent an elitist approach with coopted public participation. The approach is also in line with the deeply entrenched hierarchical structure of Vienna. The key actors involved include real estate businesses, international investors, and public opinion leaders.

5 CONCLUSION

The analysis conducted in this study has illustrated that TOD, albeit called by other names or not named at all in policy, has been an intrinsic principle of planning in Austria, the Netherlands, and Sweden and in their respective capitals since WWII. Far from being a recent North American invention, TOD has its roots in Europe and dates back many decades. Clearly, the enthusiasm with which TOD in its recent embodiment has been received in the US and Canada has done much to highlight and promote the concept over recent decades in Europe. The study has illustrated that the extent to which the TOD concept can find resonance in a European context is closely related to the prevailing societal environment as well as the planning environment.

In the early postwar period, entire new satellite towns or lobes were developed around the peripheral stations of the train and metro systems of Vienna, Amsterdam, and Stockholm. This period reflected the economic prosperity and the popular desire to suburbanize in that era. In later years, in parallel with the urban revival movement, TOD efforts were transposed to the inner cities, in new brownfield redevelopments. In both cases (earlier suburban and later urban TODs), the national, regional, and local governments played a major role in steering development (a planning artifact) towards public transit stations and lines – or in servicing existing housing developments with public transport. The TOD phenomenon (a mix of transit and land use) did not occur naturally.

Current planning in Austria, the Netherlands, and Sweden is in a state of flux. The discourses contained in policy documents show support for sustainable and resilient urban and regional development, and include TOD in a major way. At the same time, changing political priorities and administrative reform (affecting the planning environment) have led to a gradual decline of the status of the planning profession. The recent economic crisis has favored deregulation and market-led economic development. Planning is increasingly framed as a time-consuming and cost-intensive activity. The concept of space as a regulated public domain has weakened. Spatial planning has lost ground especially at the national and regional levels. Economic growth has priority at the moment. As a result, the interests of developers are generally placed ahead of strategic efforts to structure cities and regions in a more environmentally sustainable manner. Given that planning has a long tradition in all three countries, this reorientation is seen by many commentators as a dramatic step backwards (Kunzmann and Koll-Schretzenmayr 2015).

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Auf dem Weg zur digitalen Stadt – Aufbau der digitalen Planungsinfrastruktur Hamburg

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1 ABSTRACT

In dem „Zentralen Planungsinformationssystem Hamburg" (PLIS-HH) werden rechtsgültige digitale georeferenzierte Planwerke des Bau- und Planungsrechtes (verbindliche und vorbereitende Bauleitpläne auf Basis des Baugesetzbuches (BauGB) / Bundesbaugesetzes (BBauG); Planwerke auf Basis alten Planrechts: Baustufenpläne, Durchführungspläne, Teilbebauungspläne; Erhaltungsverordnungen nach §172 BauGB und Gestaltungverordnungen nach §12 Hamburgische Bauordnung (HBauO)) erfasst und als Bestandteil der Geodateninfrastruktur der Freien und Hansestadt Hamburg (FHH) zentral in einer Geofachdatenhaltungskomponente in einer einheitlichen semantischen Struktur vorgehalten.

Diese zentrale Datenhaltung erlaubt gleichzeitig eine dezentrale Fortführung und Pflege der Datenbestände durch den jeweiligen Sachbearbeiter an seinem Arbeitsplatz, setzt aber die Entwicklung und Einrichtung vereinheitlichter und abgestimmter Datenaustausch- und Aktualisierungsprozesse voraus. Damit ist gewährleistet, dass alle in der FHH vorgehaltenen Auskunfts- und Monitoringsysteme, Beteiligungs- und Baugenehmigungsverfahren, die Bauleitpläne und sonstigen Verordnungen als Informationsbasis benötigen, eine einheitliche Datenbasis zur Verfügung haben. Eine arbeitsaufwändige Recherche nach aktuellem Planrecht und die damit verbundene Aktualisierung der Datenhaltung für die unterschiedlichen Fachinformationssysteme können somit zukünftig entfallen.

Keywords: Digital City, Geodata, Geodata, Monitoring, Planning

2 PLANUNG

Wo darf gebaut werden, welche Nutzungen können wo angesiedelt werden, wie sind Grünflächen und Landschaftsräume gesichert oder wo können neue Parkanlagen entstehen? Alle Bewohnerinnen und Bewohner Hamburgs sind direkt von den Folgen der Planungen berührt. Und weil alle betroffen sind, haben auch alle die gesetzlich verbriefte Möglichkeit, daran mitzuwirken. Die Bauleitplanung steuert und regelt die bauliche und sonstige Nutzung des Bodens. Sie besteht aus dem Flächennutzungsplan (FNP - vorbereitender Bauleitplan) und dem Bebauungsplan (BPlan - verbindlicher Bauleitplan). Diese Bauleitpläne müssen in einem förmlichen Verfahren aufgestellt, geändert, ergänzt oder aufgehoben werden. Die hierfür geltenden Verfahrensvorschriften sind im BauGB geregelt, wobei die Bauleitpläne in Hamburg abweichend vom BauGB nicht als Satzung, sondern als Verordnung oder Gesetz erlassen werden. Auch ältere Planarten (Baustufenpläne, Durchführungspläne oder Teilbebauungspläne) werden heute unter dem Oberbegriff Bebauungsplan zusammengefasst.

Die grundgesetzlich garantierte Planungshoheit der Gemeinde hat zunächst einmal die FHH als Ganzes. Seit 1997 ist in Hamburg das Recht, Bebauungspläne aufzustellen, grundsätzlich auf die sieben Bezirke übertragen worden. Jeder der Bezirke hat ein Fachamt für Stadt- und Landschaftsplanung. Die Bebauungspläne, die für die Stadt von übergeordneter Bedeutung sind, werden vom Senat oder der Bürgerschaft aufgestellt. Zu diesem Zweck wurde für die Überplanung des Altonaer Bahnhofs das Vorbehaltsgebiet „Mitte Altona" erlassen. Alle Bebauungspläne in diesem Gebiet fallen unter die Kategorie „von übergeordneter Bedeutung", genauso wie die in dem für die Stadtentwicklung besonders bedeutsamen Stadtteil HafenCity. Darüber hinaus kann der Senat einzelne wichtige Pläne von gesamtstädtischer Bedeutung in einem besonderen Verfahren von der bezirklichen Ebene zur eigenen Erledigung an sich ziehen (Evokation). Unabhängig davon kann der Senat Bebauungspläne der Bürgerschaft zur Feststellung als Gesetz vorlegen. Für die Bezirks- wie für die sogenannten Senatsbebauungspläne gelten die Verfahrensvorschriften des BauGB und die Regelungen zur Beteiligung der Öffentlichkeit in gleicher Weise (FHH, 2011).

Wenn neue städtebauliche Anforderungen entstehen oder Vorstellungen zur weiteren Entwicklung der Stadt diskutiert werden, die mit dem geltenden Planungsrecht nicht realisiert werden können, dann kann dieses durch die Aufstellung eines neuen Bebauungsplans durch das Bezirksamt geändert werden.

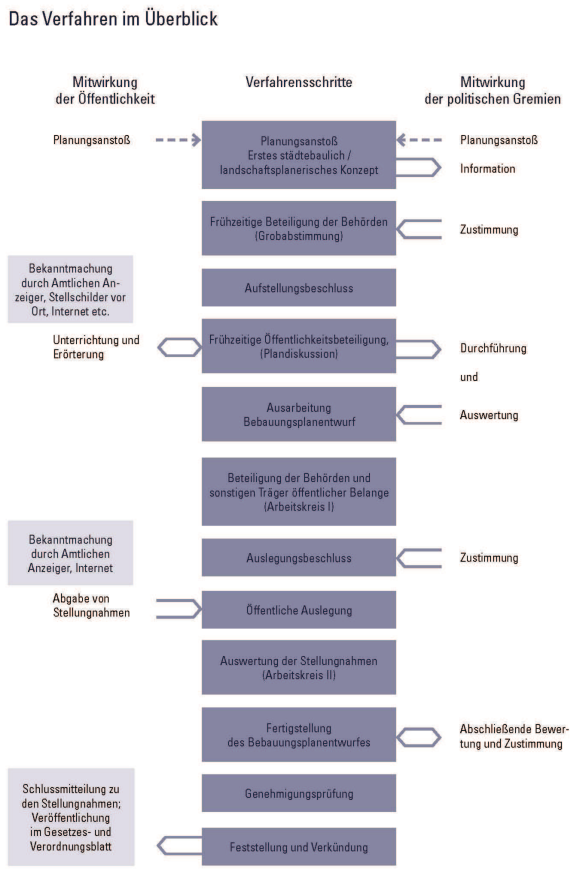

Abb. 1: Bebauungsplanverfahren in Hamburg (Quelle: FHH, 2011)

Bebauungspläne werden in Hamburg mit dem Namen des Stadtteils, in dem das Plangebiet liegt, und einer Ordnungsnummer bezeichnet.

Bebauungspläne bestehen aus der Planzeichnung, den textlichen Festsetzungen und der Begründung. Als Planunterlage dient die digitale Stadtgrundkarte des Landesbetriebs für Geoinformation und Vermessung (LGV), die z.B. Flurstücksgrenzen und Flurstücksnummern sowie vorhandene Straßen, Gewässer und Gebäude enthält.

3 DIGITALISIERUNG

Verwaltung, Wissenschaft und Wirtschaft der FHH setzen bereits heute neue Technologien und Innovationen in allen Bereichen der Stadtentwicklung ein. Sie sind wichtige Bausteine auf dem Weg zur „Digitalen Stadt Hamburg“ und damit zur nachhaltigen Verbesserung der Lebensqualität der Bürgerinnen und Bürger.

Die Digitalisierungsstrategie in Hamburg umfasst die Bereitstellung digitaler Daten für Entscheidungen, Prozesse, zur Informationsgewinnung und deren Verbreitung (Freie und Hansestadt Hamburg, 2015). Hinsichtlich der Anwendungen für die Öffentlichkeit kann man in Hamburg zwischen allgemeinen Auskunftsanwendungen und elektronisch gestützten Beteiligungsverfahren in der Bauleitplanung differenzieren. Die Auskunftsanwendung „Stadt- und Landschaftsplanung Online“ (Planportal) bildet das geltende Planrecht Hamburgs flächendeckend ab und stellt weiterführende Informationen bereit. Das IT-gestützte Beteiligungsverfahren Bauleitplanung-online (BOP) unterstützt die planenden hamburgischen Dienststellen bei der Durchführung der formellen Verfahrensschritte. Die Dienststellen stellen Unterlagen in die Online-Plattform ein, sodass am Verfahren beteiligte Behörden und sonstige Träger öffentlicher Belange sowie Bürgerinnen und Bürger die Informationen direkt im Internet einsehen und Stellungnahmen abgeben können. Zusätzlich zu den allgemein im Internet verfügbaren Anwendungen werden innerhalb des Intranets der FHH weitere Anwendungen als Auskunftssystem (Geoportal 3AWeb, Flächennutzungsplan Viewer, Landschaftsprogramm Viewer) zur Verfügung gestellt. Ebenso werden die Planwerke und Abgrenzungen als Geodatendienste in E-Government-Anwendungen (z.B. Kartenportal „Fachinformationssystem zum

Grundstück“) oder in das Monitoringsystem der Landesplanung (z.B. Potentialflächenauskunft (PAUL)) integriert. Die daraus abgeleiteten Erkenntnisse und Entscheidungen betreffen einen konkreten räumlichen Teil der Stadt. Diesen Raumbezug gilt es unter Einsatz moderner und nachhaltiger Technologien zu berücksichtigen. Nur so wird eine Wertschöpfung durch Dritte im Sinne einer vernetzten und „klugen“ Stadt möglich.

Nachfolgend wird beispielhaft ein Projekt vorgestellt, das zeigt, wo Hamburg bereits digital ist und wie der weitere Weg zur Digitalen Stadt aussehen kann.

4 PLANUNGSINFORMATIONSSYSTEM

4.1 Motivation

Vor Projektbeginn im Jahr 2011 wurden die jeweils benötigten planerischen Daten projektweise speziell für die jeweilige Fachanwendung aufbereitet, fortgeführt und redundant in den beteiligten Fachbereichen gespeichert. Eine konsistente Auskunft über aktuelle Planwerke und Gebietsabgrenzungen im Internet und Intranet konnte auf Grundlage dieser verteilten Geodatenspeicherung nicht gewährleistet werden.

4.2 Ziel

Das Projektziel war der Aufbau eines zentralen Planungsinformationssystems (PLIS) in der FHH mit Integration in die Geodateninfrastruktur Hamburg (GDI HH) sowie der Aufbau einer Verfahrensdatenbank zur Dokumentation von Bauleitplanverfahren.

Die Planwerke und Abgrenzungen des Planungsrechts (Bebauungspläne auf Basis des BauGB / BBauG sowie Planwerke auf Basis alten Planrechts: Baustufenpläne, Durchführungspläne, Teilbebauungspläne) und die Verordnungen nach §34, §35 und §172 BauGB als Bestandteil der Geodateninfrastruktur der FHH sollen zentral in einer Geofachdatenhaltungskomponente in einer einheitlichen semantischen Struktur vorgehalten werden.

Diese zentrale Datenhaltung wird die dezentrale Fortführung und Pflege der Datenbestände durch den jeweiligen Sachbearbeiter an seinem Arbeitsplatz mit den dort zur Verfügung stehenden GIS/CAD-Arbeitsplätzen und -Systemen (z.B. WS LANDCAD, ArcGIS) ermöglichen, setzt aber die Entwicklung und Einrichtung vereinheitlichter und abgestimmter Datenaustausch- und -aktualisierungsprozesse im Rahmen dieses Projektes voraus. Die Verantwortlichkeit sowie der technische Zugriff auf die Daten verbleiben bei den Dateneigentümern.

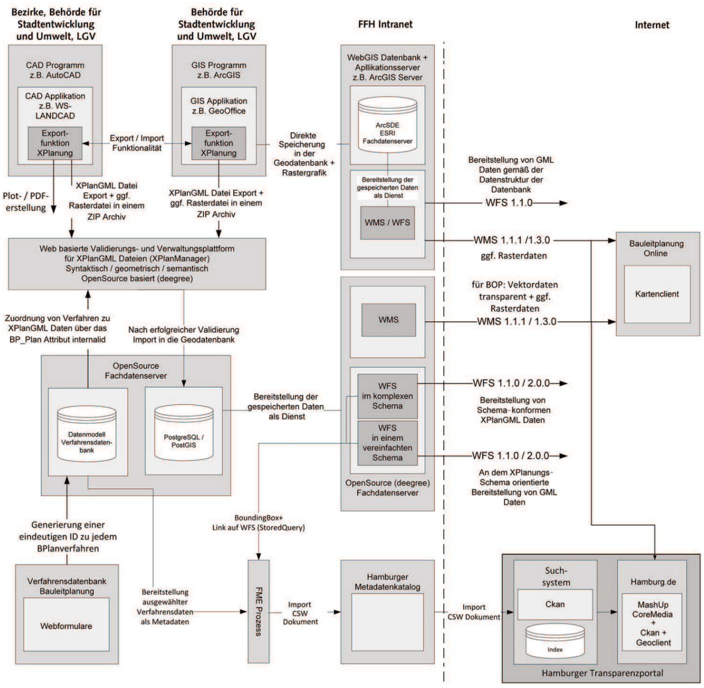

Abb. 2: IT-Architektur zur Erfassung und Bereitstellung von Bebauungsplänen in Hamburg (Quelle: Krause, 2014)

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Die verteilte Datenhaltung von festgestellten bzw. schon freigegebenen Plänen ist durch eine zentrale Datenhaltung auf technischer Basis des GDI-HH OpenSource Fachdatenserver (basierend auf dem Open-Source-Framework deegree (degree, 2016)) ersetzt worden. Damit ist gewährleistet, dass alle in der FHH vorgehaltenen Auskunfts- und Monitoringsysteme, Beteiligungs- und Baugenehmigungsverfahren, die Bauleitpläne als Informationsbasis benötigen, eine einheitliche Datenbasis zur Verfügung haben.

4.3 Projektergebnisse

Standards sowie Softwarekomponenten sind in einem kooperativen Verfahren mit gleichberechtigten Partnern aus allen 7 Bezirken und der ehemaligen Behörde für Stadtentwicklung und Umwelt (BSU) entwickelt worden. In konstruktiver Zusammenarbeit haben die Beschäftigten in den bezirklichen Fachämtern für Stadt- und Landschaftsplanung (LP) und dem Amt für Landes- und Landschaftsplanung der BSU sowie dem Auftragnehmer LGV (LGV, 2016) das Projekt PLIS mitgestaltet, so dass mit Abschluss des Projektes folgende Standards sowie Softwarekomponenten zur Einführung zur Verfügung stehen.

4.3.1 Standard XPlanGML (Datenformat erzeugt aus WS LandCAD)

Das semantische Datenmodell „XPlanung“ (XPlanung, 2011) sowie das objektorientierte Datenaustauschfomat XPlanGML für Bauleitpläne, spezifizieren einen herstellerunabhängigen Standard zur Beschreibung und zum Datenaustausch, der die Festlegungen von Baugesetzbuch, Baunutzungsverordnung und der Planzeichenverordnung berücksichtigt. Die Inhalte dieser Gesetze werden in „XPlanGML“ in ein Datenaustauschformat umgesetzt, das von IT-Systemen erzeugt, gelesen und interpretiert werden kann. Für eine einheitliche, den gesetzlichen Vorgaben entsprechende Visualisierung der Planwerke werden Visualisierungsvorschriften von „XPlanung“ bereitgestellt. „XPlanung“ sieht eine einheitliche Datenmodellierung für alle Länder Deutschlands vor. Der Standard ist auch schon in unterschiedlichen Softwarelösungen (z.B. WSLandCAD) implementiert.

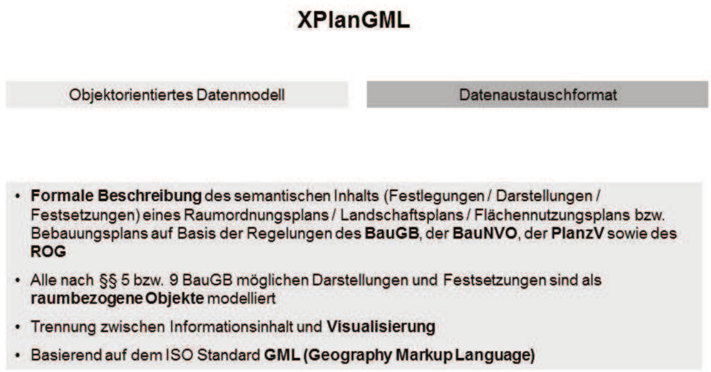

Abb. 2: Standard XPlanGML

4.3.2 XPlanungs-konforme Fortführungskomponente

Zur Fortführung der Planwerke des besonderen Städtebaurechts, des FNP und des Landschaftsprogramms (LAPRO) in der Behörde für Stadtentwicklung und Wohnen (BSW) sowie der Behörde für Umwelt und Energie (BUE) ist langfristig die ArcGISbasierte-XPlanungs-Fortführungskomponente vorgesehen.

Sie ist kein Ersatz für die in den Bezirken bzw. bei BSW/LP im Einsatz befindliche AutoCAD Applikation WS LANDCAD. Neue Pläne werden in WS LANDCAD erstellt und die Pflege sowohl der neuen als auch der alten BPläne soll zukünftig mit WS LANDCAD erfolgen.

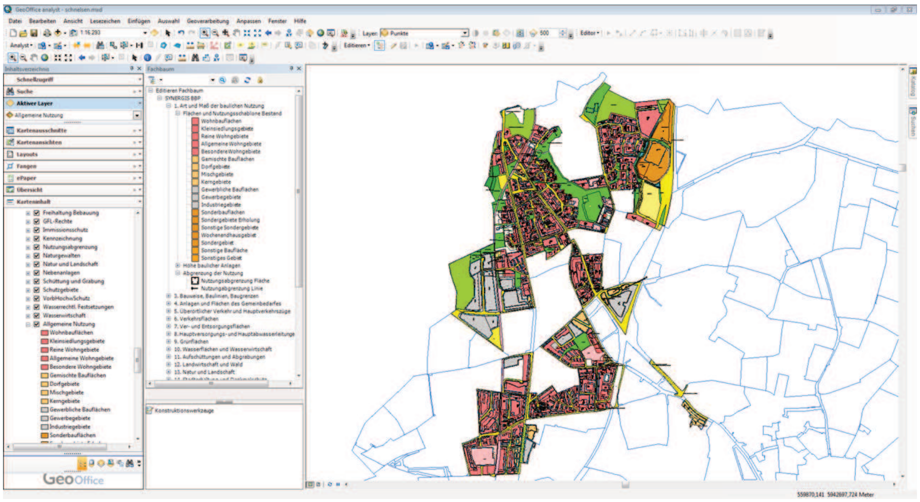

Abb. 4: XPlanung-konforme Fortführungskomponente (Quelle: LGV, 2016)

4.3.3 XPlanManager

Um zu gewährleisten, dass nur syntaktisch, geometrisch und semantisch korrekte XPlanGML-Dateien im Open-Source-Fachdatenserver gespeichert werden, erfolgt eine Validierung der Daten in der Open-Source-Anwendung „XPlanManager“. Nur wenn die Planwerke erfolgreich validiert wurden, können diese in die Datenhaltung importiert werden.

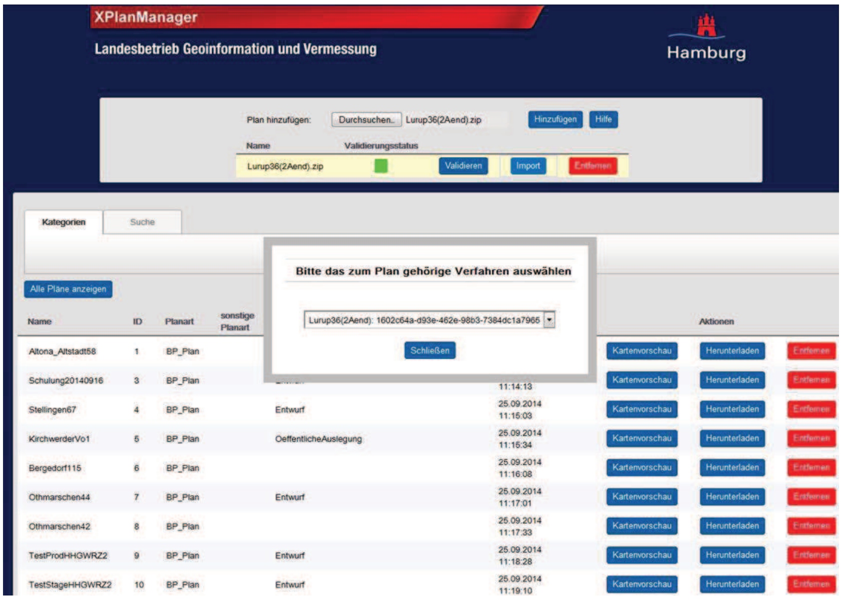

Abb. 3: XPlanManager (Quelle: LGV, 2016)

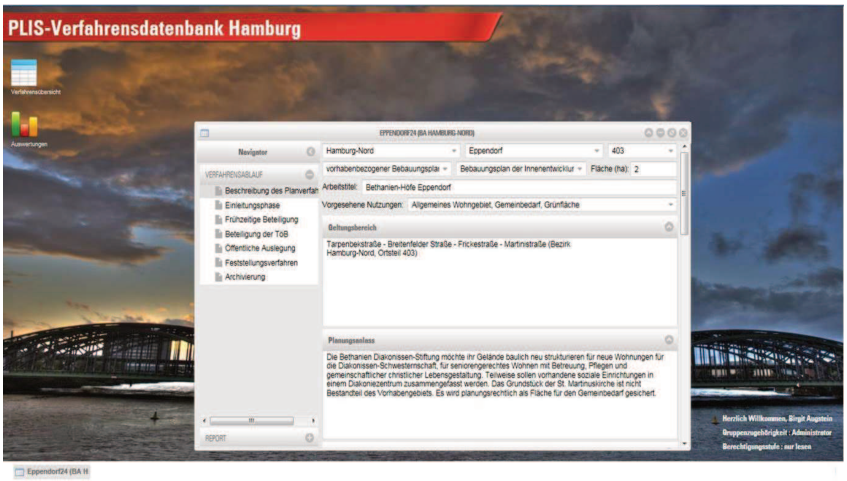

Abb. 5: PLIS-VFDB

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Mit dem Instrument „XPlanManager“ (Validierungsplattform) sollen die bezirklichen und fachbehördlichen Dienststellen in die Lage versetzt werden, die von ihnen erstellten Bebauungspläne selbst zu verwalten, und zu überprüfen (Validierung). Mit der Validierungsplattform kann auch geprüft werden, ob Aufträge von privaten Planungsakteuren korrekt ausgeführt wurden. Über diese Anwendung können auch die XPlanGML-Dateien mit der entsprechenden Dokumentation des Verfahrens in der Verfahrensdatenbank verknüpft werden.

4.3.4 PLIS-Verfahrensdatenbank

In der PLIS-Verfahrensdatenbank wird der „Lebenslauf“ eines Bebauungsplans dokumentiert, welcher dann über Datenbanktechnologien auswertbar ist. In der Verfahrensdatenbank sind die Verfahrensschritte eines Bauleitplanverfahrens / einer Verordnung nach §34, §35 und §172 BauGB in den Bezirken und in der Fachbehörde elektronisch zu beschreiben.

4.3.5 Recherche-Tool für das gültige Planrecht der FHH

Da alle Planwerke in der zentralen Datenbank des GDI-HH OpenSource Fachdatenserver abgespeichert werden, stehen unter ArcGIS sämtliche räumlichen und attributiven Abfragemöglichkeiten zur Verfügung. Das Projekt hat sich zusätzlich für die Suche über eine Metadaten-Anbindung entschieden, weil die Informationen so gleichzeitig für die Verfahren Bauleitplanung-online (BOP und Transparenzportal (Informationsregister)genutzt werden können. Die Beschreibungen der Pläne werden in der Verfahrensdatenbank in Verknüpfung mit dem Hamburger Metadaten Katalog (HMDK) dokumentiert. Über das „Liefersystem“ HMDK werden die mit Metadaten beschriebenen Bauleitpläne im Transparenzportal bereitgestellt. Im Rahmen des IT-Projektes zur XPlanGML-konformen Erfassung des geltenden Planrechtes werden alle Planwerke im HMDK erfasst.

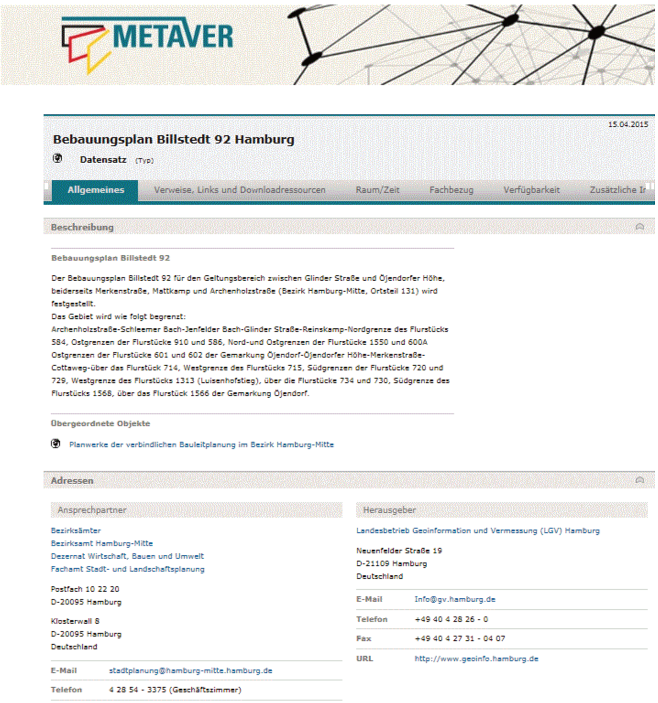

Abb. 6: Metadaten (Internet)-Beschreibung (Quelle: MetaVer, 2016)

Neben der Beschreibung und der Verortung enthalten die Metadatenobjekte sowohl einen Downloadlink zu der Verordnung (inkl. Plangrafik) im PDF-Format als auch zu der Begründung des Planwerkes (ebenfalls im PDF-Format). In den Metadaten der Bauleitpläne wird zusätzlich eine WFS Downloadressource (WFS stored query) dokumentiert, über die die bereits XPlanungs-konform erfassten Bauleitpläne bereitgestellt werden.

Die Pläne werden über eine individuelle BoundingBox (individueller rechteckig begrenzter Kartenausschnitt) verortet. Eine Suche im Umkreis ist somit möglich. Informationen über Bauleitpläne sowie Downloadressourcen zu den Inhalten von Bauleitplänen sind über die initiale Beschreibung im HMDK und ebenso in anderen Metadatenkatalogen auf nationaler bzw. europäischer Ebene (z.B. MetaVer (MetaVer, 2016)) recherchierbar (Krause, 2014).

Abb. 7: HMDK (Intranet) Downloadlink

5 ZUSAMMENFASSUNG UND AUSBLICK

Im Projekt „PLIS-HH“ der BSW wurden Standards und Softwarekomponenten entwickelt, um rechtsgültige digitale georeferenzierte Planwerke, die als Informationsbasis benötigt werden, in einer einheitlich und dokumentierten Datenbasis zur Verfügung zu stellen sowie Planwerke verlustfrei zwischen unterschiedlichen Akteuren und den von ihnen genutzten Softwaresystemen austauschen zu können.

Parallel werden in der FHH in einem Projekt der Bezirksverwaltung alle bislang geltenden Planwerke (ca. 1800 BPläne, ca. 80 Baustufenpläne, ca. 300 Durchführungspläne und ca. 550 Teilbebauungspläne) der verbindlichen Bauleitplanung gemäß dem Objektmodell XPlanung durch den LGV neu digitalisiert und als XPlanGML-Dateien über OGC-konforme Webdienste zur Darstellung und zum Download bereitgestellt (WALTER, CATHOLY, 2015).

Während des Projektzeitraums (2011-2014) wurden weitergehende Anforderungen an die realisierten Anwendungen formuliert. Zudem wurde deutlich, dass zu den bestehenden Verfahren im Bau- und Planungsbereich (z.B. digital gestützte Baugenehmigungsprozess Digitales Bauamt, Beteiligungsprozesse wie BOP und dem digitalen Archivierungssystem Eldorado) Schnittstellen zu erstellen bzw. zu optimieren sind, um eine nachhaltige und intelligente Datenhaltung zu gewährleisten.

Die Aufgabe der nächsten Jahre besteht darin, die digitalen Arbeitsprozesse anzupassen sowie erweiterte technischen Anforderungen umzusetzen und somit das Planunginformationssytem zu einer nachhaltigen „Planungsinfrastruktur“ auszubauen. Zur Erzielung von Synergieeffekten ist es erforderlich, über Prozessketten, die von bestehenden Anwendungen ausgehen, hinaus auch Arbeitsprozesse zu berücksichtigen, die außerhalb der Anwendungen vorhanden sind. Damit werden die Inhalte von Bauleitplänen über Verwaltungsgrenzen hinweg standardisiert auswertbar und stehen auch für die anstehenden Transformationsprozesse (Klimawandel, Energiewende, demograpischer Wandel, Nachverdichtung) zur Verfügung.

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City Information Modelling – Potenziale für eine intelligente Stadtplanung

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1 ABSTRACT

Dreidimensionale Darstellungen haben sich in der Stadtplanung als unverzichtbares Kommunikationsmedium etabliert. Primär fungieren sie derzeit als unterstützendes Instrument in Bürgerbeteiligungsprozessen und bei der Darstellung von Planungsalternativen als Entscheidungshilfe. Moderne computergestützte Architekturmodelle erfahren seit jüngster Zeit eine Weiterentwicklung der herkömmlichen Planungsmethoden. Unter dem Begriff des Building Information Modeling zusammengefasst, lassen sich mit dieser neuen Methode virtuelle Modelle erzeugen, deren Informationsgehalt gegenüber klassischen virtuellen Modellen um ein Vielfaches höher ist. Zudem finden sie nicht nur in einzelnen Planungsphasen Anwendung, sondern begleiten ein Projekt über den gesamten Gebäudezyklus hinweg.

Um die Vorteile und Potenziale solch intelligenter Modelle ausschöpfen zu können, gilt es nun diesen Ansatz auch für die Stadtplanung weiterzuentwickeln und auf diese zu übertragen. Mit diesem Ansatz des City Information Modeling ist es beispielsweise möglich, über die reine Erfassung geometrischer Formen hinaus, Bilanzen zu erstellen, versorgungsinfrastrukturelle Daten einzupflegen, objektspezifische Informationen zu hinterlegen und diese anschließend in automatisierten Prozessen auszuwerten und zu analysieren. Das hier vorgestellte Paper ist eine Kurzfassung der Arbeit „City Information Modeling – Potenziale für eine intelligente Stadtplanung“ (MÜLLER 2015) die am Fachgebiet CPE der TU Kaiserslautern entstanden ist. Die im Rahmen dieser Arbeit untersuchten Anwendungen zeigen auf, dass es mittels aktueller Software möglich ist, den Informationsgehalt von Planungen deutlich zu erhöhen.

Keywords: Building Information Modelling, BIM, CIM, City Information Modelling, Stadtplanung

2 PROBLEMSTELLUNG

„Ein Bild sagt mehr als tausend Worte.“ Diese Metapher zeigt auf, wie komplexe Zusammenhänge durch bildliche Darstellungen einfacher erklärbar werden. Nicht zuletzt aus diesem Grund haben sich dreidimensionale Visualisierungen in der Stadtplanung als unverzichtbares Medium etabliert. Für nahezu jede größere Planung werden aufwändige Modelle erstellt, die anschließend in Beteiligungsprozessen mit Planungsbeteiligten eingesetzt werden, um der Öffentlichkeit ein besseres Bild der zukünftigen Realität liefern zu können als es bei der Auslegung von zweidimensionalen Plänen möglich ist. Der Gebrauch beschränkt sich jedoch in der Regel ausschließlich auf die Darstellung einer möglichen Raumwirkung der Planung. Der eigentliche Planungsprozess findet weiterhin auf Basis von zweidimensionalen Plänen statt und erfährt oftmals erst in einer finalen Phase der Planung eine zusätzliche Erweiterung um die dritte Dimension. Haben diese nach Betrachtung und Veröffentlichung ihren Zweck erfüllt werden sie archiviert und erfahren keine weitere Nutzung. Das Potential, welches sich hinter solchen virtuellen Modellen verbirgt, wird folglich bei weitem noch nicht ausgeschöpft. Im Gegensatz zur Stadtplanung, werden im Bereich der Architektur, des Bauingenieurwesens und des Facility Managements bereits Modelle erschaffen, die ein Projekt von Anfang an begleiten, Bewirtschaftungsprozesse unterstützen und bei Umbau- oder Rückbauarbeiten eine große Arbeitserleichterung bieten können. Dementsprechend stellt sich die Frage, inwiefern sich eine solche Methode des „Building Information Modeling“ auf den Bereich der Stadtplanung übertragen lässt. Inwieweit sind bestehende Softwarelösungen für die räumliche Planung bereits geeignet, um mit Hilfe „intelligenter“ Werkzeuge städtebauliche Planungen zu unterstützen oder im Idealfall gänzlich umzusetzen?

3 CITY INFORMATION MODELLING

Die Anforderungen an 3D-Stadtmodelle sind in den letzten Jahren enorm gewachsen. Neben der stetig steigenden Qualität der 3D-Darstellungen enthalten die Modelle eine Vielzahl an semantischen Informationen, welche automatisierte Analysen und Modellmanipulationen ermöglichen. Diese „intelligenten“ Stadtmodelle werden unter dem Begriff des City Information Model (CIM) zusammengefasst. Hierfür besteht bislang keine klar abzugrenzende Begrifflichkeit. Diese Methode resultiert aus der starken Weiterentwicklung herkömmlicher 3D-Stadtmodelle, den steigenden Anforderungen an diese und dem Vorbild des Building Information Modeling. So ist diese nicht mehr länger allein auf die visuelle Ebene beschränkt, sondern enthalten zahlreiche Zusatzinformationen und beschreibende Merkmale.

Auf Quartiers- oder Stadtebene bestehen solche intelligenten Modelle, im Gegensatz zu Building Information Modeling, nicht aus kleinteiligen Gebäudemodulen. Vielmehr kann ein CIM als eine generalisierte Darstellung einer Vielzahl von BIM‘s angesehen werden. Neben diesem zentralen Gebäudebaustein, können zusätzliche weitere (Stadt-)Bausteine kategorisiert werden: der Verkehrsbaustein, der Gewässerbaustein, der Stadtmöblierungsbaustein und der Versorgungsbaustein. Diese Module sind jedoch nicht immer alle zu berücksichtigen. Je nach Planungsschwerpunkt kann die Zusammensetzung der Bausteine variieren oder unterschiedlich stark gewichtet werden (XU ET AL. 2014:294).

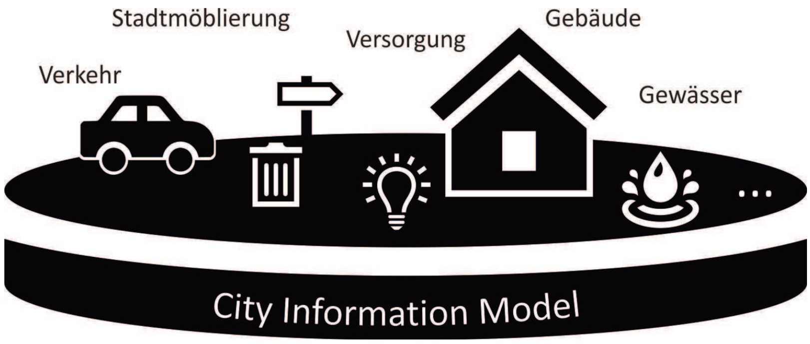

Abb. 1: Bausteine eines CIM (XU ET AL. 2014)

Die Gebäude einer Stadt zeichnen sich durch ihre Individualität aus. Jedes Gebäude stammt aus einer anderen Zeit, die verwendeten Materialien und die Bauweise sind daher unterschiedlich. Das Gebäudemodul setzt sich daher aus Gebäuden mit unterschiedlichem Informationsgehalt zusammen. Hochmoderne Bauten besitzen bereits abgespeicherte Gebäudeinformationen, welche direkt in ein City Information Model importiert werden können. Für den überwiegenden Anteil der Häuser müssen jedoch moderne Laserscanning-Verfahren eingesetzt werden, um die notwendigen Informationen zu erhalten. Die in das Modell importierten Gebäude besitzen dann Informationen wie etwa deren Materialien oder Gebäudestruktur. Der Baustein der Verkehrsinfrastruktur kann Informationen zu Straßenlängen und -breiten, sowie Kosten besitzen. Möglich wäre es in diesem Modul Echtzeit-Straßenüberwachungen, Verkehrsmanagement, Fahrzeugortung und Routenberatungen zu schaffen. Ein weiterer Baustein, die Stadtmöblierung, umfasst sämtliche Nebenanlagen im öffentlichen Raum, wie beispielsweise öffentliche Toiletten, Parkanlagen und öffentliche Versorgungseinrichtungen. Wird dieses Modul in einem solchen Modell auf städtischer Ebene berücksichtigt, können zuständige Behörden die erforderlichen Informationen auslesen und somit einen enormen Zeitaufwand einsparen. Mit dem technischen Modul werden Elemente wie unterirdische Rohrleitungen und elektrische Beleuchtungen in das City Information Model integriert. Der Gewässerbaustein beinhaltet sämtliche Gewässer innerhalb einer Stadt und in deren Einzugsgebiet. Dieses Element ist sowohl für den Menschen, als Grundnahrungsmittel und zur Befriedigung der Hygienebedürfnisse, als auch für das Ökosystem, also Tiere und Pflanzen, elementar und überlebenswichtig. Innerhalb urbaner Räume kommt es jedoch oftmals zu einer Übernutzung dieses Gutes, sowie zu einer Verunreinigung und somit Minderung der Wasserqualität. Wasserbezogene Informationen können in das Modell importiert und ausgewertet werden (XU ET AL. 2014:294).

Ein umfangreiches City Information Model beinhaltet äußerst komplexe Prozesse, was ein Übergang von bisherigen Arbeitsabläufen und Methoden auf diese neue Methode erschwert. Ein empfohlener schrittweiser Umstieg auf ein umfassendes City Information Modeling verdeutlicht ein in vier Stufen gegliedertes Reifegradmodell (vgl. Abbildung 2). In Form aufeinander folgender Stufen gestaltet, verwenden die vier Level charakteristische Merkmale, wie die jeweils verwendeten Austauschformate, die Datenqualität sowie die Art des Datenaustausches, bzw. die Art der Koordination der Zusammenarbeit, um sich voneinander abzuheben (BORMANN ET AL. 2015:9f).

Bei der Anwendung des Levels 0 handelt es sich ausschließlich um zweidimensionale CAD-Zeichnungen die beispielsweise durch Office-Anwendungen präsentiert werden. Der Kommunikationsprozess erfolgt hierbei ausschließlich verbal oder in Form von Erläuterungstexten. Bei Level 1 werden Geographische Informationssysteme als Tool für die Bearbeitung und Analyse von Planungen eingesetzt. Diese können etwa der Erstellung und Auswertung von geplanten oder bestehenden Straßennetzen dienen. Als DesktopGIS kann hierfür beispielsweise ArcMap verwendet werden, im Bereich der WebGIS-Anwendungen sind virtuelle Globen, wie Google Earth, zu nennen, die entweder über einen Desktop-PC oder auch über mobile Endgeräte bedienbar sind. Die Darstellungen können sowohl zwei- als auch dreidimensional sein. Level 2 kombiniert CAD- und GIS-Anwendungen, wobei die erzeugten Daten noch herstellergebunden sind. Ab dieser Maturity-Stufe wird vom eigentlichen City Information Modell gesprochen, während die vorangehenden Stufen die Entwicklung zu ebendiesem darstellen. Level 3 stützt sich vollständig auf, mit anderen Softwares kompatiblen, herstellerneutrale Formate und fordert dabei beispielsweise CityGML- und Geoserver-Kompatibilität. Während Level 2 noch auf eine einzelne Planung und deren Analyse beschränkt ist, begleitet das umfassende CIM ein Quartier oder eine ganze Stadt über mehrere Phasen von Planung, Nutzung, Umbau und Rückbau hinweg (GIL 2015:5ff). Diese schrittweise Entwicklung von bestehenden CAD-Zeichnungen hin zu umfassenden City Information Models ist in Anbetracht der sich stetig weiterentwickelnden Technologien unabdingbar, um langfristig Kosten zu sparen, wettbewerbsfähig zu bleiben und Beteiligungsprozesse durch neue Methoden interessanter zu gestalten.

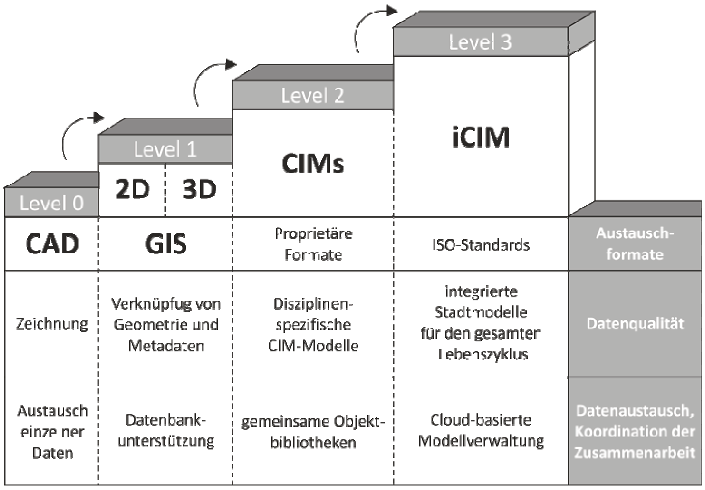

Abb. 2: Maturity-Modell eines CIM (Eigene Darstellung nach GIL 2015:5)

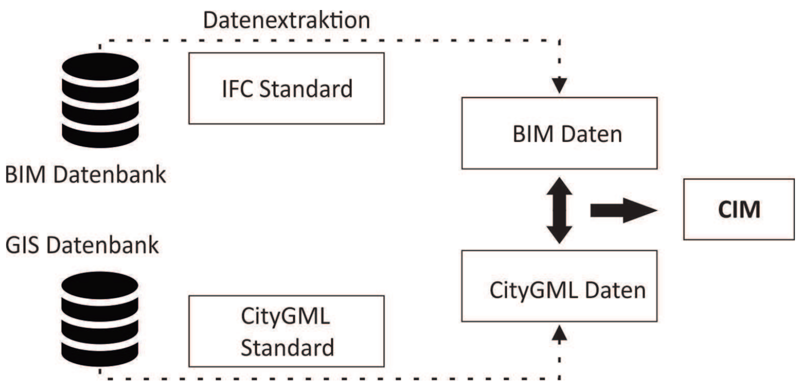

Abb. 3: Datenstruktur eines CIM (Eigene Darstellung nach XU ET AL. 2014:295)

Für ein automatisiertes Verfahren zur Generierung von CIM existiert zum aktuellen Zeitpunkt noch keine unterstützende Anwendung. Vielmehr ist dies aus theoretischer Sicht möglich, insofern die BIM- und GIS-Daten nach einem im Idealfall zumindest herstellerungebundenen, standardisierten Format erzeugt wurden. Hier bedarf es einer Schnittstelle für die Konvertierung der BIM- und GIS-Daten hin zum City Information Model (XU ET AL. 2014:295).

3.1 CIM – Praxistest in aktueller Software

Für Building Information Modeling existieren in der Praxis bereits zahlreiche Softwareprogramme, welche z.T. langjährig erprobt und stetig weiterentwickelt wurden. Daraus resultiert eine neue, zuverlässige Methode des modernen Bauwesens. Die aus dem BIM abgeleitete Methode des City Information Modelings hat diesen Optimierungs-und Reifungsprozess dagegen noch nicht durchlaufen. Da bezüglich Definition und dem Spektrum des Leistungsumfangs einer solchen Methode auf Quartiers- oder Stadtebene noch Unklarheit

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herrscht, ist die Anzahl der Softwareanwendungen in diesem Bereich folglich noch stark eingeschränkt. Aktuelle Programme aus dem Gebiet der Stadtplanung verfügen jedoch über ein breites Planungs-, Anpassungs- und Analysepotenzial, welche somit Ansätze vom CIM beinhalten. Unter der Verwendung eines Bebauungsplans als klassisches Beispiel der Bauleitplanung, werden nachfolgend drei Programme auf ihre potenziellen CIM-Funktionalitäten untersucht. Durch die stark unterschiedliche Grundausrichtung dieser Anwendungen wird ein umfassendes Bild gängiger Lösungsansätze für CIM-Methoden begünstigt.

3.2 StadtCAD Hippodamos

Im Bereich der Stadt- und Landschaftsplanung hat sich StadtCAD Hippodamos als das umfassende, integrative CAD-GI-System etabliert, welches auf der Software AutoCAD basiert. Mehr als 700 deutsche Kommunen und Ingenieurbüros sowie neun deutsche Hochschulen machen von dieser Stadtplanungslösung Gebrauch. Das Stadtplanungssystem des Herstellers euroGIS ist modular strukturiert und setzt sich aus dem „Grundmodul“, dem Modul „Bauleitplanung“ und dem Modul „Objektplanung“ zusammen. Diese Module können als Gesamtpaket oder jeweils einzeln auf dem Desktop PC installiert werden. Zusätzlich besteht die Möglichkeit, das System mit dem Modul „Pflanzenverwendung“ um Funktionalitäten der Landschaftsarchitektur und Landschaftsplanung zu erweitern (SCHULTHEIß 2014:20).

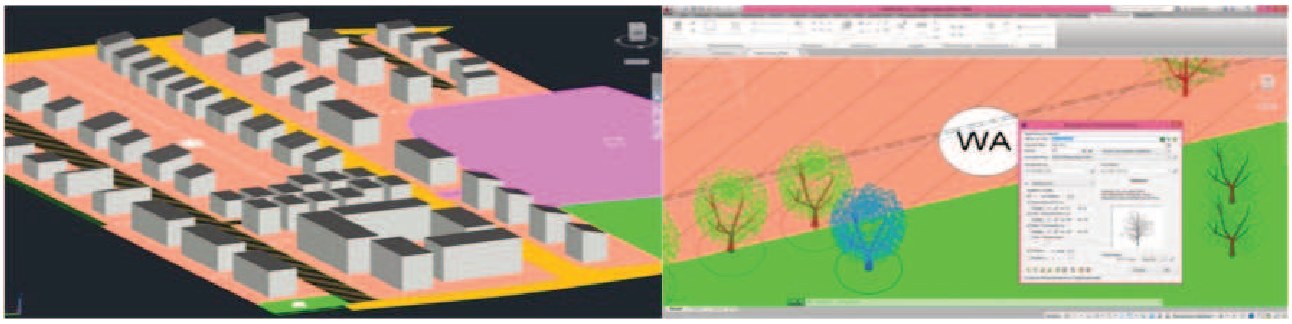

Abb. 4: Bebauungsplan mit Gebäudemodellen (links) und Manager der Pflanzenverwendung (rechts) (Eigene Darstellung)

Mit den umfangreichen Planungs-, Darstellungs-, Visualisierungs-, und Analysemöglichkeiten des StadtCAD Hippodamos Modulaufsatzes stellt sich diese Anwendung als ein umfangreiches Programm für die Stadtplanung dar, dass primär durch die StadtCAD Signothek mit den vielfältigen Objektprofilen eine wesentliche Arbeitserleichterung schafft. Jedoch besteht in mancher Hinsicht noch Verbesserungsbedarf: Es ist beispielsweise nicht möglich, bereits erstellte und platzierte 3D Objekte wie Gebäude als Flächen- oder Volumenmodell in Echtzeit bezüglich ihrer Größe und Ausgestaltung zu verändern. Zudem ist das Zeichnen des Bebauungsplanes mit Polygonen nur wenig dynamisch und das Verändern einzelner Flächen damit noch aufwendig.

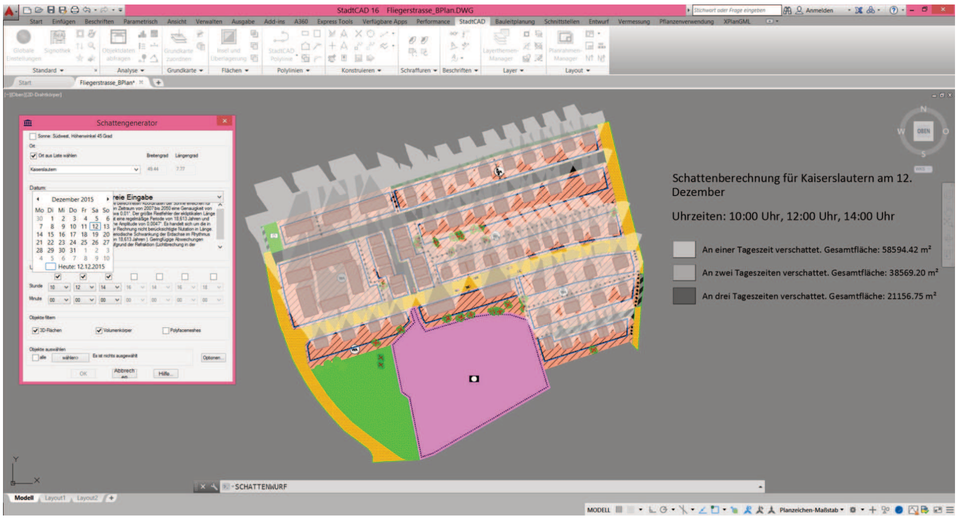

Abb. 5: Ermittlung und Darstellung des Schattenwurfs (Eigene Darstellung)

Die Analysemöglichkeiten beschränken sich fast ausschließ auf geometrische Auswertungen wie Zählungen, Längen- und Flächenberechnungen kategorisiert nach verschiedenen Geometrietypen. Ausnahme bildet die umfangreiche Funktion der Pflanzenverwendung, wobei der Nutzer keine Möglichkeit hat die vorgegebenen

Attribute um eigene zu ergänzen. Ein grundlegendes Defizit der Anwendung besteht in der Programmstabilität, die in Kombination mit der genutzten AutoCAD Version (2016) nicht immer gegeben war. Positiv hervorzuheben ist die Möglichkeit einer Schattensimulation, welche die Beschattungszeit der erzeugten Kubaturen berechnen kann.

3.3 CityCAD

Weniger Zeichnen, mehr Modellieren. Diesen neuen Ansatz der Stadtplanung greift der britische Hersteller Holistic City in seiner Software CityCAD auf. Seit 2008 ist das Programm auf dem Markt erhältlich, welches für die konzeptionelle 3D Masterplanung mit bis zu einer Größe von 200 Hektar konzipiert wurde (HOLISTIC CITY 2015). Jedes in CityCAD modellierte Element kann mit Werten beziehungsweise Eigenschaften belegt werden um den Informationsgehalt eines Plangebiets zu erhöhen.

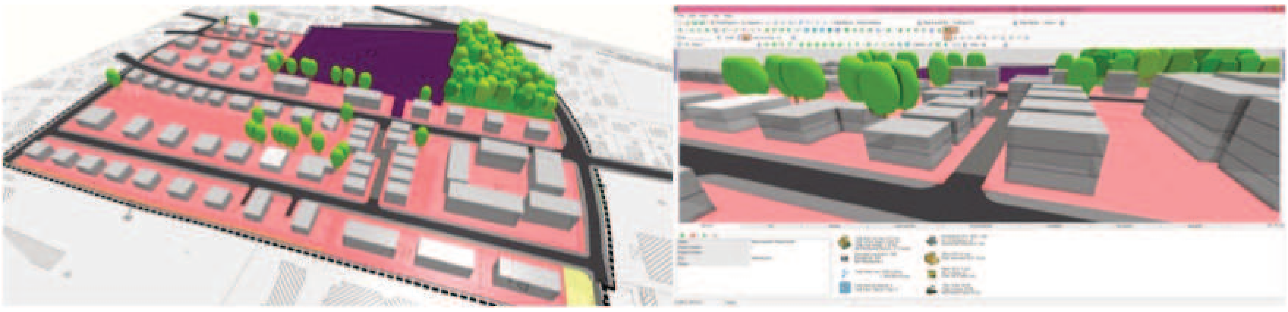

Abb. 6: Modelliertes Plangebiet in CityCAD (links) und zugehöriges Analysefenster (rechts) (Eigene Darstellung)

Die Softwareanwendung CityCAD ist für das Planen in Echtzeit urbaner Räume konzipiert. Planänderungen wirken sich sofort auf sämtliche Statistiken und Analysen aus. Die Anwendung deckt nahezu das gesamte Spektrum von erfassbaren Parametern zu den verschiedensten die Planung betreffende Thematiken, wie Landnutzung, Energiewirtschaft, Ver- und Entsorgung sowie Verkehr ab. Als kleines Manko bei der praktischen Anwendung hat sich gezeigt, dass im Gegensatz zu den vordefinierten Gebäudetypen, die genutzten Gebäudeblöcke nicht mit Durchschnittswerten für Kennziffern wie beispielsweise dem Wasserverbrauch vorbelegbar sind und für jedes Gebäude einzeln erfasst werden müssen. Großer Vorteil von CityCAD sind die Visualisierungen und Auswertungen, die in Echtzeit mithilfe der Anwendung generiert werden können. Dabei ist besonders hervorzuheben, dass der Nutzer nicht auf diese Methodiken festgelegt ist sondern durch entsprechende Exportfunktionalitäten, unter anderem als CSV-Datei, eine Schnittstelle für eine Vielzahl an anderen Anwendungen für die Auswertung zur Verfügung steht. Auch die Option der Erweiterung des Datenmodells durch eigens definierte Parameter steigert den Nutzen und die universelle Anwendbarkeit von CityCAD enorm. Es ist jedoch zu beachten, dass die Anwendung nicht für eine maßgenaue Erfassung und Modellierung geeignet ist. Straßenmodellierungen sind oftmals nur ungenau umsetzbar und zurückgesetzte Gebäude führen bei nicht rechtwinkliger Grundstücksfläche zu Darstellungsfehlern. Auch fehlt die Möglichkeit verschiedene Dachformen auf den erstellten Gebäudekubaturen darzustellen, welche wesentlich für die Charakteristika eines Gebietes sein können. Die Software ist darüber hinaus für britische Masterpläne konzipiert und berücksichtigt derzeit keine deutschen Gesetzte und Planzeichen. CityCAD bietet jedoch eine Vielzahl von CIM-Analysemethoden, welche den Planer bei sämtlichen Phasen des städtischen Lebenszykluses neben den etablierten Methoden unterstützen können.

3.4 CityEngine

Dreidimensionale Stadtmodelle sind in ihrer Erstellung, auch bei geringem LOD, sehr arbeitsaufwendig und kleinste Änderungen bedeuten oftmals einen nicht zu unterschätzenden Mehraufwand. So fällt es bei händisch modellierten 3D-Modellen schwer verschiedene Varianten zeitnah oder gar in Echtzeit als Unterstützung des Planungsprozesses zu visualisieren. Einen unkonventionellen Ansatz für diese Problematik bietet die Software CityEngine von ESRI. Nach vordefinierten Regeln können aus vorliegenden 2D-Geometrieinformationen in Echtzeit 3D-Darstellungen generiert werden. Einzelne Parameter sind interaktiv veränderbar und dem Anwender werden sofort die Auswirkungen der unterschiedlichsten Szenarien aufgezeigt. Neben der Visualisierung besitzen die einzelnen Objekte Metainformationen welche als Grundlage für automatisierte Auswertungen zu Rate gezogen werden können. Die Software findet neben

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der Stadtplanung und Architektur auch Anwendung in der Film- und Spielindustrie zur dortigen zufallsbasierten Generierung von Stadtkulissen (ESRI DEUTSCHLAND 2015).

Abb. 7: Modellierter Bebauungsplan in CityEngine und Menü einer zugehörigen erstellten Regel für die parametrische Bearbeitung (Eigene Darstellung)

Die Programmierbarkeit von City Engine bietet dem Nutzer die Möglichkeit eigene Funktionalitäten, welche beispielsweise in CityCAD enthalten sind, nachzubilden und darüber hinaus auf den konkreten Anwendungsfall hin anzupassen. Die Anwendung ist ein Baukasten für die Bearbeitung komplexer Problemstellungen im städtebaulichen Kontext, welcher in der derzeitigen Version (2015.2) jedoch noch einige bedeutende Grundfunktionalitäten vermissen lässt und durch diese das Programmrepertoire erheblich aufgewertet werden würde.

Es fehlt beispielsweise eine Optionen, dass sich einzelne Attributparameter durch entsprechende Programmierung gegenseitig beeinflussen können. Im konkreten Anwendungsfall könnte dies bedeuten, dass beispielsweise die Grundfläche eines Gebäudes definierbar ist und in Abhängigkeit dieser Einstellung automatisch eine gültige Kombination von Breite und Tiefe eines Gebäudes ermittelt würde. Eine Veränderung der Tiefe würde bei gleichbleibender Fläche somit eine automatisierte Änderung der Breite mit sich führen. Da solche Abhängigkeiten durch die Programmieroberfläche der Anwendung (derzeit) jedoch nicht möglich sind mussten bei der Erprobung Alternativen für die Flächenbestimmung genutzt werden. Hinzu kommt, dass die direkte Erzeugung einer Fläche mit festen Maßen ohnehin nur mittels der Definition des Abstandes zur Außenfläche der umgebenen Fläche möglich ist. Die Geometrieerzeugung mit Hilfe der zur Verfügung gestellten Befehle kann demnach allgemein hin als sehr eingeschränkt angesehen werden. Prinzipiell stehen Funktionalitäten für die Generierung komplexer Gebäudeformen zur Verfügung. Diese sind jedoch in der Möglichkeit ihrer Parameter limitiert. So ist die Höhe des Daches nur über den Winkel steuerbar, nicht aber über die Firsthöhe. Wird eine wie in diesem Kapitel aufgezeigte Regel konzipiert, bei der mehrere Flächen in direkter Abhängigkeit zueinander stehen, so ist nur die Erzeugung einfacher, rechteckiger Kubaturen umsetzbar. An dieser Stelle zeigt sich, dass City Engine primär für die Erzeugung zufallsgenerierter Modelle entwickelt wurde, die nur im groben den wirklichen Gegebenheiten entsprechen. Diese Limitation könnte jedoch mit entsprechenden Erweiterungen behoben werden, sodass sich die Anwendungen zu einem universell einsetzbaren Instrument für CIM-Methoden entwickeln könnte. Die Umsetzung der Regel für Grundstücksflächen zeigt, dass es sich dabei um keine reine Theorie handelt, sondern eine Anwendung in der Praxis bereits denkbar wäre. Eine solche Regeldefinition bedarf jedoch der stetigen Validierung und Weiterentwicklung. Denkbar wären neben der Integration weiterer Festsetzungsmöglichkeiten der Nutzungsschablone auch automatisierte Statistiken beispielsweise für den Energieverbrauch oder die CO2-Emission in Abhängigkeit der Geschossfläche des Gebäudes oder der Anzahl der Bewohner bzw. Arbeitskräfte. Hier zeigt sich nochmals der große Vorteil durch die Programmierbarkeit: Eigens erstellte Funktionen können somit Parameter auswerten und darstellen, die den Standard anderer Anwendungen übersteigen.

4 FAZIT

City Information Modeling versteht sich im Allgemeinen als eine Menge an generalisierten BIM-Modellen, deren Erfassungsbereich über die Grundstücksgrenze hinaus, bis auf gesamtstädtische Ebene reichen kann. Bei genauerer Betrachtung stellen City Information Modelle intelligente Stadtmodelle dar, deren einzelne

Geometrie- und Objektbestandteile mit semantischen Informationen angereichert werden und über die reine Geometrie hinaus auch funktionell miteinander in Beziehung stehen. Sie können dem Planer als eine wichtige Stütze dienen, um Städtebauprojekte vom ersten Entwurf, über die Bauausführung und Bewirtschaftung bis hin zu Umbau- oder Rückbaumaßnahmen zielgerichtet durchführen zu können. Grundlegende Berechnungen können künftig parallel mit der Modellierung erfolgen, so dass beispielsweise Stücklisten, Energieverbrauch oder Flächenaufteilungen auf Knopfdruck ausgegeben werden. Zudem können CIM eine wichtige Basis für Verwaltungsaufgaben darstellen, indem relevante Daten kontinuierlich im Modell eingetragen und gepflegt werden. Bedarf ein Quartier einer Überplanung, so können direkt am bestehenden Modell Planungsvarianten erstellt werden.

Jedoch stellt sich eine direkte Umstellung von der herkömmlichen Planung auf umfangreiche City Information Models als komplex dar, da bestimmte teils kaum kalkulierbare Faktoren berücksichtigt werden müssen. Die passende Software zu erwerben und das Personal einzuarbeiten ist lediglich die Spitze des Eisberges, den es zu bewältigen gilt. Es bedarf einer Umstrukturierung konventioneller unternehmens- und verwaltungsinterner Abläufe. Der Vorteil von CIM-Methoden muss aufgezeigt und durch stetige Schulungen und Trainings gefestigt werden. In diesem Zusammenhang spielt die allgemeine Etablierung und Akzeptanzschaffung in der Planungspraxis eine bedeutende Rolle.

Abb. 8: Die Kosten eines CIM (Eigene Darstellung nach SMITH ET AL. 2009)

Die aktuellen Programme im Bereich der Stadtplanung besitzen mit ihren Funktionen jedoch nur Ansätze für die Erstellung eines City Information Models. Wie bei den drei untersuchten Programmen deutlich wird, ist das Potenzial, welches eine solche Methode birgt, noch lange nicht ausgeschöpft. Mit unterschiedlichen Funktionsweisen besitzt jedes der Programme individuelle Vor- und Nachteile, die zudem für unterschiedliche Einsatzfelder konzipiert wurden. CityCAD dient primär dazu, rechtskräftige Bebauungspläne mit einer gewissen Intelligenz zu erstellen. Der Schwerpunkt hierbei liegt bei der Erzeugung von Geometrieinformationen. CityCAD und CityEngine setzen ihren Schwerpunkt hingegen auf die Modellierung von Planungen in Echtzeit. Als besonders umfangreich ist die Analysefunktion in CityCAD anzusehen, die weit über die Erfassung gängiger Parameter hinausreicht. CityEngine bietet dem Planer aufgrund der Programmierbarkeit die Möglichkeit, individuelle, planungs- und problemspezifische Lösungen zu erarbeiten. Da CityEngine und CityCAD allerdings wichtige Elemente der Bauleitplanung unberücksichtigt lassen, können sie derzeit nur unterstützend wirken. Um eine Erhöhung des CIM Potenzials zu erzielen bedarf es einer Software, die den Grundgedanken einer Bibliothek mit Planzeichen und Objekten von StadtCAD aufgreift, gleichzeitig jedoch den Informationsgehalt durch das Programmieren von Regeln, wie es CityEngine erlaubt, erhöhen lässt. Nicht zuletzt sollte eine umfangreiche CIM Anwendung die Möglichkeit einer Echtzeitanalyse- und Auswertung bieten, wie es in CityCAD bereits erfolgt ist.

Besonders herauszustellen ist, dass das eigentliche Potenzial für City Information Modeling nur indirekt im genutzten Programm liegt sondern vielmehr in der Datenqualität. CIM-Methodiken sollten im Rahmen eines Raummonitorings über die eigentliche Planungsphase hinaus genutzte werden, sodass bei etwaigen Planungs- und Entscheidungsprozess stets aktuelle Daten vorliegen (BIG CIM). So können zukünftig im Optimalfall aufwendige Bestandsanalysen entfallen und mit zunehmender Anzahl an Maßnahmen führt dies zu einer immer größer werdenden Zeit und Kostenersparnis. Reaktionszeiten verkürzen sich und sich entwickelnde Problematiken können, womöglich unterstützt durch ein automatisiertes Analysesystem, frühzeitig erkannt werden. Aus Sicht des Planers sollten die genutzten Anwendungen stets möglichst

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herstellerneutrale Schnittstellen besitzen (OPEN CIM). Die Software ist vergleichsweise leicht austauschbar, die Daten hingegen nicht.

Die untersuchten Anwendungen zeigen jedoch noch einige Limitierungen auf. Die Pflege und Erhaltung historischer Daten, welche für ein nachvollziehbares Monitoring entscheidend sind, ist bislang nicht möglich. Da sich ein umfassender Monitoringprozess allerdings als elementar bezüglich Planungen unter Berücksichtigung der Flächenkreislaufwirtschaft herausgestellt hat, ist die Softwareindustrie dazu angehalten, bei der Weiterentwicklung moderner Anwendungen eine Lösung zu erarbeiten, die diesen Schwachpunkt beheben kann. Möglich wäre es beispielsweise, für jedes Objekt ein Dialogfeld einzurichten, in welchem die Daten eingepflegt, aktualisiert und langfristig gespeichert werden können. Die untersuchten Anwendungen arbeiten zudem alle auf Dateibasis. Dies ist als entscheidender Nachteil für das Arbeiten im Team anzusehen, da so in der Regel nur eine einzelne Person gleichzeitig produktiv an den Inhalten arbeiten kann. Für eine ausgereifte CIM-Lösung ist daher zwingend eine Datenbankanbindung, wie sie von gängigen GIS-Anwendungen unterstützt wird, erforderlich, um darüber hinaus ein Konfliktmanagement zu ermöglichen.

Der Einsatz von CIM-Methoden steht in enger Verbindung mit der Vision der vernetzten Stadt. So ist es denkbar, dass CIM-Systeme in einem automatisierten Prozess stetig mit neuen oder aktualisierten Informationen des urbanen Raumes versorgt werden und eine permanenten Evaluierung in Echtzeit durchführen. Zudem wäre eine zunehmende Nutzung von AR-Visualierungen mit mobilen Endgeräten vor Ort denkbar. Diese könnten an ein CIM gekoppelt sein und direkte Dokumentationen, Optimierungen und Analysen von Planungsvarianten vor Ort ermöglichen. Auch umfangreiche VR-Simulationen könnten sich aufgrund der ansteigenden Qualität und Quantität der Daten und des ansteigenden Verständnisses von räumlichen Wirkungsketten als immer verlässlicher werdende Instrumente etablieren. Neben den technologischen Entwicklungen werden die Interessen und die soziale Dynamik künftiger Generationen entscheidend für die Planung der nächsten Jahre sein.

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Deconstructing Economic, Ecologic and Social Urban Discourses for Innovation Policies

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1 ABSTRACT

Worldwide, cities are called upon to help achieve a wide variety of policy goals, varying from economic growth, increased energy efficiency and the mitigation of global warming, to improving the liveability of urban neighbourhoods and the active participation of the population in urban planning. In particular, cities are supposed to help achieve necessary innovations in these domains. Both local governments (municipalities) and regional alliances of local governments (in metropolitan areas) are thought to have a thorough insight into relevant local and regional circumstances, are supposed to be able to act relatively quickly and decisively, and are thought to be able experimenters.

This paper acknowledges that a growing number of (larger) cities present ambitious policy plans and take effective action in the (combined) fields of economic growth, the mitigation of climate change, and improving liveability and sociale inclusion in urban neighhourhoods. However, it also acknoweldges that there are limits to the capacities of cities to help achieve innovations, think of cities' limited abilities to change established large-scale systems in the field of energy production.

The following central question is addressed: Under which conditions are (cooperating) cities able to plan and act quickly and decisively, learn from local experiments, and share insights across national borders and sectoral domains?

This question is approached by performing a discourse analysis of the relevant scholarly literature and policies and plans regarding the roles of cities in innovation processes in the combined fields introduced above. The paper takes the current debate in the Netherlands as a starting point, considering it in the context of related debates in the international arena.

Keywords: Discourse, Experiment, Innovation, Policy, Urban

2 INTRODUCTION

2.1 Background: cities are expected to act as agents of change

Worldwide, cities are called upon to help achieve a wide variety of policy goals, varying from economic growth, increased energy efficiency and the mitigation of global warming, to improving the liveability of urban neighbourhoods and the active participation of the population in urban planning. In particular, cities are supposed to help achieve necessary innovations in these domains. Both local governments (municipalities) and regional alliances of local governments (in metropolitan areas) are thought to have a thorough insight into relevant local and regional circumstances, are supposed to be able to act relatively quickly and decisively, and are thought to be able experimenters.

On the one hand there is certainly evidence to substantiate claims such as these, both in the scholarly literature (e.g. on smart cities, eco-cities and inclusive cities) as well as in the policy and planning practice. For instance, a growing number of (larger) cities present ambitious policy plans for decoupling natural resource use and environmental impacts from economic growth. Also, cities increasingly share lessons learned from local experiments with their counterparts in international networks, opening up opportunities for scaling-up best practices. On the other hand critics point towards the limited capacities of cities to affect established systems that function on a global scale, e.g. the interdependent infrastructures facilitating fossil-fuel dependent energy production. This paper acknowledges the merit of both positions in the ongoing debate about the scope of metropolitan innovation in the combined fields of economic development, energy use and climate change, and liveability and social participation.

2.2 Research question and objective

In order to assess and discuss both cities' opportunities and limitations regarding policy and planning innovation in the combined fields mentioned above, this paper addresses the following central question:

Under which conditions are (cooperating) cities able to plan and act quickly and decisively, learn from local experiments, and share insights across national borders and sectoral domains?

This question is approached by performing a discourse analysis of the relevant scholarly literature and policies and plans regarding the roles of cities in the combined fields introduced above. The paper takes the current debate in the Netherlands as a starting point, considering it in the context of related debates in the international arena. Sub-questions are: How are cities defined from a (spatial-)economic, energy/climate, and social/liveability perspective? How are policy and planning innovations framed from the different perspectives? How do so-called living labs (testbeds for experiments) function in practice? And, what do they ask of both government bodies and civic collectives?

By exploring these questions, the concepts of the city and the urban condition that feature so prominently in both the current scholarly and policy and planning debates – e.g. think of the Dutch national Urban Agenda, the Urban Agenda for the EU and the United Nations' New Urban Agenda – can be deconstructed. Black boxes are opened and light can be shed on complex material, metabolic, institutional and social assemblages that make up our cities. By doing so, this paper aims to help scholars, policy makers and planning professionals to reconsider and reassess pressing issues related to experimentation and innovation, and draw their attention to both the potential and the limits of urban policies in the fields of economic growth, energy use and climate change, and social inclusion and liveability.

3 RESULTS OF THE DISCOURSE ANALYSIS

3.1 The innovative city in three different guises

This paper is based on a quite elaborate analysis of scholarly and policy and planning literature that is expected to be published by PBL Netherlands Environmental Assessment Agency shortly (Hamers 2016, forthcoming, in Dutch). Without trying to dive into details, this paper presents some of the key results of the discourse analysis. The analysis clearly shows that in the debate about the role that cities can play in innovation processes in the fields introduced above, cities appear in three different guises. These three guises are presented in the diagram below (figure 1).

The circles in the diagram represent the three domains: economy, climate and energy, and liveability and inclusion. In each of these domains the innovative city is characterised differently. Five key characteristics are summerised in five layers (in blue, to be read in outward direction): (1) the dominant concept of the city; (2) the city considered as an opportunity and/or threat; (3) the key policy objective; (4) the main strategy to achieve the objective; (5) the prevalent concrete implementation of this strategy in the urban practice. Additionally, the tensions between all three domains are shown (in red), as well as key concepts that summarise what the three domains have in common (in green).

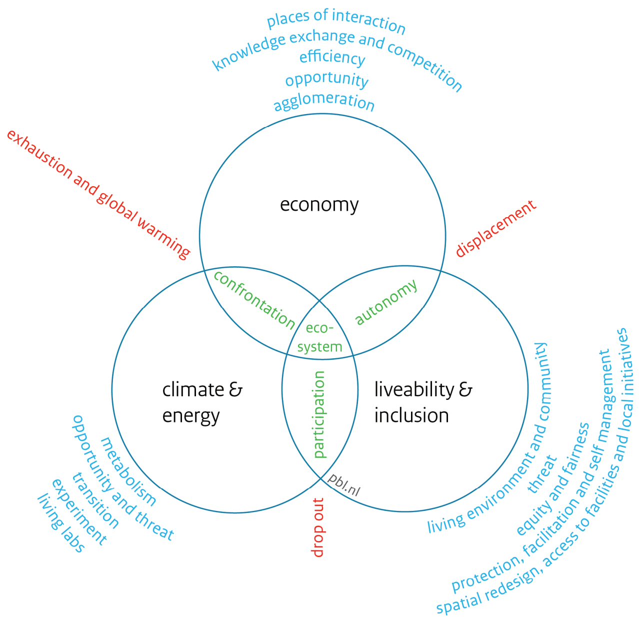

Fig. 1: The innovative city in three different guises.

It is widely acknowledged that the problems that cities need to address in the three fields identified in this paper, can only be solved in interrelation to one another. However, the fact that the innovative city appears in different guises in each of the three domains indicates that developing policies and plans for innovation in the combined fields is a considerable challenge. This applies to all actors involved in innovation processes, varying from the national government and (coalitions of) municipalities, to private companies, civic collectives, and active individual citizens. Together, they have to face this challenge. In each of the domains different actors act as key advocates of certain innovations. They operate in varying alliances, that encounter different obstacles and create different opportunities to change existing policy frameworks and established institutions.

3.2 The city as an engine of economic growth: places of interaction for knowledge exchange

In cities as so-called engines of economic growth, knowledge exchange is considered a key aspect of achieving agglomeration economies, especially regarding innovation. Developing new products and systems requires face-to-face meetings. Personal meetings provide opportunities to get to know each other, create trust and exchange ideas (Storper and Venables 2004). For cross-pollination to take place, creative people need to be near each other. Physical proximity (and a certain urban density and mass) is a necessay condition: innovation is highly localized (Moretti 2012). Cities can provide proximity. By planning and designing ‘places of interaction’, an urban environment is created that can help strengthen urban actors’ (not only companies, but also government bodies) ability to learn, i.e. to enter into new relationships, inspire each other and explore opportunities across (sectoral) boundaries and (physical and institutional) borders.

On the basis of a series of examples of several types of these places of interaction (in the fields of congress, culture and knowledge, in Amsterdam, Rotterdam, and Delft) a number of important characteristics can be identified. One can think of mixed use, a walkable and bicycle-friendly urban environment, a lively public space and a certain overlap of the collective domains of different types of users. Although all of these characteristics are known qualities in urban planning and design, in many cities they are not self-evident; they require subtstantial additional support from policy makers, not only on the municipal level, but also on the national level.

Arguing for planning and design that focusses on creating the spatial conditions for interaction, however, does not mean that actual knowledge exchange can be garanteed. Fortunately, one could add, because in addition to planned meetings, accidental encounters are highly regarded in both economic and spatial disciplines. Several researchers stress the importance of so-called looseness and slack in the urban environment. Interaction that allows for innovation to take place requires room for unforeseen use, as can be

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illustrated by the many informal and sometimes even illegal interventions by all kinds of pioneers in so-called brown fields in the past decades, that only recently have resulted in official urban transformation policies and plans. Some novel ideas remain outside the mainstream for a long time before they become more widespread and lead to a breakthrough in institutionalized, somewhat 'rusty' practices. This kind of innovation goes beyond innovation in product development or new technical applications that are the central topic of a considerable part of the economic literature. It involves more radical forms of change, in which cities play a different role and other actors take the lead. This kind of innovation will be addressed in the next section, that deals not with the economic city but with the possible roles of cities in the light of climate change.

3.3 The city as a living lab: testbeds as experimental practices

Cities represented as so-called low-carbon, eco and green cities are quite different from the city as an engine of economic growth. Such cities do not strive for modest innovations and efficiency gains, but aim for a breakthrough in conventional climate and energy related institutions and practices. Such a breakthrough is usually framed as a transition from one climate and energy regime to another, in short, a system change. A number of examples (Freiburg, Graz, Stockholm, Copenhagen) show that cities can play an important role in helping to set things in motion (Blok 2013; Rohracher and Späth 2014; Rutherford 2014). On the basis of ambitious policy plans and concrete regional and local actions, municipalities can be key actors in alliances that often also include private companies and civic collectives. Together, they can experiment with innovative approaches, including not only new technologies, but also novel financial and legal arrangements as well as new ways of collaborating in hybrid public-private coalitions.

However, the same examples also clearly show that even the most ambitious cities encounter serious obstacles to radical change. In some cases, different government bodies work against each other (e.g. a municipality and province), while in other cases different departments within one government institution (e.g. a municipality) have contradictory policies in place. It also becomes clear that policy makers and planners underestimate the messy character of most experiments. Many so-called living labs and testbeds do not function as clean and orderly laboratories. They can include quite unruly practices, involving a wide variety of actors (both professionals and active 'ordinary' citizens) with varying motives, often working with a trial-and-error approach, and producing different kinds of knowledge. To learn from experiments such as these, conventional project management is not sufficient. Working with clear targets, a one-to-one relationship between means and ends, and a focus on short-term efficiency can even be an obstacle to achieving innovation. Instead, providing room for adjustments to unforeseen events and welcoming interferences by unexpected actors can point towards opportunities for radical change.

This argument for involving a variety of actors and confronting different ideas (and types of knowledge) resonates with proposals by urban sociologists such as Sennett (1970) to plan and design the urban environment not to avoid confrontations but to provoke them: cities should encourage conflict. Although this perspective on the city goes well beyond what economists have to offer (section 3.2), it is less far removed from the economic urban discourse than might be expected. Moretti (2012), for instance, advocates a fertile urban environment in which ideas (unexpectedly) collide; it is only when ideas collide that something is created that did not exist before. Currently, however, a large part of urban policy and planning (worldwide) points in the opposite direction: a need for control. Although control can be understood from certain policy angles (and in certain parts of the city), it can act as a barrier to the development of the city as a living lab.

3.4 The liveable and inclusive city: room for local initiatives and resources for self-management

The third and final guise of the city in this paper is the city as a collection of neighborhoods and as the everyday environment of different types of inhabitants. Urban dwellers can differ considerably, for instance in terms of their socio-economic status. Factors such as education and income correlate with and to a large extent explain differences in the quality of life in neighbourhoods, the average health of different population groups, and the extent to which they have control over their lives (autonomy). The city – mirroring society as a whole – does not provide a level playing field. For different socio-economic groups, development opportunities vary. The same holds true for the extent to which different groups (can and wish to) contribute to innovation processes.

From the perspective of liveability and inclusion, planning, organising and designing the city is not a matter of increasing efficiency (section 3.2) or aiming for a transition (section 3.3), but primarily a matter of equity, justice and fairness (Rawls 1999). Equity does not necessarily mean equality (of outcomes); it is much more about providing different people with equal and fair opportunities (to start with).

Inviting various stakeholders to contribute to innovation processes may seem a good idea in theory; in practice, however, enabling different urban actors to collaborate in experiments appears to be a formidable challenge. Local policy, planning and design can help improve the liveability in urban neigborhoods in a variety of ways, think of taking measures against air polution in certain urban areas and improving access to all kinds of social and health facilities for low-income groups. But stimulating less-educated and low-income groups to team up to take action aimed at innovation appears to be more difficult.

In the Netherlands, Van den Berg (2013) and Franke *et al*. (2015) provide a good overview of how different urban dwellers help change cities (the urban environment) and use cities (the urban condition) to change the policy and planning practice by developing and testing social and institutional innovations. These tests show that (a limited number of) citizens find their way in the newly developing so-called participatory society (that, in some respects, can be considered a Dutch version of the UK's Big Society). Additionally, they make clear that government bodies struggle with their role in new alliances and arrangements. A number of cases (in Amsterdan and Rotterdam) reveal a collision between a traditional command and control culture and the unpredictable nature of citizen-led (bottom-up) local projects. Too often, for instance, policy makers expect outcomes to be known in advance, whereas local participants need room for manoeuvre. A certain degree of freedom is what inspires them to take the initiative and collaborate for change. If there is no room for surprises (and failure), it hardly makes sense to experiment with do-it-yourself ways of working.

This does not mean that government has no role to play anymore. To the contrary, active citizens can benefit from municipalities offering a clear framework that helps set priorities and safeguard public values. Providing space for bottom-up initiatives does not mean that anything goes. It does, however, require that government dares to differentiate between policies in different areas and make room for (temporary) exceptions to rules in certain cases (Reuser interviewed by Miazzo and Kee 2014), since, if government wants to fulfill its intended role of the so-called facilitator, it needs to open up new possibilities rather than limit them. Refering to Sennett (2007), policies that aim for (cities to play a leading role in) experimentation and innovation, should have a certain degree of indeterminacy. Along the same lines, spatial planning should to some extent be incomplete and design should be porous.

4 CONCLUSION

To conclude this paper, it is good to recall that policy makers and planners on local, national, EU and global levels expect cities to play a leading role in innovation processes, in the combined fields of economic growth, energy and global warming, and liveability and social inclusion. The discourse analysis in this paper – better, the much larger research project on which this paper is based (Hamers 2016, forthcoming) – shows that cities are indeed well-equiped to provide the necessary insight into relevant local circumstances, to act relatively quickly and decisively, to conduct experiments, and to share results across borders. However, cities' (like any entity's) capacities for change are limited. Municipalities, for instance, often are not in command of large-scale infrastructures, and their room for manoeuvre is limited by (inter)national rules and regulations. Additionally, for municipalities (as well as the private companies and civic collectives they collaborate with) to effectively act as agents of change, higher tiers of government have to change their attitude towards experiment and innovation. To stimulate innovation, policy makers should allow for diversity in regulations in different areas and (temporary) exceptions to rules in certain cases. Furthermore, to conduct experiments, policy makers and planners should realise that living labs are messy practices: they involve multiple stakeholders with varying backgrounds and motives, they are characterised by unpredictable processes, they yield unexpected results and produce new types of knowledge.

Finally, policy makers and planners propagating (cities' role in) innovation should be aware that experiments do not only involve technical innovations, but also social and institutional innovations. They can challenge not only conventional policies and planning approaches, but also form a new political arena that competes with familiar government and governance arrangements (Bulkeley and Castán Broto 2013; Evans 2011). If local participants are (expected to be) involved, they will ask for a certain degree of autonomy, including adequate resources to make things happen. In this sense, it is clear that experiments and innovation involve taking risks: established positions will be challenged, with trial comes error (failures are inevitable), and success has many faces.

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Envisioning Sustainable Lifestyles in Stockholm's Urban Development

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1 ABSTRACT

The urban development in Stockholm, Sweden is an obvious example of the materialisation of the idea of a compact and traditional city as the sustainable city. This paper develops on this theme using the ongoing planning and development of the area Årstafältet in the south of Stockholm as example. With the central planning documents as empirical material, this paper investigates urban discourses that construct and give meaning to an area as urban/suburban, including the role of green space. The city and the urban are today better understood as ideological constructions than descriptions of a place or lifestyle. However, the city/country (or urban/suburban) division still lives on in planning. Årstafältet, on the edge of the inner city is interesting in this context, since it is currently being transformed from a typical Swedish post-war suburb into a post-modern 'urban area'. Its green space is also being re-conceptualised as a "world class park". At the same time as the urban has been coined the "quintessential floating signifier", urban densification and functional mix are considered the solutions to almost all problems. Certain constructions of the city and the urban lifestyle have an undisputed status, and others are given the role of the problem to be solved. In Swedish cities the problems to be solved are often found, or located, in the periphery. The suburb that used to represent the most modern in welfare state urban planning now represents its failure. This paper investigates how planning practice responds discursively to these representations.

Keywords: discourses, sustainability, Sweden, urban , visions

2 INTRODUCTION

Paradoxically, at the same time as the urban has been coined the "quintessential floating signifier: devoid of any clear definitional parameters, morphological coherence, or cartographic fixity" by Neil Brenner (2013: 90), densification and functional mix are considered the solutions to almost all urban problems – whether economic, environmental or social. And, whether or not concepts are considered incoherent or outdated, the division between city and country as well as between urban and suburban definitely lives on in urban planning and development strategies (Brenner 2013, Lees 2010; Tunström 2009; Wachsmut 2014). Planning and planning discourse draws borders between city and countryside, between the urban and the suburban, and between different eras and areas, in spite of their elusiveness and in spite of citizens crossing those borders on a daily basis.

Brenner, in several writings, has taken as a starting point that the city and the urban as concepts today are so multifaceted and diverse that they have lost almost all meaning. Brenner & Schmid (2015) for example, consider the urban as a strong frame of interpretation; a theoretical category, but not a bounded unit or a certain type of settlement. The way that definitions and measurements are used in turn has consequences:

"In a striking parallel to the long-discredited modernization theories of the postwar period, the various strands of this metanarrative are now being used as discursive frames to legitimate a wide range of neoliberalizing proposal to transform inherited urban built environments …" (Brenner & Schmid 2015, 158)

Constructions of the urban and suburban materialise in policy and practice – as e.g. types of densification, in focus on ground floor shops or grid street structures, in different views on car traffic, etc. Categories and categorisations are one of the more central planning tools; pointing at places, giving them an identity and thereby projecting onto them all the ideas, experiences, memories etc. of cities, countryside and suburbs that people carry around.

Swedish planning is internationally known as being at the forefront of environmental technologies and planning for sustainability. However, the technical solutions to environmental problems are rarely framed in social and political terms highlighting justice, gentrification or public/private relations (Tunström & Bradley 2014, Hult 2013, Bradley et al 2013), making technology less evident. In this paper, rather than promoting certain planning solutions or discussing the importance of technologies for sustainable development, the aim is to find and deconstruct the conceptualisations and "makings" of norms and values related to the built environment, to sustainability, everyday life, green space etc. in Swedish planning visions.

3 A GREEN AND DISCURSIVE FIELD

In this paper a green space called Årstafältet (the 'Årsta field') in Stockholm, and the plans for new development there, is in focus. Årstafältet is currently a 50 hectares recreational area located just outside of inner city Stockholm. The green field is located between several residential and industrial areas and is planned to become a new neighbourhood with 6000 dwellings for 15 000 inhabitants sharing a park area smaller than the current green field. The project developing the green field into a neighbourhood is a major one, but it is not framed as a flagship sustainability project such as the previous Stockholm development areas Hammarby Sjöstad or Royal Seaport, which were internationally marketed as spearhead projects of sustainable urban planning. In spite of being ordinary in some ways, Årstafältet is also currently one of the biggest green fields in Stockholm and includes open fields, areas reserved for activities such as golf, rugby and allotment gardens as well as left-overs from a main through road and an old historical road that led to the inner city. The existing housing in the area was planned and constructed during different eras. Consequently, this is quite an ordinary mixed suburban landscape with green structures, infrastructures and housing and other functions from different eras. In addition to the architectural and urban planning related differences, the areas surrounding Årstafältet differ from each other in demographic and socioeconomic aspects.

4 THE ROLE OF PUBLIC SPACE

Apart from the ambitions stated in the comprehensive plan, the main goal in the visions and detailed development plans for Årstafältet is to make the new area "a place for meetings". This is repeated in planning documents, and illustrated and exemplified in both text and images. It does not have to do with arranged meetings as in conferences, as it may seem at first, but "meeting places" is the Swedish and perhaps less abstract equivalent of saying public spaces, and a concept recurrent in most contemporary planning documents. This can be seen as a pragmatic position in the debate on the privatisation of public space and as related to the idea of the disappearance of public space. Urban spaces are public-private in different degrees everywhere, and there are places formally public but privatised, or formally private, but functioning as public. In light of this, it can be seen as more constructive to focus on collective spaces, regardless of whether they are public or private (Hajer & Reijndorp 2001).

The focus on public spaces or places for meetings does not only indicate the ambition for the new district at Årstafältet, but it is also an analysis on how the area functions today – that this is considered as lacking. Through this vision, the existing areas around Årstafältet are constructed as – currently – segregated from each other, and as unattractive to visitors. Meetings are also connected to an "urban life":

"Where local and regional passages overlap the flow of people is the biggest and the potential for meetings between dwellers and visitors is the strongest. These are the passages that usually are seen as most central, with a more intense urban life and better preconditions for activities and services." (City of Stockholm 2010, p.18)

Another ambition in the plans is presented as the importance in connecting the two existing areas Årsta and Östberga to each other. In the architectural competition program the existing area is described as being characterised by barriers. This is stated as a fact, even though it is a characterisation rooted in one particular perception of the area. The emphasis on barriers and focus on creating connections and a continuous urban environment also has as a consequence that the current green space – the field, the park - appears as a barrier more than a park and a place to meet (City of Stockholm 2008, p.7). The architectural competition program emphasizes words like "contact", "bridging, "holistic approach" and "connections". This adds to the construction of the new development as a social integration project rather than a housing project. Also, a coherent and compact structure is considered more "urban", so the ambitions to create connections must be seen as a part of the "urbanisation" of the area. In the architectural competition program, it is stated that Årstafältet will become: "An urban neighbourhood in which people, environment and architecture blendwith the existing neighbourhoods to form a new entity." (City of Stockholm 2008, p.5) Nya Årstafältet Architecture competition, Brief for an invited architecture competition for Nya Årstafältet, p.5, author's translation And further on:

”The aim is for the area to have a mix of housing and non-housing to have a functional configuration resembling that of the inner city of Stockholm. A close-knit urban development will create better prospects for shops, cafés, culture and meeting points.” (City of Stockholm 2008, p.7)

Both the focus on public spaces and on physical connections can be interpreted as addressing segregation – but without using that particular, and problematic, word. The emphasis on meetings between different groups positions isolation, segregation and planning for only residential areas as the opposite of the current plans. The fact that meeting places are so central in the plans, and mentioned explicitly and frequently, indicates that it is not any kind of meetings that are imagined, but good, positive and constructive meetings. In images and text a certain kind of public life and urban space is portrayed, not for everyone or for every activity. For example, political gatherings or demonstrations, experiments or ceremonies, food provision, religion, lectures and pedagogics, care etc. are not imagined. In that sense there is a certain construction of public space and the social meetings envisioned there (see also Tunström 2009, pp.111-114).

5 URBAN NATURE AND SUSTAINABILITY

The plans for Årstafältet are not explicitly designated as sustainable, and planning for sustainability is frankly not that visible in the documents, unless the central ambition of a “world class park” is interpreted as a sustainability measure. The existing green space is already a park in many ways and was until now planned to be something called a “landscape park”. The existing green field is however now instead to be “… developed and refined in order to create a good living environment in a more compact city” (City of Stockholm 2010, p.20). In relation to the character of the planned development it is also stated: “When the inner city is growing, the importance of the park will increase.” Statements such as this are interesting both in relation to the strong norm in the idea that the inner city is growing in this very suburban surrounding, and that the park is, ironically, considered to be more important when its size is reduced. In relation to both the expansion of the compact urban structure and to the reduction of green space, the park becomes important to protect – by developing it.

The current plans involve a reduction of green space in the area due to the new housing being developed, but also a redesign of the current space, relocating the gardening plots and creating a pond and wooden pedestrian decks. However, the current plans can be understood to be as much about the designation of the place as about the design of it. The green space that is there today is a field, the Årsta field. A field is easily associated with the countryside, and it could be considered an endangered landscape type in an urban setting. The planning documents emphasize its transformation into a park, but the new development as a whole is still called “Nya Årstafältet”, ‘the New Årsta field’. It is possible to interpret the plan as a development towards a more programmed green space. If a “landscape park” seems more nature-like, the plans instead are a way of transforming this nature into a space of organised activities that can be seen, counted and evaluated. But, there is still nature oriented image-making when it comes to the planned pond. There is a small stream running through the field, and this stream will be made into a pond that will be a “natural” part of the park – even though it is artificial (City of Stockholm 2010, p.15). Clearly, there are both ideas of the city and of nature at play here.

The explicit sustainability vision is not intimately related to the park. In the architectural competition program sustainable development is e.g. about encouraging the dwellers to use public transportation, walk or cycle, about designing the area to maximise use of public transport, about connecting the new development to existing areas so this has an “effect on the urban life”, and about creating an integrated network of streets. It is stated that “[t]he urbanism developing under the shadow of the climatic menace has every chance of becoming more innovative and locally adapted than the large-scale, traffic-centred planning of decades gone by.” City of Stockholm 2008, p.15). Competition contributions should relate to sustainability mainly by climate adaption in transportation, housing and waste disposal. This is also how the planning documents overall mainly operationalise it. The competition program does however bring up social sustainability, defining it as preconditions for people with different lifestyles, ages and backgrounds to live together. It is also about safety, social mix, places for people to meet, accessibility and planning and design from a child perspective. The planned improvements in the public transport are however relatively small, and there are next to no references at all to e.g. alternative lifestyles or affordable housing, and no discussions about reduced consumption of goods or reduced dwelling space in the future or about the choice of building

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materials. All in all it must be considered as a vague and weak, light green, local and eco-modernisation oriented sustainability vision.

6 URBAN RATHER THAN SUBURBAN

Rather than emphasizing sustainability, it has already become clear that the dominant vision of Årstafältet is as an urban area. It appears that it is of central importance that the new development is considered urban, and that it builds on the structure and density of the inner city:

”Årstafältet is a part of the expansion of the inner city (…) Several factors have contributed to the more central and attractive location of Årstafältet.” (City of Stockholm 2010, p.6)

Furthermore, there are certain urban qualities that come with density:

”A strong ambition is that Årstafältet will become an area with a rich urban life and many functions. A mixed city demands a certain density, a large flow of people, a strong public space and access to tempting attractions. The development of Årstafältet is part of the development of a more compact Stockholm and a more compact southern district. In addition to the new development planned nearby (…) it is estimated that Årstafältet will get the number of dwellers and working population demanded in order to create the urban qualities that are missing in many suburbs today. Other factors that is beneficial for a lively, mixed and attractive urban environment is the location near the tram, Södra länken and Huddingevägen as well as the big park.” (City of Stockholm 2010, p.19)

Urbanity is in this case also constructed – in addition to the common words and concepts (urbanity, attractiveness, diversity, variation etc.) – as natural, human scale, personal, world class, playfulness, variegated, angled and permissive. For example:

“The new city silhouette signals playfulness and variation which is something completely new for Stockholm.” (City of Stockholm 2012, p.13)

Apart from using “playfulness” as a planning ambition, the quotation above is a strong statement that tells about the perception of the existing built environment of Årstafältet, or even Stockholm as a whole. It is not playful or varied at the moment. There are several examples indicating that the area today is not considered lively, mixed or attractive, and that also implies that it is a certain kind of liveliness, mix or attractiveness that is sought after. The architectural competition program is perhaps the most illustrative example of the inner city norm. Words like urban, city, central or centre are constantly used and in text and images it is referred to the city centre and to compact urban structures as the norm and goal. Further on, in one of the plans it is repeatedly stated that the new built environment will construct an obvious “urban front” to the park (City of Stockholm 2012). The use of the quite strong expression urban front (compare “urban frontier” etc., see Smith 1996) is somewhat surprising; however it is not commented upon in the documents. An urban front is apparently something making the relation between the built environment and the park not to be understood as functionalist. An urban front is however not the same as a “monumental silhouette” as in the following: “The monumental silhouette of Valla gärde will be replaced by a more varied urban silhouette.” (City of Stockholm 2012, p.37). It appears as there must be no hesitation as to whether the built environment is urban, or that the park is an urban park.

Finally, in order to try to understand how certain words or concepts are used to describe plans or places, it is relevant to reflect as much on what is said in the documents as on what is not said and excluded. In the attempt to construct the place as urban, the suburban is silenced. It appears important to not associate the new development on Årstafältet with anything suburban. This has the effect that the new development appears as a kind of ‘point zero’. There is nothing there today worth developing further, no major qualities to emphasize. The fact that the area currently is characterized by housing from different eras, a big green space, public transport connections and public spaces, planning and architecture history, is not brought forward. The documents contain very few images from today's Årstafältet, or references to current functions of the green space. Instead, the park is presented several times as if it is a new addition to this part of Stockholm, as in this visionary statement from the planning program for the area as a whole:

”On Årstafältet a big park is created for people to meet. The park will be the heart of the new area, with big spaces for play and activities, and more closed off parts for seclusion and peaceful walks. A compact and varied urban environment surround the northern and western parts of the park and connect Årsta and Östberga." (City of Stockholm 2010, p.12)

Similarly, the shift from "landscape park" to an urban park emphasizes the plans as something new, as plans for something that does not exist currently. The current Årstafältet is instead characterised by barriers – the current green field is a barrier for integration, existing roads are barriers and the housing areas suffer from deficiencies that can only be cured by new housing – and the lives that are lived in the area at today are basically invisible. One consequence of the downplaying of both history and the present conditions and lifestyles is that it appears as if Årstafältet today is an empty place, a void.

7 CONCLUSION

As was stated in the introduction, the objective of this paper is to investigate and critically analyse the various images, ideas, values and norms that are associated with the notions of the sustainable city and sustainable lifestyles in contemporary urban planning. In doing this, a vision characterised by a specific kind of conceptualisation of sustainability has been found. If it previously was about safeguarding green space sustaianbility, is now rather about developing green space into a post-modern housing area. In Årstafältet sustainability in addition is downplayed in favour of urbanity and social integration. The planning vision for Årstafältet is an obvious example of how the division between city and suburb might have lost importance in practice, but still lives on in planning.

It is a compact city structure that is envisioned in order to create a stronger basis for public transport and local services. There are allotments, greenhouses and a park, but urban gardening is not emphasized to any large degree. A sustainable lifestyle is an urban lifestyle and the compact city is the place for it, in this case. However, the envisioned lifestyles are only implicit, in images and choices of words. There is no strong vision of a New Årstafältet being a place for any kind of alternative lifestyles, judging from the vision. It also appears as if the New Årstafältet is planned for activities other than the ones ongoing, in line with the presented 'point zero' analysis. Årsta being one of the prime examples of the neighbourhood and community planning of the 1940s and 50s, the contemporary vision for Årstafältet is a strong contrast. If post-war planning was primarily for the residents, and materialised values of local and collective organisation through its public places and community spaces, contemporary urban development such as New Årstafältet embodies a different set of values. It emphasizes visitors as important for public life, safety and attractiveness, and the envisioned public spaces are for recreation rather than collective organisation. Also, certain constructions of the city and the urban lifestyle seem to have an undisputed status, and others have been given the role of the problem to be solved. In Swedish cities, the problems to be solved are almost unanimously found, or located, in the urban periphery. The suburb that used to represent the most modern in welfare state urban planning now instead represents the failure of planning.

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EO-based Smart City Decision Support Services for Integrated Urban Governance: the DECUMANUS Project

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1 ABSTRACT

Urbanization is a fundamental force of change and in Europe has underpinned the flourishing of civilization for millennia. However, the 21st-century is also witnessing the impact of other societal challenges, including climate change adaptation, and mitigation, as well as the need to secure the efficient utilisation of finite resources. These societal challenges are impacting not only the social fabric of urban life, and the economy of cities, but also the civil quality of urban environments throughout Europe.

It is clear that if properly governed cities can become a major part of the solutions to the growing threat of these urban challenges, and so can become economically vital, culturally vibrant, and healthy environments delivering first-class quality of life for hundreds of millions of city dwellers throughout Europe. Nonetheless, the challenge of urban governance is immense, and must address the complex and interconnected reality of urban systems to secure a proper balance between the socio-economic and environmental dynamics of urban areas.

The key to effective governance of cities is the generation of the necessary intelligence to inform decision-making by city administrations and politicians, to guide urban policy making and implementation, and to inform and engage all citizens in the delivery of sustainable urban development. DECUMANUS (DEvelopment and Consolidation of geo-spatial sUstainability services for adaptation and environmental and cliMAte chaNge Urban impactS) underpins this understanding that the delivery of more sustainable cities requires the application of enhanced intelligence in urban management, to produce an effective basis for assessment of urban complexity and decision-making. The enhanced services proposed by DECUMANUS offer the potential to provide urban planners with the tools and intelligence that allow city managers to deploy geo-spatial products in the development and implementation of their climate change strategies, and more generally in meeting the diverse challenges of sustainable urban development.

Keywords: Climate Change Adaptation, Earth Observation, Urban Environment, Urban Governance, Urban Intelligence

2 URBAN PLANNING PERSPECTIVES – INTEGRATED URBAN GOVERNANCE

Effective governance of the cities and city regions of Europe today is fundamentally undermined by urban complexity, whereby the high degree of interconnectedness and multiple interactions between socioeconomic and environmental factors in a territorial context create major barriers to the effective implementation of sustainable urban development. In response to this interconnectedness and complexity, the principles for integrated urban governance have become the pre-eminent framework for the development of appropriate policy responses to urban challenges.

Two fundamental poles of this integrated policy response concern first, the horizontal policy integration necessary between the sectoral agencies responsibilities for land-use management, transport and environmental planning, at the local and regional levels of governance. Horizontal integration demonstrates the need for integrated inter-sectoral, inter-departmental collaborations regarding the specification and implementation of policy and territorial decision making at city-region scale. Failure to secure an integrated policy response is attributed to variety of factors including notably organizational and procedural barriers to achieve active coordination, as well as problems of communication between organisations, frequently linked the lack of common intelligence and monitoring information on urban issues.

The second dimension of policy integration concerns vertical coordination between agencies responsible for policy delivery at local, regional, national and EU levels. Vertical integration supports the development of planning strategies that are specified and implemented simultaneously at different levels of governance, with impacts monitored at both city-region and EU levels. Similar factors to those identified in the horizontal perspective, are equally applicable in the vertical dimension, emphasising the need for a common understanding of urban challenges at all levels of governance.

Common understanding of urban challenges requires effective monitoring of the pressures, state and impacts at the urban level, as well as the effectiveness of policy responses in controlling urban development. The key to effective governance of cities is the generation and application of enhanced intelligence to inform decision-making by politicians, to guide urban policy making and implementation, and to inform and engage all citizens in the delivery of sustainable urban development. Thereby, the governance of cities is a collective effort requiring joint initiative between planning and management agencies from EU to local level, clear coordination between a variety of agencies at the local level, as well as critical inputs from all stakeholder groups including citizens. Accordingly urban governance addresses the fundamental needs of all citizens for sustainable urban futures, as well as the key components of the political priorities of the European Union as defined by the framework policies of Europe 2020 and the Lisbon agenda, as well as those specifically targeting sustainable urban development.

3 DECUMANUS SERVICES

In response to these demands and to support effective integrated urban governance, the DECUMANUS project aims to provide enhanced integrated urban intelligence and so develop a more effective governance of the cities of Europe. These services are focused on providing information that allows urban decision-makers to understand the problems identified and deploy tools to mitigate the climate change and environmental impacts in cities, including land monitoring services targeting urban change and urban ecosystems; provision of information related to building energy efficiency, citizen awareness and health services related to air quality, heat wave and urban heat island, etc. The DECUMANUS services aim to make more effective use of existing vast data sources, including in situ measurement of environmental variables and the socio-economic characteristics of the city, by combining with innovative Earth observation (EO) derived data driven applications. Furthermore, development of integrated governance tools is critically dependent on end user requirements, and review of the added value potentials of new applications. Accordingly all DECUMANUS applications are developed in full collaboration with urban planning agencies in the partner cities of Helsinki, Antwerp, Madrid, Milan and the Royal Borough of Kensington and Chelsea (RBKC) in London. The DECUMANUS business model is based on two services levels, according to considerations of scale and detail: Strategic Services (large scale, based on freely available data) and Local Service (local scale, on demand, based on local input data)

3.1 Land Monitoring Service

The DECUMANUS Land Monitoring Service provides novel Earth observation (EO) based products which reliably characterize built-up and paved surfaces, as well as urban green areas. In particular, they allow urban planners to better understand, assess and take action on climate change at both the regional and local levels. Currently, similar land monitoring products are generally extremely costly and time demanding for the municipalities as they are mostly produced by photointerpretation of very high resolution airborne imagery or in situ surveys by experts. Instead, the implemented services rely on completely automatic algorithms where the support of an operator is eventually required only at the end of the processing chain to visually check the outputs. This results in significantly lower costs and shorter production times, but also allows an easy and straightforward update once supplied with new suitable input data.

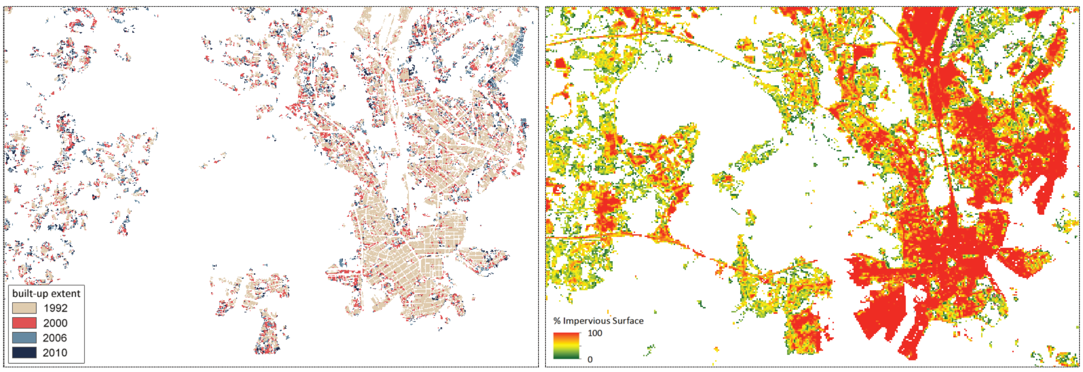

Fig. 1: Helsinki – extent of built-up growth (left) and 2014 percentage of impervious surface (right) for an area including the city center.

With the Strategic Services, urban planners are provided with key information about the temporal growth of built-up areas along with the extent of impervious surfaces (Figure 1 above).

Local Services supply maps of current and potential green roofs, along with the corresponding expected impact (estimated analyzing the local imperviousness) as well as tree locations and their canopy coverage (Figure 2 below). This suite of products is of great value in improving mitigation and adaptation planning strategies aimed at reducing stormwater runoff (which transports toxic chemicals, dirt and rubbish from roofs and roads into lakes, streams and rivers, and also leads to increased occurrence of urban flooding events), lowering air pollution (which is responsible for a variety of respiratory and cardiovascular conditions), mitigating the urban heat island effect (which causes high-energy consumption for cooling, and an increase of heat-related illness and fatalities), as well as enhancing the wellbeing and quality of life of urban residents. As an example, among the ~40.000 buildings in the RBKC, currently 600 (i.e., 1.5%) already mount a green roof, but about 19.000 (i.e., 47.5%) exhibit geometrical features suitable for their installation.

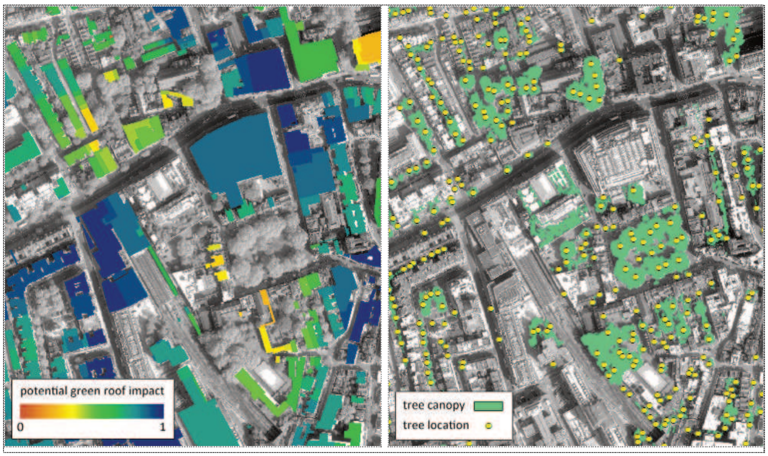

Fig. 2: London – estimated impact of identified potential green roofs (left), tree canopy coverage and tree locations (right) derived for part of the RBKC.

3.2 City Energy Efficiency Service

The DECUMANUS City Energy Efficiency Service enables detection of heat loss from building roofs (~30% of all energy losses for a standard house) and excessive lighting (night-time emissions). The Service can be used by city planners as policy support for large-scale retrofitting campaigns, and also to alert citizens to the benefits of saving energy.

The Strategic Service is derived from satellite data, while the Local Service requires the acquisition of specific data, such as aerial data. The broader resolution of the strategic products makes them useful for analysis at a neighborhood scale (several building blocks) and for inter-city comparisons (Figure 3). On the other hand, the high-resolution local products provide enough details to detect, and moreover to identify energy losses at a building and a street light scale. These characteristics of strategic and local products make their uses complementary.

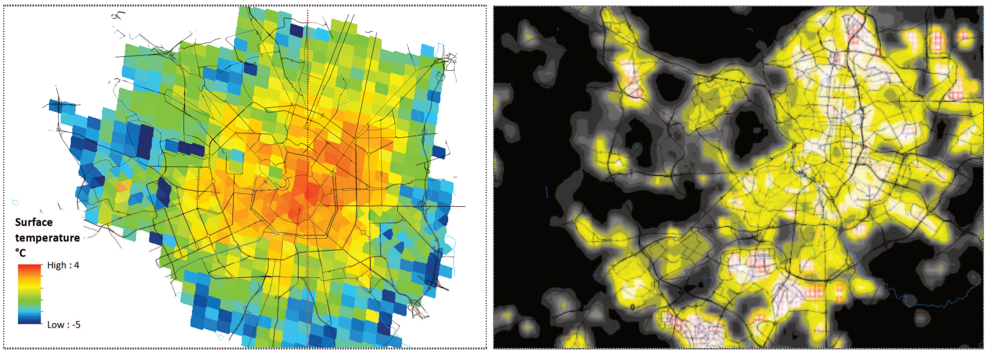

Fig. 3: Milan – heat loss map (750 m resolution) based on night-time satellite acquisition (Landsat-8 and Suomi-NPP data) (left) and light emission (375 m resolution) detecting light spots at neighbourhood scale (several building blocks) (right)

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Furthermore, a Local Service evaluates the photovoltaic potential of each building (Figure 4). This service uses high resolution terrain data and a solar model to identify areas suitable for the installation of solar panels and to evaluate potential electricity yield (Figure 4).

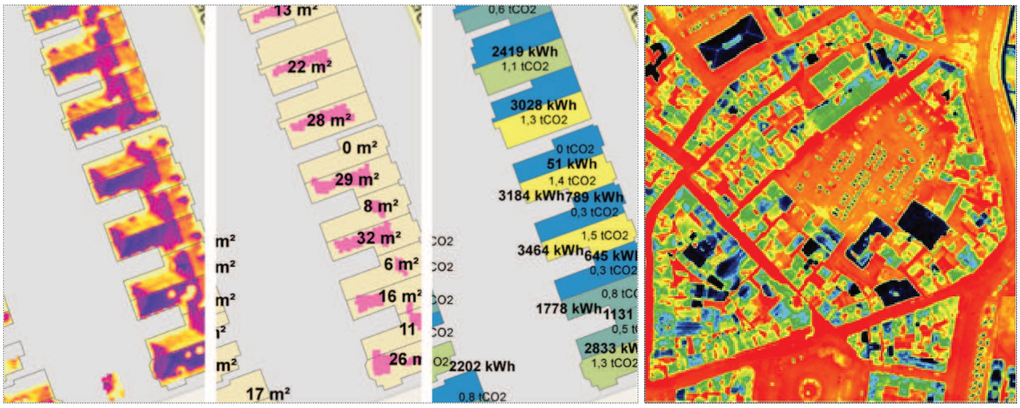

Fig. 4: London – photovoltaic potential maps derived for part of the Royal Borough of Kensington and Chelsea (left) and high resolution (50 cm) heat loss map based on aerial thermography in Helsinki (blue = very good to red = very bad) (right)

With the Strategic Service, city planners are able to locate neighbourhoods with anomalously high energy losses from building roofs. It enables also to detect city light spots at a neighbourhood scale, and to monitor street lights over time. By doing so, the service can be used as evidence-based policy support for large-scale retrofitting campaigns across the city (i.e. conversion to LED lights).

With the Local Service, city planners can launch campaigns among their citizens to encourage the improvement of their roof insulation (using aerial thermography) and the installation of solar panels. Each citizen is able to verify the quality of their roof insulation on a map, as well as the suitable areas for the installation of solar panels and the corresponding potential electricity yield. This allows for estimations regarding potential areas for energy savings. By using their full photovoltaic potential, rooftop solar panels could, for example, cover between 14% (Helsinki) to 30% (Madrid) of yearly electricity consumption.

		Buildings			Suitable area		Potential electricity yield		CO2 Savings per City (kCO2/year)	Current Electricity consumption per City	
	Area (km²)	Number	Area total (km²)	Number suitable	Total (km²)	Average by roof (m²)	Total (GWh/year)	Mean by roof (kWh/year)		GWh/year	Solar potential in % of current consumption
ANTWERP	204,3	157.843	27	107.396	10	66	1.163	7368	227.615	6000	19%
HELSINKI	765,6	261.409	40	114.454	17	66	1.870	7154	356.763	13200	14%
MADRID	604,4	498.534	50	333.062	26	51	4.465	8956	1.299.250	15125	30%

Moreover, the service can be used by the city planners to make an overall evaluation of the street lighting network (using aerial data). The luminance values are compared to European standards to detect over-exposed areas and thus potential areas for energy savings.

3.3 Population Impact Assessment

The DECUMANUS Population Impact Assessment Service analyses the impact of climate change scenarios for both the night (residential) and the day-time populations. The products are based on freely available EO-based land cover and land use data (Strategic Service) and locally-provided data from the cities (Local Service) to refine available census information and so the spatial distribution of the population (Figure 5 below). Knowing, for example, the type of urban fabric (residential or non-residential) or the number of commuters and work places can permit very detailed population estimates both during the night as well as the day.

From the DECUMANUS services, city planners can get a better understanding of where people are located in the night and day, the real scale of commuting, and the locations of the main concentrations of population. Accordingly, city planners can derive new information on the extent of population exposed to climatic impacts such as poor air quality, floods, storm waters, heatwaves and sea level rise. This information can then be used to support effective climate change adaptation and mitigation. In the case of Helsinki, especially sea level rise will have a tremendous impact on the population in the Metropolitan Area. With the developed service not only the most affected areas and the number of affected building can be detected, but also the number of potentially affected population. Such information is of major importance for urban planners, especially to support climate change adaption and mitigation strategies.

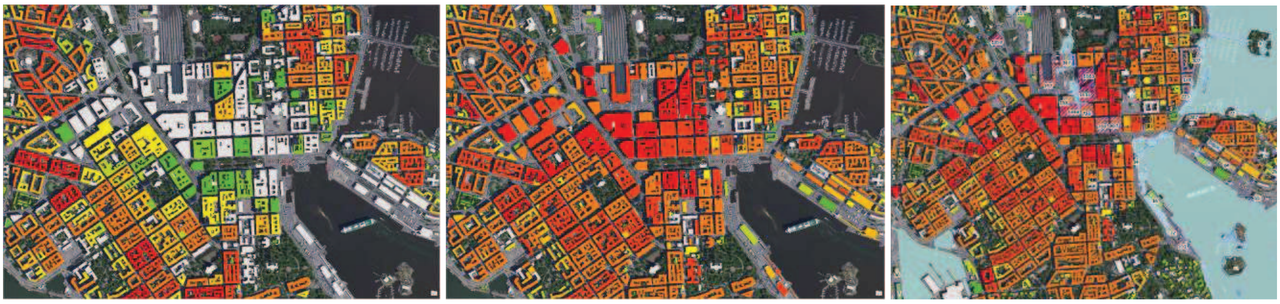

Fig. 5: Helsinki – The maps show three different Local Service outcomes. The first and the second image show the night- and day-time differences of the population in the area of the Helsinki central station. The third image shows the potential impact of a 250 year sea flood event for the population per building.

HELSINKI		Potentially affected buildings			Potentially affected people (night)			Potentially affected people (day)		
		20 year flood event	100 year flood event	250 year flood event	20 year flood event	100 year flood event	250 year flood event	20 year flood event	100 year flood event	250 year flood event
	River flood	497	697	745	427	1.475	2.111	1.100	1.984	2.345
	Sea flood	1.722	2.528	3.058	4.939	8.806	12.343	14.754	25.677	33.698

Beyond the scope of the project, the service can furthermore be used for traffic or public transport planning, geo-marketing, the creation of emergency/evacuation plans or the calculation of health effects on the population e.g. at street level. Additionally, depending on data availability, demographic data can be used to further refine these datasets in respect of , for example, a focus on elderly or children.

4 CONCLUSION

DECUMANUS tools and methodologies reviewed above are supporting the development of a new integrated, hugely more powerful and effective urban governance, creating the expectation that the most intractable urban planning issues, including the management of the vast complexity of urban interactions, evident as city living specified in socio-economic activity, can be managed within both environmental limits and the territorial frame. Ongoing validation activities in cooperation with the project partner cities to assess the accuracy of the corresponding EO-based products, confirms their great potential for supporting sustainable urban development strategies both at district and local level.

Full realisation of the vision of an integrated and necessarily transformational governance is critically dependent on end-user engagement in system redesign and intelligence requirement specification, as the system of urban governance cannot be transformed effectively and appropriately on the basis of systems re-engineering alone. DECUMANUS city partners support these objectives, providing end user specifications aligned with technological capacity to ensure effective solutions and effective urban management.

Realisation of transformational governance also requires greater stakeholder engagement in the urban planning process, as municipal experts providing a top-down view of the urban vision, and its local level specification, are no longer able to manage the inherent complexity of the sustainable city alone. Greater bottom-up stakeholder engagement thereby secures the quality of integrated assessment necessary to effectively plan the modern city, providing inputs in respect of the political diversity of views on the best way forward, all essential to secure the democratic legitimacy of the urban plan.

DECUMANUS tool and methdologies are simultaneously sources of intelligence, and means of communication, and so perform vital roles in supporting bottom-up engagement in the planning process as an essential complement of the top-down municipal system of guidance.

DECUMANUS therefore has the potential to drive new experiments in the co-design and co-production of plans, in which technological opportunity including social media allied to other ICT dynamics, such as mobile technologies supporting citizen science, has significantly enlivened the dynamic of governance development supporting more effective integrated urban governance.

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ERP hoch 3: Energieraumplanung entlang von ÖV-Achsen

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1 ABSTRACT

Im Rahmen des national geförderten Forschungsprojekt „ERP_hoch3“ wird der Themenschwerpunkt Energieraumplanung in drei Fokusebenen betrachtet, untersucht und simuliert. Während „ERP“ für Energieraum-planung steht, steht die „3“ für drei verschiedene Raumbezüge – Stadtquartiere, öffentliche Verkehrsachsen und interkommunale Flächenpotenziale erneuerbarer Energien (Region).

ERP_hoch3 ist ein zweijähriges Grundlagenforschungsprojekt, gefördert vom österreichischen Klimafonds. Das Forschungsteam besteht aus 14 Expertinnen und Experten der Fachbereiche für Regionalplanung und für örtliche Raumplanung (TU Wien, Department für Raumplanung) und der Institute für Städtebau und Prozess- und Partikeltechnik (TU Graz).

Keywords: Energie, Energieraumplanung, Mobilität, Smart City, öffentlicher Verkehr

2 PROZESS EINER „SMARTEN“ VERDICHTUNG ENTLANG VON ÖFFENTLICHEN VERKEHRSACHSEN MIT FOKUS AUF DEN NAHBEREICH VON BAHNHALTESTATIONEN

2.1 “Smarte” Verdichtung entlang von öffentlichen Verkehrsachsen

Der Fokus des praktischen Teiles des Arbeitspaketes 02 (AP 02) von „ERP_hoch3“ liegt in der „smarten“ Verdichtung entlang von öffentlichen Verkehrsachsen mit besonderer Berücksichtigung der Verdichtung im Nahbereich der einzelnen Bahnhaltestationen.

Quartiere im Nahbereich von Bahnhaltestationen sind „Kerngebiete“ einer energieeffizienten Nachverdichtung. Unter einem solchen Quartier verstehen wir einen zu Fuß und mit dem Fahrrad schnell erreichbaren Zentrumsbereich. Mehrere solcher Gebiete entlang einer Achse (in dem Fall die der Bahnachse), ähnlich einer „Perlenkette“, bilden wichtige regionale Entwicklungsachsen in einer Region.

Mobilität spielt an derartigen Bahnknotenpunkten eine zentral wichtige Rolle. Das Bauten- und Verkehrsmanagement ist bislang noch stark über den motorisierten Individualverkehr (MIV) organisiert und zu schwach über den öffentlichen Verkehr (ÖV). Die Verflechtung des ÖV mit den zu erreichenden Zielgebieten (Funktionen Wohnen, Arbeiten, soziale Infrastruktur etc.) nimmt von urbanen über suburbane bis hin zu ländlichen Knotenpunkten tendenziell eher ab.

Den zentralen Schwerpunkt dieses Arbeitspaketes bildet der zugrundeliegende städtebauliche und raumplanerische Prozess, ohne den eine qualitaiv hochwertige und nachhaltige Energieraumplanung nicht möglich ist. Im Wesentlichen geht es in diesem Arbeitspaket um die Erarbeitung übertragbarer Handlungsempfehlungen zur schrittweisen Entwicklung von Smart-City-Energieregionen (als „Schneeballeffekt“ von smarten Quartieren auf die Region).

2.2 Strategische Referenzen

Ebenezer Howard war einer der Ersten, die sich intensiv mit dem Thema der Verdichtung entlang von Bahnachsen auseinandersetzten. Dies tat er vor allem mit seiner Idee der sogenannten „Gartenstadt“, die quasi im Grünen (in der Region) liegt und als „kompakte“ ländliche Wohnsiedlung ausgebaut ist. Einhergehend mit der Wohninfrastruktur wurden auch die ökonomischen Infrastrukturen (in Form von lokalen Produktionsstätten) und alle notwendigen sozialen Infrastrukturen mitgeplant. Zentraler Ausgangspunkt der Siedlungsentwicklung war dabei der lokale Bahnhof (siehe Abbildungen 1 und 2).

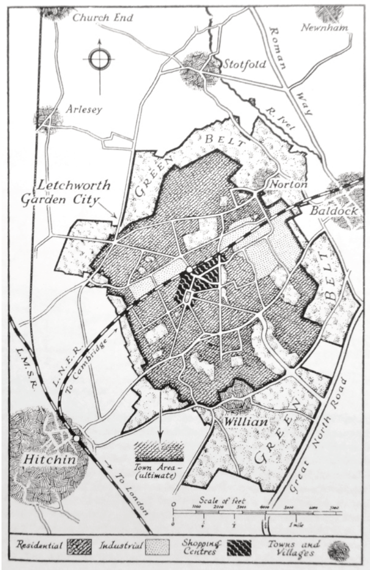

Abbildung 1: Die nach den Prinzipien von Ebenezer Howard geplante Gartenstadt „Letchworth Garden City“ (Quelle: Posener, Julius: Ebenezer Howard Gartenstädte von Morgen. Das Buch und seine Geschichte. Basel 2015)

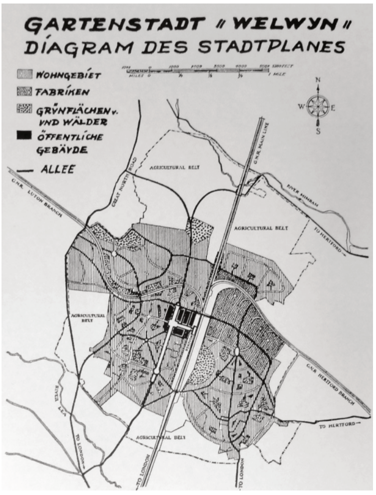

Abbildung 2: Die nach den Prinzipien von Ebenezer Howard geplante Gartenstadt „Welwyn“ (Quelle: Posener, Julius: Ebenezer Howard Gartenstädte von Morgen. Das Buch und seine Geschichte. Basel 2015)

Ein für uns von zentraler Bedeutung gegenwärtiges Good-Practise-Beispiel ist die internationale Studie „Transit-oriented development“, kurz „TOD“ (Transport orientierten Entwicklung). TOD konzentriert sich auf die Entwicklung kompakter Mischnutzung, die gut zu Fuß erreichbar ist und sich im Nahbereich von S-Bahn-Stationen befindet. Das Ergebnis ist ein lebendiger Stadt-Raum, der fußgängerorientiert organisiert und aufgebaut ist gemäß dem Motto „Stadt der kurzen Wege“, ein Raum, in dem man sich sicher aufhalten kann und der nur von Fußgängern, Radfahrern und öffentlichem Verkehr dominiert wird (siehe Abbildungen 3 bis 9). Diese aktuelle Studie verdeutlicht sehr gut, „wie es sein sollte“ und „wie es nicht bleiben darf“. Eine hohe Aufenthaltsqualität zeichnet sich durch Fußläufigkeit, Fahrraderreichbarkeit, gute Anbindung an öffentliche Verkehrsmittel und entsprechende Gestaltung sowie Organisation des Raumes und seiner Funktionen aus (z. B. Verdichtung von Funktionen und Gebäuden).

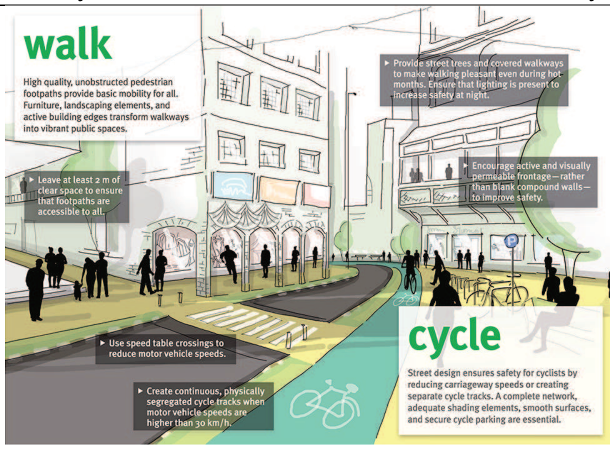

Abbildung 3: Die Abbildung zeigt die Prinzipien der Transport orientierten Entwicklung TOD „Walkability“ und „Cyclability“. (Quelle zuletzt abgerufen am 10.2.2016: https://www.itdp.org/transport-oriented-development-poster/)

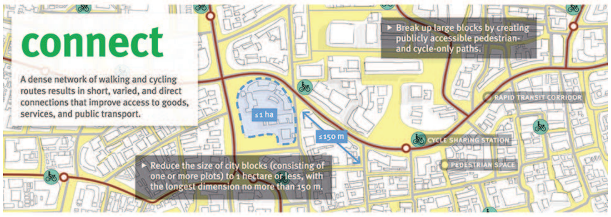

Abbildung 4: TOD – Ein dichtes Netzwerk von Fuß-, Fahrradwegen und einem verdichteten ÖV System ist notwendig. (Quelle zuletzt abgerufen am 10.2.2016: https://www.itdp.org/transport-oriented-development-poster/)

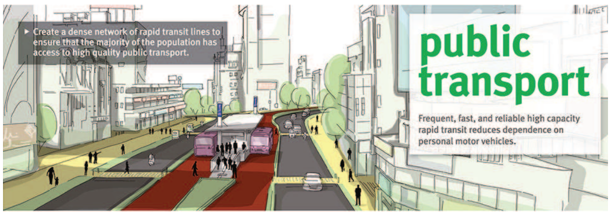

Abbildung 5: TOD – Integration und Ausbau öffentlicher Verkehrsmittel. (Quelle zuletzt abgerufen am 10.2.2016: https://www.itdp.org/transport-oriented-development-poster/)

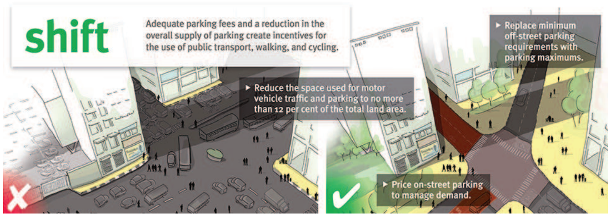

Abbildung 6: TOD – Gegenüberstellung was „nicht sein soll“ und „wie man es machen sollte bzw. kann“. (Quelle zuletzt abgerufen am 10.2.2016: https://www.itdp.org/transport-oriented-development-poster/)

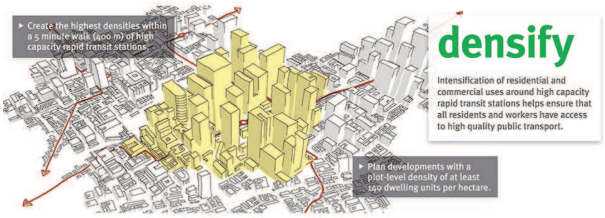

Abbildung 7: TOD – Verdichtung und ihre Auswirkung auf die dichte des ÖV-Angebotes. (Quelle zuletzt abgerufen am 10.2.2016: https://www.itdp.org/transport-oriented-development-poster/)

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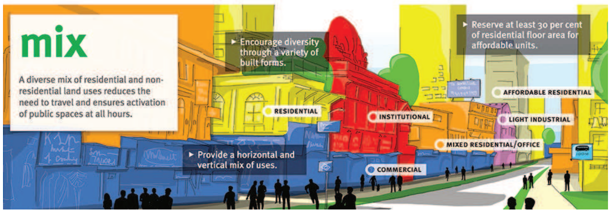

Abbildung 8: TOD – Mischnutzungen als Instrument für Aktivität und Vermeidung von Schlafstädten. (Quelle zuletzt abgerufen am 10.2.2016: https://www.itdp.org/transport-oriented-development-poster/)

Abbildung 9: TOD – Verdichtung statt Zersiedelung. (Quelle zuletzt abgerufen am 10.2.2016: https://www.itdp.org/transport-oriented-development-poster/)

3 SCHRITT FÜR SCHRITT ZU EINER SMARTEN VERDICHTUNG

Verdichtung im energieraumplanerischen Kontext ist ein komplexer und interdisziplinärer Prozess. Eines unserer wichtigsten Ziele war es, einen geeigneten Prozess und eine geeignete Methode bzw. Herangehensweise an die Problematik zu finden gemäß dem Motto „der Weg ist das Ziel“. Aus diesem Grund wurden für das AP 02 zwei ÖV-Achsen in Wien und der Steiermark (siehe Abbildungen 10 und 11) gewählt, die als Fallstudiengebiete dienen sollen, anhand derer beispielhaft ein Prozess und eine Methode erarbeitet werden.

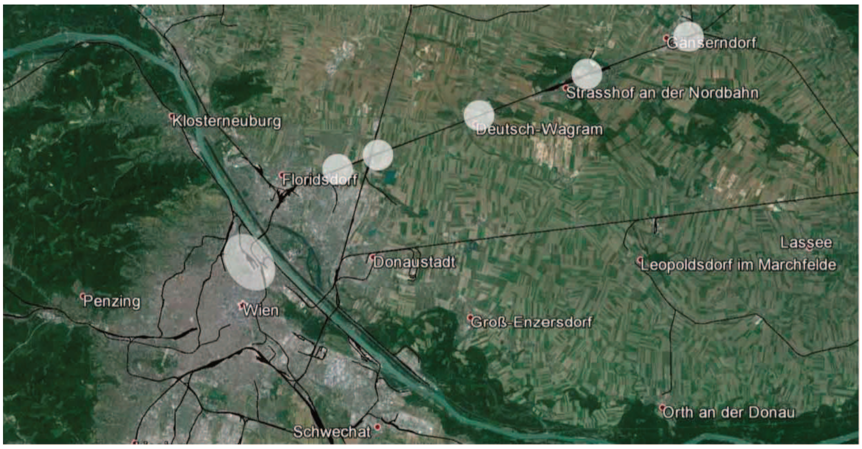

Abbildung 10: Übersicht Achse Wien - Gänserndorf mit der Potenzialzone Wien aus dem AP 01 / Quelle: Google Earth (zuletzt abgerufen am 29.10.2015) / Bearbeitung: TU Graz, Institut für Städtebau (29.10.2015)

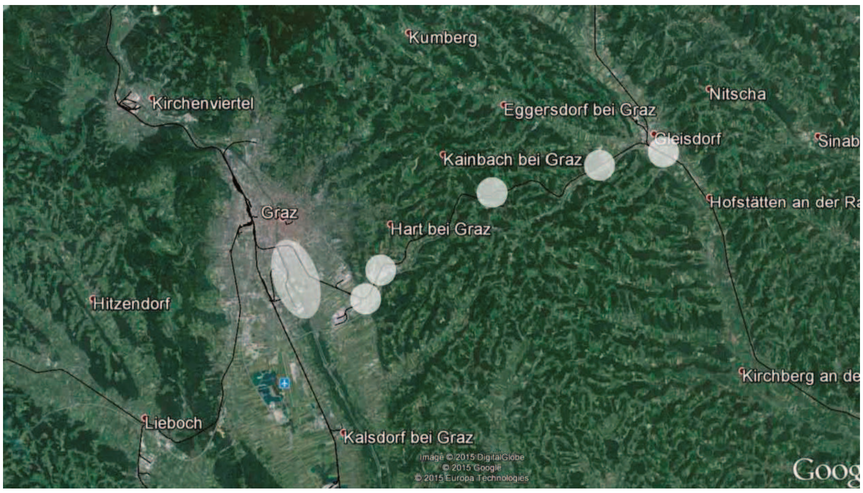

Abbildung 11: Übersicht Achse Graz - Gleisdorf mit der Potenzialzone Graz aus dem AP 01 / Quelle: Google Earth (zuletzt abgerufen am 29.10.2015) / Bearbeitung: TU Graz, Institut für Städtebau (29.10.2015)

Um eine möglichst nachhaltige – „smarte" Verdichtung entlang von öffentlichen Verkehrsachsen mit Fokus auf die Nahbereiche von Bahnhaltestationen – zu erreichen, muss man sich geduldig dem Kern der Sache nähern und dies geschieht Schritt für Schritt. Eine umfangreiche holistische Herangehensweise gewährt die notwendige Qualität.

Entlang der zwei ÖV-Achsen (Wien – Gänserndorf und Graz - Gleisdorf) wurden im Siedlungsbereich des Bahnhalteumfeldes im Wesentlichen zwei Untersuchungsfokusse verfolgt:

(1) Eine qualitative holistische Bewertung des Status Quo der einzelnen Knoten (dies inkludiert eine Potenzialuntersuchung mittels Multilayeranalyse, eine qualitative Punktebewertung, eine Erstellung von Bewertungsdiagrammen, Berücksichtigung individueller Potenziale und einen Vergleich unter ähnlichen Knotentypen).

(2) Ableitung geeigneter Strategien basierend auf der qualitativen Bewertung des Status Quo der Knoten mit dem Ziel einer konkreten Entscheidung möglicher Schwerpunkte für eine smarte Verdichtung. Je nach Schwerpunktsetzung werden Knoten exemplarisch hinsichtlich ihres Verdichtungspotenzials betrachtet, sodass ein erster Ist- und Soll-Vergleich möglich ist.

Die Resultate dieser zwei Untersuchungsfokusse dienen als Handlungsempfehlungen für eine schrittweise Entwicklung und können in Folge als Basis einer möglichen Umsetzungsstrategie herangezogen werden (z. B. im Zuge von Masterplänen, Testentwürfen und Standortkonzepten).

Die Analyse und Priorisierung der ausgewählten Knotenpunkte entlang dieser ÖV-Achsen soll Aufschluss darüber geben, wie dort eine möglichst energieeffiziente zukünftige räumliche Nutzung aussehen könnte- mit generischer Übertragbarkeit auch für andere Planungsgebiete in Österreich.

Ein derartiger Prozess erfordert vor allem die Aktivierung und Mithilfe aller relevanten Akteure aus Politik, Verwaltung, intermediären Einrichtungen, Wirtschaft und schließlich der Zivilgesellschaft.

Eine der wichtigsten Zielgruppen sind vermutlich die Gemeinden und ihre Bürgermeister, lokale und überregionale Verkehrs- und Infrastrukturunternehmen und die lokalen Wirtschaftsunternehmen.

4 ABLEITBARE ZIELE UND EMPFEHLUNGEN

Ableitbare Ziele und Empfehlungen könnten zum Beispiel überörtliche Achsenentwicklungskonzepte mit mobilitäts-, energie- und ressourcenschonenden Schwerpunkten sein.

Insgesamt soll ein fairer Ausgleich entlang einer Achse stattfinden als auch angestrebt werden, bei dem sich der eine Knoten für das eignet, der andere für das usw. Kein Knoten soll vernachlässigt werden – jeder Knoten sollte profitieren und nicht ein Knoten allein. Dies befürwortet entsprechend „überregionale" und verwaltungstechnisch grenzüberschreitende „Achsenkonzepte", womit ein Diskurs auf allen Planungs- und Entscheidungsebenen (Bund, Land, Gemeinden, Infrastrukturversorgungsunternehmen, Verkehrsanbieter etc.) vorausgesetzt werden muss. Derzeit ist keine übergeordnete Organisationsstruktur ablesbar.

Wenn man sich nicht in naher Zukunft dem Thema der Energieraumplanung entlang von ÖV-Achsen (vor allem in Agglomerationen von Städten und ländlichen Regionen) annimmt, läuft man früher oder später Gefahr, dass die Zersiedelung unserer Landschaft und damit die einhergehende Ressourcenvergeudung unkontrolliert die Oberhand gewinnt – ein Umstand, den wir uns in Zeiten wie diesen nicht leisten können.

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Experimenting New Forms of Urban Governance in Vienna

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1 ABSTRACT

This paper aims to synthesise the research findings from the implementation of an Urban Living Lab in Liesing, a fast growing suburban-type area in the City of Vienna. The aim of this paper is to contribute to an understanding of the Urban Living Lab approach in the negotiation of conflicting local development goals and citizen inclusion in the area of transport and mobility. To this end, the analysis intends to illustrate how the different elements of the ULL approach are addressed in existing strategies and projects in the area. This will be exemplified by a comparison of 5 different strategies, policies or research projects. The results of this analysis will be compared to local, interactive methods developed by the researchers in view of setting up a local example for inclusive governance in the area of mobility and transport. By summarizing the activities and experiences of the Urban Living Lab, we will be able to better understand the theoretical implications/ potentials of the Urban Living Lab concept as applied in this context.

Keywords: Cultural Probes, Communal Probes, Governance, Mobility behaviour, Urban Living Lab

2 CHARACTERISTICS OF THE URBAN LIVING LAB APPROACH

Cities are laboratories that allow us to experience changes to a situation, which may instigate new roles of conduct that are markedly different from existing conditions.

The roots of the urban living lab approach can be found in the Chicago School, which viewed cities as both: places for urban experiments and places that allow us to test our observations of changes in society generally. The grounding hypothesis of urban laboratories is that urban problems are sets of relations that can be infinitely re-calibrated in order to enhance or simply alter the experience of the people that are part of it (Cutchin 2008: pp. 1565).

The Urban Living Lab approach is constituted by a set of characteristics, of which co-creation, exploration and experimentation are the most prevalent. Co-creation relates to the objective that Urban Living Labs offer a place for co-production and experimentation above and beyond business as usual instruments, methods and processes and incorporates high standards of actor inclusion. Exploration and experimentation promote the idea of a grounding openness towards new perspectives and views without positing a predefined outcome. Furthermore the Urban Living Lab approach follows three normative principles, which can be utilized as evaluation criteria of an intervention: the situatedness of a particular intervention in a local context; the change orientation of the process; and finally the contingency of the process and the results it produces. The challenge of experimentation is to "go beyond the existing constellation of actors and develop more participatory agendas that can imagine significantly different urban futures" (Karvonen et al. 2014: 147.

3 DELINEATING THE LABORATORY BOUNDARIES

As a federal province and municipality, Vienna can look back on a long history of quasi-autonomous policy making in the regulation of the built environment. Liesing is a functionally heterogenous urban area on the southern periphery of Vienna, characterized by the coexistence of historically emerged individual parts (the former villages) providing identification and the absence of a determining urban centre. Since the 1960s, the area has seen an increasing tendency for industrial agglomeration. A major challenge for the area concerns the theme of transport and mobility; Liesing has an over proportionately high percentage of motorized traffic and the road network and transport infrastructure are at capacity limits because of cross-boundary traffic to suburban areas outside the city.

On the interstice between the historically emerged parts of Liesing there are many empty spaces, reservoirs of past and future spatial development potentials for construction of the City of Vienna, that define the area as a prominent suburban intervention field of city-wide planning experiments. Liesing as a preferential territory for urban development was further highlighted in Vienna's urban development strategy where parts of Liesing were selected as a target area in 2005. Its focus lies on the restructuring of the industrial site and the the provision of new housing for about 28.000 new residents, a significant increase over the current

90.000. The planned increase in density and fears of a traffic desaster have sparked a set of conflicts between the municipal apparatus, existing residents and the local borough authority; about the image of Liesing as largely green suburban and rural territory and its likely transition; conflicts about the impact of future developments on the quality of life in the area and the necessity for improvements in infrastructure; and finally about the capacity of a transport system at capacity limits to keep pace with the demands for the wider expansion of housing and living functions in the near future. The rationale for focusing on sustainable mobility behaviour has been driven by the particular local context in which mobility behaviour is an important facet but has yet been ignored as an issue.

4 METHODS

In our project the Urban Living Lab approach was applied twofold: First, as an analytical tool for the understanding of policies applied in a particular area. In that sense policies are conceived as hypotheses about particular change effect of an intervention in a defined territory. For this purpose five policies were selected, that represent a diversiy of policy approaches as for what concerns interventions in urban mobility, temporal and spatial scope of intervention and divesity of actors represented. We conducted expert inter¬views and desk research of relevant documents in order to find answers to our reserach questions: What are the spatio-temporal boundary settings, actor-networks, contrasting forms of public engagement and demon¬stration exercises of different policies? How open to experimentation and co-creation is the existing policy context? How inclusive is the existing policy framework in Liesing?

Second, the ULL approach was deployed as policy instrument – as a way of creating a case where experi¬mentation of urban development issues takes place; as an intervention by the researches supposed to feature elements of co-creation, experimentation, knowledge creation and learning. Its guiding question was how existing and incoming residents can be motivated to change towards sustainable mobility patterns, to guarantee long-term life quality in the neighbourhoods. In order to achieve this, a three part process was designed which started with a telephone survey with 400 residents of Liesing on mobility lifestyles and behaviour. The results of this survey formed the backbone of a second step, the utilization of so-called communal probes[1] that allowed for co-creation and the qualitative enhancement of quantitative survey results. The combined results from step one and two were then transformed into a public exhibition that was shown in a former factory in the development area. The process was given the name ‘Mobile in Liesing-experimenting lifestyles and mobility’ and concluded with the public exhibition in September 2015, approximately one year after the process had started. In addition, the research team conducted expert interviews and organised a workshop with local neighbourhood managements (from other districts) in Vienna to identify best practices in the local governance of mobility lifestyles.

Due to the limited space, this paper will put more emphasis on conveying the results of using ULL approach as policy instrument (section 6, below).

5 URBAN LIVING LAB AS ANALYTICAL TOOL: CRITICAL INVESTIGATION INTO EXISTING AND ONGOING PROCESSES

The five policy experiments investigated, the Local Agenda 21 (non-govenrmental organization fostering civic participation), ‘Perspektive Liesing’ (city driven process leading to a strategic development plan for Liesing), ‘Transform+’ (research project guiding smart city transformation), ‘Standpunkt Liesing’ (neigh¬bourhood management for the industrial area) and the ‘Target Area Management’ (a municipal coordination unit of urban development in Liesing Mitte), display contrasting territorial coverage within Liesing and time horizon - ranging from 10 years (Local Agenda) to 6 months (Perspektive Liesing). All five processes show moderate to high degree of risk taking and experimentation. The widely differing ability to provide respectively incoporate feedback curbs the processes’ cabability to adapt to the requirements. They also show diversity in the type of stakeholders participating. Indeed, citizens as participants of a process are only really constitutive of the activities of the Local Agenda 21, whereas most other strategies

[1] Communal Probes are a creative approach to capture citizens’ perceptions and opinions about pre-defined topics. The tool was designed and used with 20 citizens in spring 2015. The study’s aim was to involve citizens in creative self-reporting activities to collect insights about citizens’ opinions and perceptions of Liesing’s mobility system, and to identify particular problem areas and suggestions for improvements. For this purpose, the tool incorporates a number of (open) questions that participants’ are expected to answer creatively using the ‘Probes Package’.

are confined to municipal and expert stakeholders, keeping the population merely informed. If they were integrated, such as in the case of Perspektive Liesing, the time intensity was too low to create the conditions for a laboratory situation. In these regards it is notable, that the target area management, whose objective and role it is to coordinate development efforts with all relevant actors on the ground in Liesing, proceeds without the inclusion of both the local borough as political entity and citizens as current residents on the territory. The fragmented character of engagement efforts translates different political goals and objectives. Overall there is a certain degree of dissatisfaction with the current organizational set-up.

6 URBAN LVING LAB AS POLICY INSTRUMENT: EXPERIMENT 'MOBILE IN LIESING'

The intervention through the experiment was mainly driven by the following hypotheses about change and transformation in the area: (1) Lifestyle and mobility patterns play an important role in transformation of future mobility behaviour of Liesing's residents. (2) Knowledge on mobility behaviour can be co-created with local residents. (3) Co-creation can have a learning effect on individuals and involved policymakers, and contribute to the institutionalization of participatory processes.

The change effects were to be experimented on different levels; by showing residents how they could benefit from reflecting on their own mobility behaviour; by showing municipality and local politics the utility of ex¬periments and risk-taking by involving local residents; and finally, by illustrating to transport planners the utility of moving from production to more consumption oriented views of the local transport system.

The following paragraphs depict the experiment 'Mobile in Liesing', having the Urban Living Lab character¬ristics in mind.

6.1 Inclusion and Exclusion – actors and topics

The experiment involved actors from the Municipal administration; neighbourhood management entities; local organizations; as well as the local borough authority. In operational terms, the project team benefitted from the support of the new cultural venue in Atzgersdorf, which integrated the exhibition in their opening days. The former coffin factory had been used for events of other projects such as 'Perspektive Liesing', so that using it was an opportunity to position the intervention in a lineage with the former. The combination of these particular actor-networks proved to be efficient and effective in setting up the intervention.

The experiment was driven by the research team supported by letters of intent of two municipal departments, but with no political support from the local borough. The support from the municipality however was weakened by the stalemate between municipality and local borough council. The research team compensated by putting effort into keeping the local borough council informed and involved in the project.

In contrast to other strategic processes, the intervention was driven by the idea to integrate residents in the production of knowledge. The participation of local residents was a constitutive aspect in the preparation and implementation of all steps necessary to conduct the experiment on the ground. If engagement efforts have achieved their objective by involving the population in the process above and beyond the level of informa¬tion, less care was given to the diversity or representativeness of participants. Quantitatively, the engagement efforts have achieved their target. However, the expectation of drawing in actors that go beyond the existing actor constellations through cooperation with the cultural centre have been frustrated by the little interest in the venue's opening. Moreover, while contact with residents was continuous through survey and communal probes, the fact that the exhibition was only opened for three days reduced the possibilities for attracting new publics considerably.

Thematically, the dimension of mobility behaviour has never been part of strategic thinking on the local level before, except for some aspects treated in self-organized citizen groups in the context of LA 21. The thematic focus was nevertheless welcomed by local politics and municipality, as well as by visitors of the exhibition. For to some extent, the integrated process, given its focus on infrastructure and places and Liesing, went above and beyond the dimension of mobility alone. As such, one could argue, rather than being thought of as a thematic constraint, the focus on behaviour and lifestyles opened up a novel perspective in apprehending planning processes in the area, of which mobility was only an exemplary case.

The question of how to organize this process in terms of governance has also been an important feature, but functioned mostly in the background and was never directly avowed in the process towards making the

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exhibition. Being of highly political nature, the question of establishing a local neighbourhood management could not be overtly discussed by certain representatives of the municipality

The experiment operated indeed in a conflicting political environment, not only between the municipality and the borough, but also between different instances of the municipal apparatus itself. This restricted to some extent the ability of experiment stakeholders to go above and beyond existing issue constellations and actors. A further restriction was the limited time frame and resources within the context of a research project.

6.2 Learning and co-creation of knowledge

By co-creation, the research team understood the act of partnering with non-scientific actors and the local population in the creation of knowledge and scientific facts about the mobility in Liesing.

The analysis shows that we can differentiate between three different types of methods in the experiment 'Mobile in Liesing'; those that were closed to co-creation (analysis of existing strategies; survey and impact analysis; secondly those that allowed only limited opportunities for co-creation of scientific results with stakeholders and experts (best-practices catalogue, discussion with scientific community and policy experts); and finally those that were highly performative in allowing the local population to co-create scientific facts in the process (communal probes and exhibition). Hence, one can argue that co-creation has not been a permanent feature of the process, but has been reserved to neatly planned instances and events that were specifically designed to allow so. Compared to the other examined strategies, the experiment has indeed exhibited dimension of partnership and tokenism that went above and beyond what has been done before except for the process of LA21.

When it comes to learning, 'Mobile in Liesing' is an attempt to routinize engagement with urban develop¬ment issues on a certain level of investigation, that is between the bottom-up and top-down level of city plan¬ning. At the point of writing, there is no evidence of institutional learning other than in terms of feedback that has been received by policy makers in the course of the experiment. This feedback points into two directions; on one side the need for a certain dimension of citizen engagement has been recognized through the process, but the questions remain how such participatory processes could concretely look like, what resources could be mobilized to foster them and on what levels these processes could be situated. On the other hand, conflicting relationships between city and local borough council have not been set aside since they are dependent on decisions outside the scope of power of the actors themselves. These conflicts are revelatory of political and even cultural frameworks that are beyond the laboratory situation created in the concrete case Liesing.

There is evidence of individual learning in the feedback of participants of the communal probes. Interviews with participants indicate that communal probes stimulated active perception of one's own mobility behavi¬our and promoted reflection and analysis of this behaviour and possible options to change it. Further they helped to animate to perceive the transport system more holistically hence promoted a better understanding of the problems. Finally it allowed them to start discussion in the participant's family, circle of friends and acquaintances. Another check came with the transport planner of the area: From the professional view, a great deal of the participants' local observations and also of the ideas created seemed plausible and relevant as input for the design of measures to improve the district´s transport system.

Lastly, learning effects are to be found on the side of the research team too. Importantly, while the aspect of mobility behaviour has opened up new perspectives on the transport issue in Liesing, it became evident that questions related to the built environment and the sheer supply of infrastructure are very relevant in the context of high population growth and the capacity limits on transport infrastructure in the area. To some extent, the experiment provided thus an opportunity to reframe existing issues from another vantage point, and thereby confirmed some results of the 'Perspektive Liesing' process as well as others. Apart from this content-driven perspective, the researches personally entered new grounds by experimenting with methods they had not mastered before: designing and analysing communal probes as well as implementing an exhibi¬tion was a first for the team. Team intern discussion about the process, the design and the outcomes multi¬plied not only within the team but also in the entire firm. It became apparent that working with these partici¬patory and active methods adds a more detailed but at the same time a more holistic view on the challenges of the area.

7 CONCLUSION

In the course of this paper we have reviewed different policy approaches towards experimentation in the Viennese neighbourhood Liesing and critically evaluated them from the vantage point of existing literature on Urban Living Labs. This investigation has been performed with two research perspectives in mind:

- The Urban Living Lab as an analytical concept: as a way to understand, compare and critically eva¬luate existing (municipal) strategies, policies and projects.
- The Urban Living Lab as constructivist approach: as a way of creating a case where experimentation of urban development issues takes place (in the context of a research project).

Our analysis of different policy strategies and instruments and the analysis of our own experiment 'Mobile in Liesing' revealed the following Liesing specific and general observations about urban experimentation:

Certain urban areas are more prone to experimentation than others. As a fast growing district, Liesing is a privileged site of experimentting a new vision for the city. But the analysis of the different processes applied in the area illustrates the lack of guidance in which projects were embedded in, ultimately to the detriment of the achievement of the different sectoral strategies. Strategic level discussion around future development scenarios did not immediately lead to a stable and secure set of strategic and operational targets for the area. The exception is provided by the functionally independent Standpunkt Liesing management, where political backing for a strategy autonomous from the wider development perspective of the area was achieved since its very inception. In the case of 'Transform+' notably, the absence of a clear target framework made the cal¬culation of energy scenarios for the area complex if not to say impossible. The shaky and contingent nature of the strategic context may thus be the very precondition for the experimentation to take place, but it also created added insecurity among actors where some security was needed.

Urban Living Labs temporally conflate strategy and implementation. To some extent the environment embo¬dies a planning situation where strategy and implementation temporally coexist, where situatedness, contin¬gency and change orientation as the main normative characteristics of the Urban Living Lab approach for¬med part and parcel of the process.

A crucial question as to what concerns the effectiveness of laboratory situations in urban development con¬texts relates to their ability to exist without a meta-governance that would be able to monitor, compare and guide the different experiments on the ground, and eventually translate them back on the city-wide level. For in principle, the municipal target area management is supposed to be such a guidance and monitoring entity, but, as the process has shown, it could not deliver upon its main objective to create consensus among the main actors around an accepted development vision for the area. The question is thus in how far governance issues can be addressed within the parameters of a given experiment or whether certain conditions need to be in place to guarantee the effectiveness and utility of policy experimentation in a particular area.

The positive effects of laboratization such as inclusion are difficult to achieve in otherwise conflicting politi¬cal environments. The (municipality-driven) 'Perspektive Liesing' process for the first time made an coordi¬nated effort to bring together local politics and municipality around an agreeable set of local development goals. However, this 'Perspektive'-process intervened only after the fact: It was neither targeted at the local population directly nor accompanied by a sufficient time-effort to allow for co-creation and/or major changes in attitudes to happen.

The lack of inclusion in the Urban Living Lab Liesing may as a consequence be explained by several factors: the first relates to the absence of the topic as a normative principle of urban development processes, the second relates to the belief in capacity of existing policies, projects and instruments to already harness the potential of citizens, finally, to the lack of a framework on which any debate around future develop¬ment goals could be based on.

We have tested the applicability of the Urban Living Lab approach in areas where there is a priori no willing¬ness to exchange in experimentation and where there is great conflict about development goals. Formally, a number of desired effects characteristic of the Living Lab approach were achieved, such as opening the space for co-creation and allowing for learning on individual mobility behaviour. Summarizing the results of this process, the intervention has certainly written a part of the local development narrative, but has not rewritten it. Limited by the research-project approach, 'Mobile in Liesing' could not change the given actor constella¬tions. At the same time it was the first strategic process of its kind, other than LA21, where inclusion of the local population featured as a prominent intervention principle. Indeed, this may well lead us to the conclu¬sion that such experiments never completely alter situations or strategically re-orient them. But as such they are setting an example and by harnessing existing potentials open up possibilities for systematic change.

At the same time, the existence of secure, agreed on framework conditions by the most important policy stakeholders as well as by the population is an essential pre-condition for experiments to meaningfully con¬tribute to the policy arena. For in the absence of a concrete urban development policy, such as in the case of Liesing, the Urban experiment can only partially substitute it. There may be need of a new organizational layer, a new institution or a set of rules beyond the laboratory situation. While the experiment allowed us to define this need, probably in a way that we could not have addressed through other means, it could not con¬tribute from within the laboratory boundaries to the in¬stitutionalization of new rules.

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How to become a Sustainable Smart City: the case of Al Quassim Eco-Neighborhood, Saudi Arabia

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1 ABSTRACT

Sustainability is a word we started to hear it lately a lot and think about it. The effect of the new approach of sustainability in architecture have been noticeable by everyone and how it will be beneficial for the environment and the next generations. Heading towards sustainability and solar energy systems in neighborhoods, cities, and apply them in a way that it will be acceptable by the Saudi Developments, especially on cities like Al Quassim. Merging the vernacular building material with the new smart techniques will allow residential modules to be self-efficient in terms of energy Consumption, taking in considerations similar experience from Hassan Fathy and contemporary projects in the Middle East. Accordingly, this paper is discussing assessment of renewable versus non-renewable resources adopted within Saudi settlements. The Discussion elaborates on material resources available and the potential creating a smart model to be adopted as a prototype in hot arid Climate around Saudi Cities.

Keywords: Cultural sustainability, Urban Settlements, Transition, Eco neighborhood, Smart Building Materials

2 INTRODUCTION

A home is a place that should provide to its inhabitants the feeling of comfort and security from the outside to the inside. What if the home turned into a neighborhood, and the neighborhood turned into an Eco-neighborhood providing you with all of you needs and your community needs. . The idea of taking care of our planet should be applied and obvious to everyone starting from our homes to everywhere. An Eco-neighborhood that provide a high level standard of living to the people with smart techniques that allow people to live in self-efficient home which comes in differnt housing units to serve the community needs. And having all the required facilities within a walkable shaded distance. The project have an objectives to be achieved which is: Improve people living, develop the social sustainability, enhance the living environment, improve our economy, develop the Social Sustainability, relations, and communication.

3 SOCIAL AND CULTURAL SUSTAINABILITY OF SAUDI TRADITIONAL HOUSES

Sustainability is the 21st century new approach of the vernacular architecture. Most of the architects around the world agreed that the vernacular architecture functioned more effectively than the modern building which was the result of what the people used befor they built from whats in existing in there enviroment, and they used very smart techniques for the natural sun light and air ventilation. (Susilawati & Al-Surf, 2011). The kingdom of Saudia Arabia has many societies with different valuable traditions and each of those societies has special physical characteristics. (Al-Naim,2008). Each societies in the world has a unique standard to differentiate it from the rest of the world. Reaching the social and cultural sustainability has to be after a social study and meet the culture needs to have a great application of the housing design. (Al-Jamea,2014).

4 PRINCIPLES OF SOCIAL AND CULTURAL SUSTAINABILITY IN SAUDI ARABIA

Dr K. Galal worked in a reseach for the Sheikh Zayed Housing Program in United Arab Emirates which turned with 8 main principles for social and cultural sustainability, however in Saudi Arabia Privacy consider to be a main principle to be add to the previously mentioned. The 9 principles are as following: Responsiveness to social needs, responsiveness to cultural values, quality of life, adaptability, safety, security, participation, accessibility, and privacy

5 URBAN SETTLEMENTS AND DEMOGRAPHIC CHARACTERISTICS

The main objective of the proposed scheme Regional is to encourage the population to stay in the Qassim region by making it a place more attractive to live and work in it. This requires basically two things: expanding the employment base and improve the access of local people to facilities and services .. indicates the region's resource base analysis capabilities that provide these two requirements satisfactorily can be

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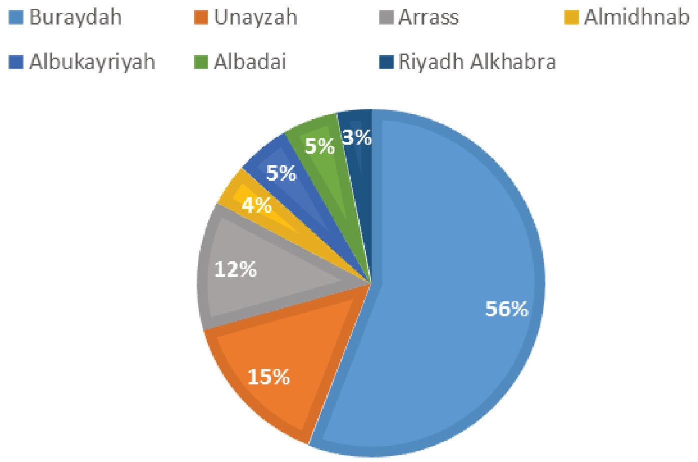
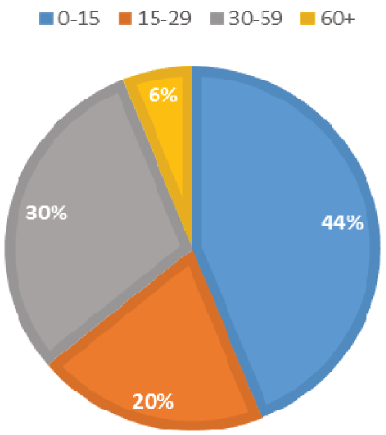
achieved by focusing development in urban centers of the seven main cities: Buraidah, Unaizah, Ar Rass, Almidhnab, Al Badayea, Albukayriyah, and Riyadh Al Khabra.

5.1 The population in the seven main cities of Qassim (conducted 2010)



5.2 Population by age (conducted 2010)

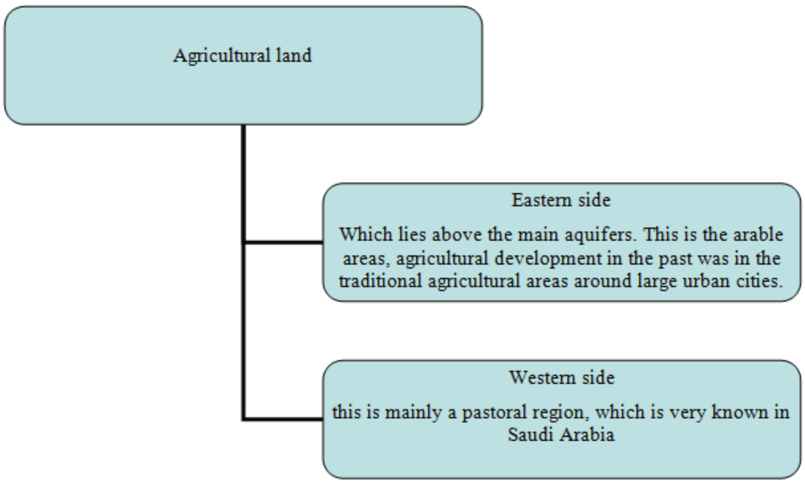


6 NATURAL RESOURCES IN AL-QUASSIM

6.1 Groundwater

Sources of groundwater provide almost all the needed water of Qassim region, the underground reservoirs is located in the eastern part of the region.

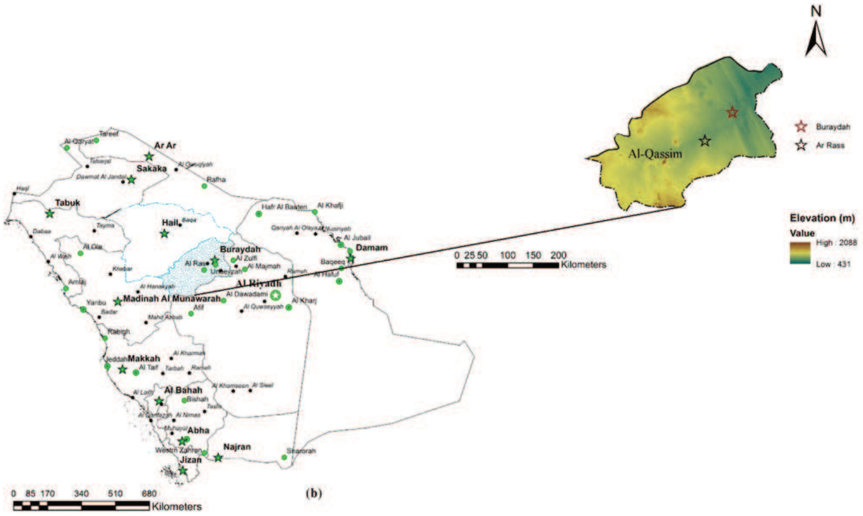
6.2 Agricultural land

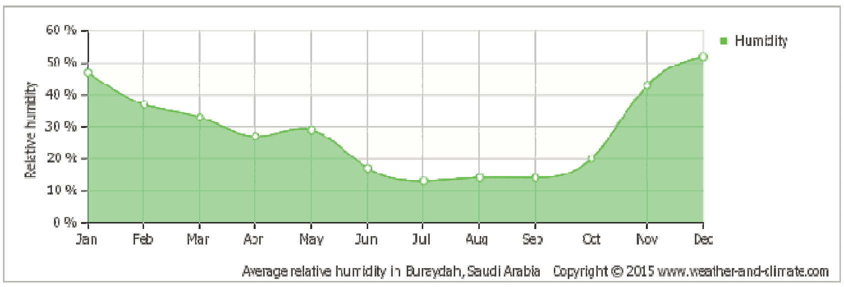


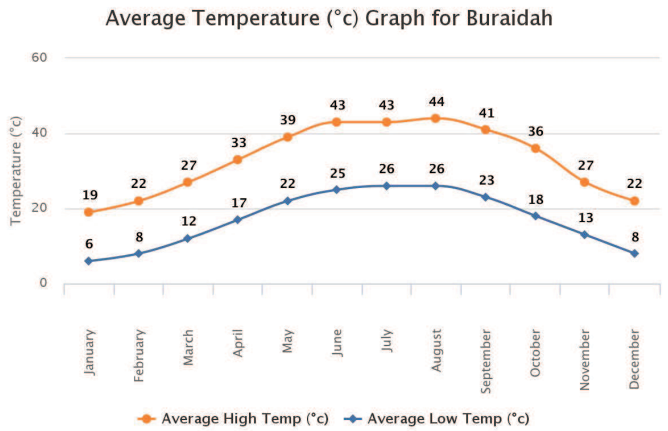
6.3 Minerals

- Mineral Bauxite in the northeastern region.
- Gold is available in Ackiberat mine.
- Salt and kaolin.
- Gypsum.
- Plutonic rocks and marble.
- Sediment used for the industries in the cement and the tiles in Qassim.

7 ENVIRONMENTAL ANALYSIS FOR BURAIDAH







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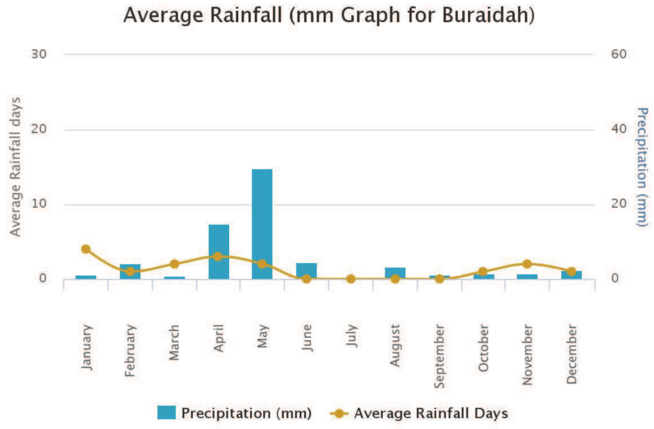

8 CONCLUSION

Saudi Arabia now in a transitional phase each region in the country have a future plan towards Sustainability. However; to reach a Sustainable level of living in Qassim we should not underestimate the social and cultural factors that's affect the society, where they are very committed to the tradition, and to consideration the environment factors which is has a huge effect on the region.

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This section (pp. 885-890) was removed due to cancellation of the author’s conference participation.

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Initiating a Smart Transportation System: Jeddah City

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1 ABSTRACT

Jeddah is a busy city, where road networks and expansion are under continuous development. Public commuting is a key issue for many social categories needs to commute within reliable transportation system. Public transportation required the quality of life, in addition to potential hybrid technologies can improve policy efficiency from users' interest point, the paper discusses potential of integrating smart transportation systems within sectors of the city; reference is made to city capacity and traffic densities and major flows of commuting within the heart of the old city. Investigation adopted in a comparative technique, between important congestive allocations nodes in Jeddah analysis in order to test public preferences between commercial or entertainment areas as a start for system initiation.

Keywords: Commuting, Jeddah, Smart Transportation, Sustainable solutions, Urban planning

2 INTRODUCTION

Public transportation is important to be integrated in urban development; it has valuable benefits and provides different types of services. The public transportation system enhances the city's environmental, economic and social aspects. The ultimate purpose of applying such a system is to equally help maximize the number of commuters, travelers and tourists to move within the city, specially people who cannot afford to purchase or rent a vehicle (Walker, 2008). On a city scale, this system helps in minimizing the vehicle traffic during rush hours; it is sustainable, and economically acceptable (Cervero and Murkami, 2009).

Applying a smart transit system in a context of a new transportation system encourages for having special attractions for people passing by. Having a professionally built station is a way of achieving this entertainment. Railway stations mainly provide two functions: the access for transit way platform and the transit information for the customers. Therefore, there should be careful consideration for each part of the station, in order to satisfy the main purposes of its existence and to play a role in improving the surrounding neighborhood.

3 STATEMENT OF RESEARCH

Today, Old Jeddah is subject to all sorts of rapid development pressure, represented in the negative impact of vehicular traffic and corresponding disruption of the fabric of the city; speculative real estate trends linked with vehicular accessibility which introduce new land-use within the historical urban fabric; the new standards of services, facilities and sanitation which are neither adapted nor integrated to the historic fabric.

4 DEFINING SMART CITIES

The purpose of the Smart Cities Mission is to drive economic growth and improve the quality of life of people by enabling local area development and harnessing technology, especially technology that leads to Smart outcomes. Area-based development will transform existing areas (retrofit and redevelop), including slums, into better planned ones, thereby improving live ability of the whole City. New areas (green field) will be developed around cities in order to accommodate the expanding population in urban areas. Application of Smart Solutions will enable cities to use technology, information and data to improve infrastructure and services. Comprehensive development in this way will improve quality of life, create employment and enhance incomes for all, especially the poor and the disadvantaged, leading to inclusive Cities.

4.1 The first question is what is meant by a 'smart city'

The answer is, there is no universally accepted definition of a Smart City. It means different things to different people. The conceptualization of Smart City, therefore, varies from city to city and country to country, depending on the level of development, willingness to change and reform, resources and aspirations of the city.

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4.2 Smart Cities Mission

the objective is to promote cities that provide core infrastructure and give a decent quality of life to its citizens, a clean and sustainable environment and application of 'Smart' Solutions.

The focus is on sustainable and inclusive development and the idea is to look at compact areas, create a replicable model which will act like a light house to other aspiring cities.

The Smart Cities Mission of the Government is a bold, new initiative. It is meant to set examples that can be replicated both within and outside the Smart City, catalyzing the creation of similar Smart Cities in various regions and parts of the country.

4.3 Infrastructure elements

The core infrastructure elements in a Smart City would include:

- Adequate water supply,
- Assured electricity supply,
- Sanitation, including solid waste management,
- Efficient urban mobility and public transport,
- Affordable housing, especially for the poor,
- Robust IT connectivity and digitalization,
- Good governance, especially e-Governance and citizen participation,
- Sustainable environment,
- Safety and security of citizens, particularly women, children and the elderly,

Health and education.buildings and the loss of 'image' and prestige of the historic centers and the misconceived 'modernity' in many locations of the center. Key buildings, mosques and merchants' houses of historical Jeddah are concealed today behind modern high rise buildings and skyscrapers that make up Jeddah's bustling business district. This severe pressure results in a dramatic treats for the continuity of the historical city into the future.

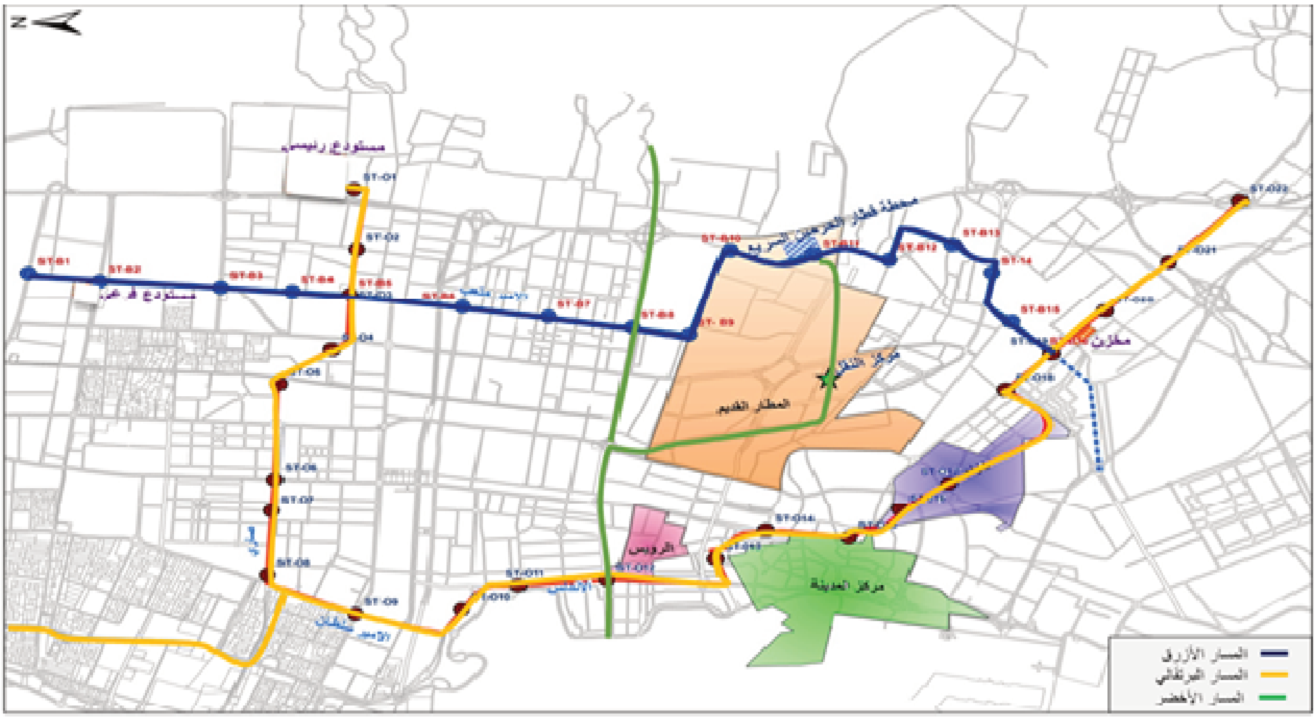

Fig. 1: Planned municipalities network (METRO)

5 PLANNED MUNICIPALITIES NETWORK (METRO)

As a result of sustained national economic development over several decades, most of the towns and cities in Saudi Arabia became developed in a way that had never before been experienced in the Arabian Peninsula. Not surprisingly, the scale and rates of growth which have been experienced, particularly since the early 1970s (A. Daghistani, 1993).

the 'boom' period of 1974-1983 saw the rapid physical development of the city, which was not always in accordance with the newlyestablished planning policies. The remainder of this paper is concerned with

the analysis of two major aspects of the original Master Plan's policies, in an attempt to discover some of the factors which have contributed to the unsuccessful and successful implementation of planning policies in Jeddah.

These case studies included the policies for retail development, Jeddah Corniche development, desalination unit, sharm abhour expansion, road network.

At this early stage transportation system was not yet considered as a community requirement since the services were mostly considering the pelegrinage route frrom and to the two holy cities via Jeddah airport.

6 METHODOLOGICAL APPROACH: POTENTIAL OF DEVELOPING TRAMWAY?

6.1 Development Potentials:

Jeddah does not have an extensive public transport system and the easiest way of getting around the city is by private vehicle. Women are not allowed to drive a car in Saudi Arabia and are therefore reliant on male members of their family or a driver for transport. It's relatively easy for male visitors to rent a car and a number of well-known international car hire companies are located at the airport and in the city Centre.

6.2 City Expansion

The explanation of rapid expansions of Jeddah city from different axis has resulted in an obvioussectoral development appears to be relatively straightforward:

(a) Because of the importance of the connections between Jeddah and the two Holy Cities of Makkah and Madina, the Makkah and Madina roads (leading east and north respectively) were the first to be surfaced. Properties close to surfaced roads conveying a certain social evolution, which is evident towards areas in the north (New aiport and future residential developments) as well towards the east (along the haramain road major connector to the holy cities).

(b) Immigrants to the city are increang due to the economical development as well as the industrial city towards the south with moderarate social level according to their careers and everyday living acticvities.

(c) At an early stage in the city's development, the northern and eastern areas came under the ownership of large landowners who, in order to maximize their returns, proceeded to sub-divide their land into large grid-iron plots (initially for villa development, but as land values rose, the more central plots were used for high-status apartments).

However, this expansion in infrastructure has not been able to accommodate increases in travel demand, hence causing high levels of congestion. Conversely, Jeddah's enormous spatial expansion has caused large changes in the daily share of travel modes (M. Aljoufie, 2012).

Current land use and transport planning practice in Jeddah municipality cannot keep up with rapid urban growth and consequent land use and transport interaction issues. Planning and policy practice focus on separate visions, causing that specific land use or transport issues should not be dealt with in isolation.

6.3 Community requirement

According to a survey done recently as part of capstone preparation thesis (Manal, 2016), typical identified requirements were aligned with smart cities initial founding as a sample of initial public requirements in figure 2.

The major investigated points are demonstrated, mainly covering:

- Potential of integrating smart transportation systems within sectors of the city; reference is made to city capacity and traffic densities and major flows of commuting within the heart of the city.

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- Secure and facilitate the movement of residents, tourists and visitors in the city of Jeddah. and guiding them to the most important monuments to visit safely and fast. and giving women's greater freedom of movement safely on their own.

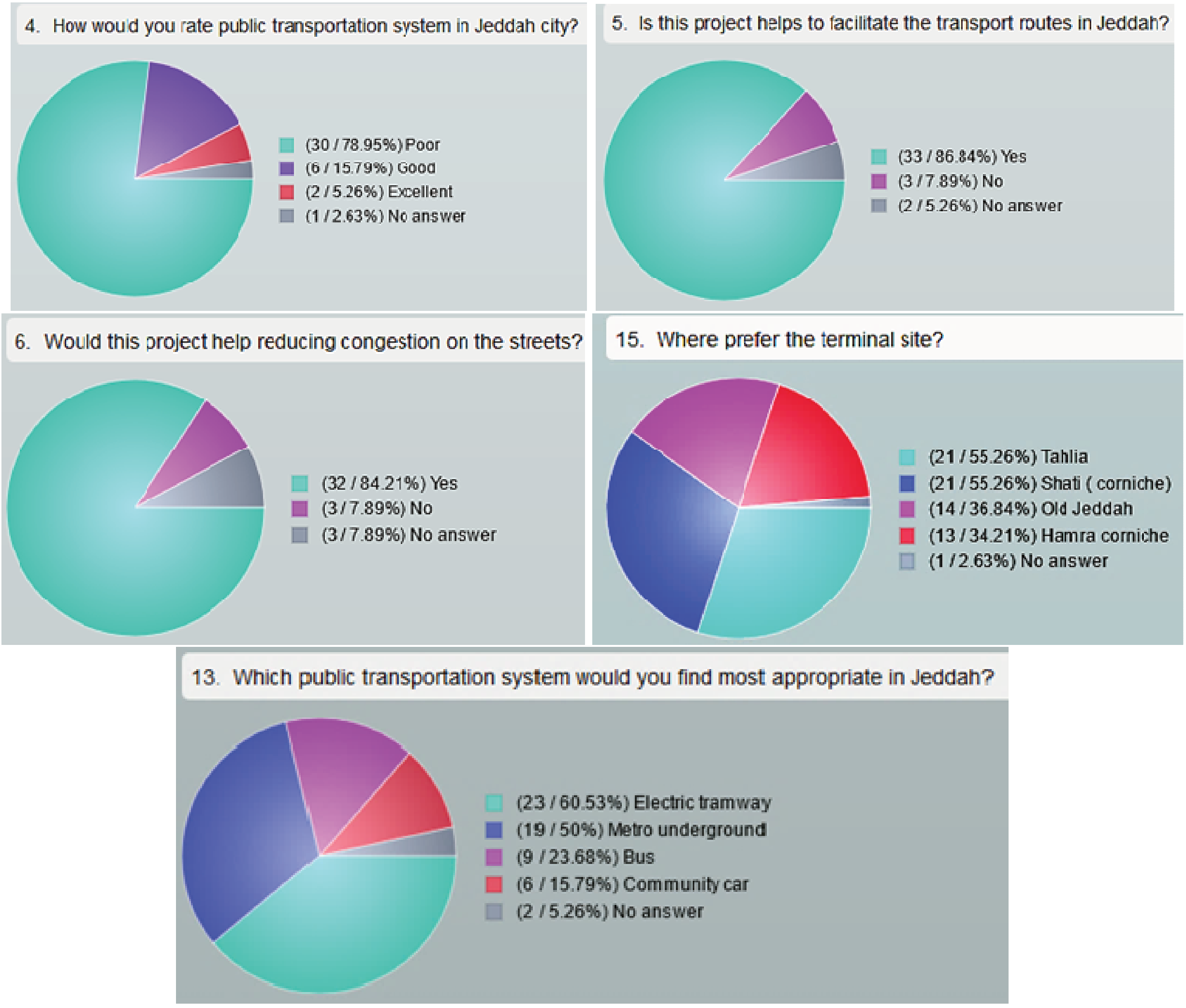

Fig. 2: Initial Public Requirements Survey.

7 SMART CITY APPROACH POTENTIALS:

- There are many factors of Saudi vision 2030 that support and motivate the Initiating a smart transportation system in Jeddah city (Tram System):
- The high quality of Applying a smart transit system
- New transportation system encourages for having special attractions that support all the possible factors and paths that will lead to this level of quality
- With this new Tram System, using the electrical power will saveoil investments and that's will be the strongest factor that will support.
- initiating a smart transportation system in Jeddah city (Tram System).
- revitalization strategies, like the initiation of campains among young generations as well as regular visitors.

8 PROPOSED TRAM SYSTEM:

Applying a smart transit system in a context of a new transportation system encourages for having special attractions for people passing by. Railway stations mainly provide two functions: the access for transit way platform and the transit information for the customers. Therefore, there should be careful consideration for each part of the station, in order to satisfy the main purposes of its existence. Major Project Aspect are cited in the following points:

8.1 Typology

A tram, usually known 'street car', 'trolley car' or 'trolley', is a car which runs on fixed rails and is designed to travel on streets, sharing road space with other traffic and pedestrians.

Tramway is a rapid transit system inside the city regularly stops to load or unload passengers.

8.2 Concept and philosophy

- tram system connecting with the proposed metro line by a common point and design its terminal (station)
- Secure and facilitate the movement of residents, tourists and visitors in the city of Jeddah. and guiding them to the most important monuments to visit safely and fast. and giving women's greater freedom of movement safely on their own.
- Potential of integrating smart transportation systems within sectors of the city; reference is made to city capacity and traffic densities and major flows of commuting within the heart of the city.

8.3 Goals and Objectives

The proposed project has environmental, economic and social objectives:

8.3.1 Environmental Objectives:

- Reducing the dependency of using petroleum for private cars.
- Reducing the air pollution and energy consumption.

8.3.2 Economic Objectives

- Public transportation is affordable and not expensive on the individuals
- Helps economic growth

8.3.3 Social Objectives

- Women, children and the elderly will find a safe transportation system that takes them to schools, offices, or entertainment places.
- It will positively impact people studying and working in remote areas, this system will provide them a safe and efficient mean of transportation.
- The station public areas will help people to gather and socially interact.

8.4 Site Selection

Based Upon considering the above potentials of Jeddah city developments, as well as the requirement of smart cities growth the following site in Tahlia main street connection has been selected in figure 3, the site has a strong potential then the area is mostly commercial and residential orientation.

The weighted criteriain table 1 indicates the various aspects considered while investigating community requirements along the expected infrastructure development as well as Jeddah metro proposed route and main stations.

The selected On tahlia street, provides for connectivity along major street network of Jeddah, as well as promotes the economical, environmental and social perspectives in the area.

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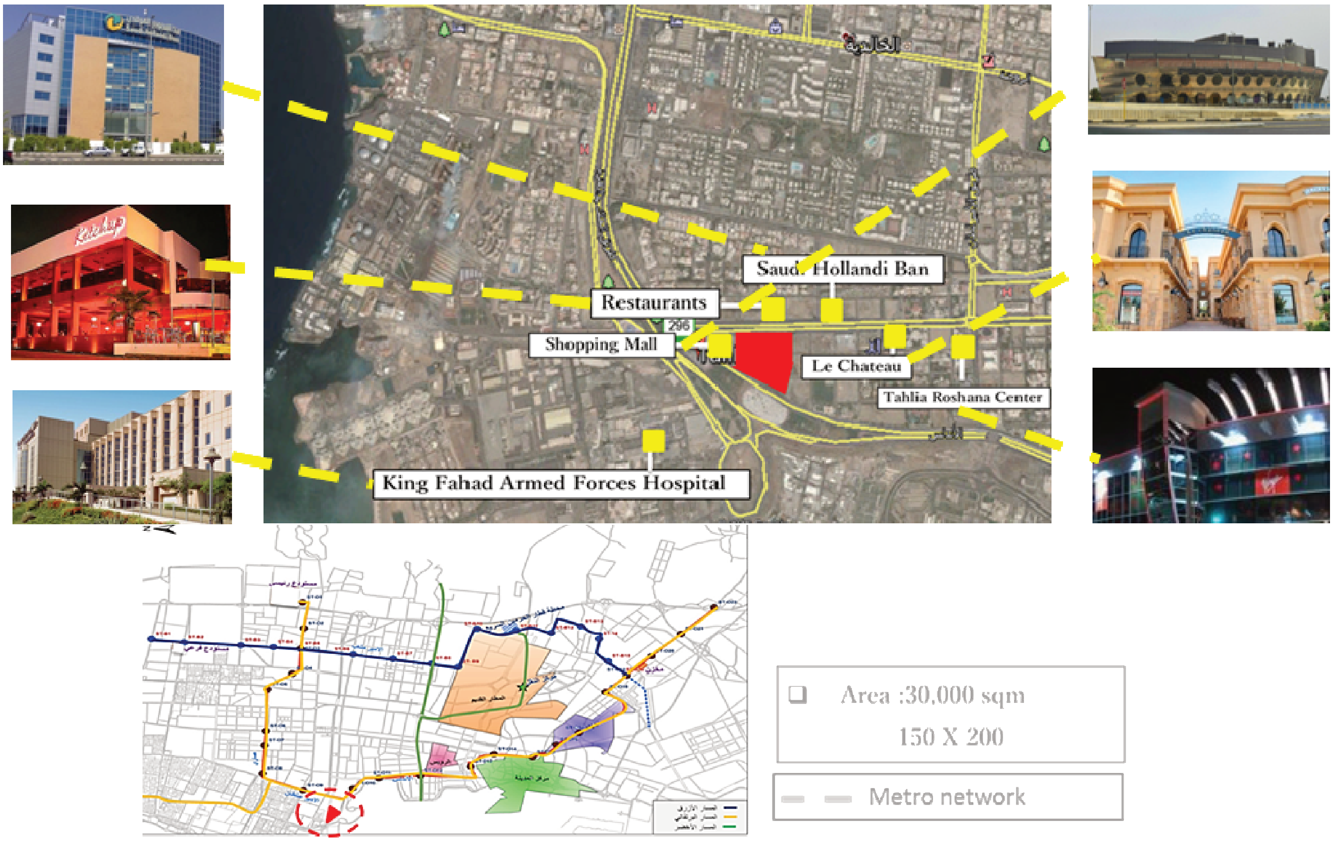

Fig. 3: Initial Public Requirements Survey.

Criteria	Corniche Site (1)	Tahliah Site (2)	Old Jeddah Site(3)
Access / Traffic (WF=3)	12	15	10
shape/Proportional (WF=2)	8	10	6
Topography (WF=1)	4	5	4
Future Development (WF=3)	15	12	15
Surrounding (WF=2)	8	10	6
Views (WF=2)	10	10	6
Visibility (WF=2)	6	8	6
Total	63	70	53

Table 1: Site Selection Weighted Criteria.

9 CONCLUSION

On a closing note, it is important to emphasize on the fact that planning, designing, building, operating and maintaining transit systems have both direct and indirect sustainable impacts on the society. In other words, transit systems have the potential to increase the environmental quality, the quality of life, and the economic prosperity of a community.

Therefore, proper planning and designing of a scalable smart transportation system is crucial in every developing and booming country since it has a direct impact in preserving communities pleasant and increasing their productivity. Public transportation systems have also, the power of moving people faster, safer and to further destinations in a ridiculous reduced time, which ultimately increases the overall productivity of the whole country.

"The goal of the public transportation project in Jeddah is to provide the best and most suitable types and choices for public transportation, in addition to the easy use of car parks that are connected to public transportation paths on the city's borders, to decrease traffic congestions inside the city and lessen pollution.

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Interactive Visualisation of Statistical Data with the CentropeSTATISTICS Cross-Border Geoportal

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1 ABSTRACT

The Centrope region consists of a number of adjacent counties and states along the borders between Austria, the Czech Republic, Hungary, and the Slovak Republic, comprising regions Jihomoravský, Bratislavský, Trnavský, Győr-Moson-Sopron, Burgenland, Lower Austria, and Vienna. It was founded 2003 by the political declaration of Kittsee and aims to strengthen partnership and economy in a region which were suffering from the Iron Curtain during the second half of the 20th century.

CentropeMAP is a geoportal connecting the region by collecting web map services from the partner countries. The services are brought together in a single map viewer and allow the user to experience a cross-border working area with dozens of data layers dealing with all topics which could be of interest for regional planners and similar professions. Layers are coming from the fields of biota, boundaries, elevation, imagery/base maps, inland waters, planning/cadastre, structure, and transportation. CentropeMAP went online in 2005 and was extended by the cross-border statistics database CentropeSTATISTICS in 2010. During 2015, CentropeMAP and CentropeSTATISTICS were relaunched with new software and remarkably higher speed of map generation.

CentropeSTATISTICS is an extensive statistics database which is directly linked to CentropeMAP and allows its users to create thematic maps and various types of charts on the fly. It is the only available free web tool to visualise cross-border statistical data in its own connected geoportal allowing the user to influence the way of visualisation in multiple ways in the Centrope region. CentropeSTATISTICS can not only create maps, it also serves charts which are interactively created from the data in the cross-border database. The statistics database is continuously expanded in close co-operation with the statistical offices of Hungary, Slovakia, the Czech Republic, Vienna, Lower Austria and Burgenland.

The CentropeMAP newsletter is published twice a year and aims to inform members of state administration and statistical offices about the capabilities of CentropeMAP and CentropeSTATISTICS as well as news from the statistical offices of the partner countries. It also distributes information regarding geodata in the CentropeMAP geoportal.

Keywords: Centrope, cross-border, Europe, geoportal, interactive

2 INTRODUCTION

The Central European region Centrope is a cross-border region situated along the mutual boundaries of Austria, the Czech Republic, Hungary, and Slovakia. The Centrope region is not naturally grown – a quarter of a century ago it was still divided by the Iron Curtain –, it is a political and economical construction to help all parts of the region to overcome the unfavourable development during the period of the Cold War when these regions were practically cut off at their edges. So it might not be a surprise that the term “Centrope” is still unknown in common everyday life.

However, for planners, politicians and stakeholders the Centrope region is an important tool to initialise cross-border projects and enhance co-operation with colleagues from neighbouring countries. CentropeMAP and CentropeSTATISTICS are a valuable help to gain cross-border information on various topics which need to be evaluated in a cross-border project. Information on CentropeMAP and the Centrope region is available through the website http://www.centropemap.org which is featuring five languages (English and the languages of the Centrope countries: Czech, Hungarian, Slovak, German). However, the CentropeMAP geoportal is available in English only due to its complexity.

3 WHY CENTROPEMAP?

3.1 CentropeMAP has deeper information than other map services

Everyone knows Google Maps or Open Street Map – both services are available worldwide and offer plenty of map information such as boundaries, transport infrastructure (roads, railway, stops, stations), facilities

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(social, shopping, nature, medical care, ...) and points of interest (cultural, sightseeing, landmarks, ...). The goal of CentropeMAP is to take a map like this as a background and add more information which are important for planners and related professions. CentropeMAP helps planners to answer questions like:

- Can I put a shopping centre here or is there any kind of protected area zoning which prohibits such a project?
- I am planning something close to my national boundaries. How is the situation on the other side of the border?
    - What about population density?
    - What age and family structure does the population have?
    - What about commuters and the economic situation?
- What was the situation like some years ago?

3.2 CentropeMAP's map data is directly obtained from official servers

Therefore, all data layers in CentropeMAP are always up to date. CentropeMAP works with cascading web map services (WMS): There are single map services for each region or country of the Centrope region which are combined into a single WMS for each topic. These single WMS are hosted on the CentropeMAP server, so if the client sends a request for one layer, the CentropeMAP server splits this request into several requests which are then sent to the partner servers. This is a background process and not directly visible to the user for reasons of simplicity (one layer, one click).

3.3 CentropeMAP includes and visualises statistical data

CentropeMAP and CentropeSTATISTICS are two interconnected services which allow the visualisation of statistical data in a topographic map. All statistical tables are directly received from the official statistical offices of the partner countries:[1]

- statistical office of the Czech Republic, https://www.czso.cz/
- Hungarian central statistical office, http://www.ksh.hu/
- statistical office of the Slovak Republic, http://www.statistics.sk/
- Statistik Wien (MA 23), https://www.wien.gv.at/statistik/
- Statistik Niederösterreich, http://www.noe.gv.at/Land-Zukunft/Raumordnung/Statistik.html
- Statistik Burgenland, http://www.burgenland.at/land-politik-verwaltung/land/statistik-burgenland/

3.4 CentropeMAP and CentropeSTATISTICS are regulary updated

Many of the tables available through CentropeSTATISTICS have annual data series from 2015 going back to 2003. These tables are updated annually to keep the range of the time series up to date. The web map servers are also regularly checked for additional services to extend the map layer range of CentropeMAP.

3.5 CentropeSTATISTICS is the only cross-border database with municipality data

Statistical datasets for the Centrope region can be obtained in multiple ways, for example from the freely accessible databases of the national statistical offices or through the EUROSTAT database maintained by the European Statistical Office. However, most of these datasets are available on diestrict, NUTS 3 or NUTS 2 levels only, which makes them less useful for a cross-border region where details are important at small scale.

Almost all tables in CentropeSTATISTICS are on municipality level (there are more than 3,500 municipalities in the Centrope region) which makes them extremly interesting for people who want to explore cross-border situations or small scale patterns. To visualise these tables, only a frew mouse clicks are necessary to convert the numbers into thematic maps which can be directly viewed in CentropeMAP. Also, a wide range of charts is available. All charts can also be created easily with a few mouse clicks.

[1] all hyperlinks last accessed 19 May 2016

4 STRUCTURE OF CENTROPEMAP AND CENTROPESTATISTICS

4.1 The CentropeMAP website

The CentropeMAP website has some basic information on the Centrope region. On the website http://www.centropemap.org you can find out more on CentropeMAP and CentropeSTATISTICS content providers, download a detailed CentropeSTATISTICS manual in English and German, and access the CentropeSTATISTICS newsletter which is published twice a year.

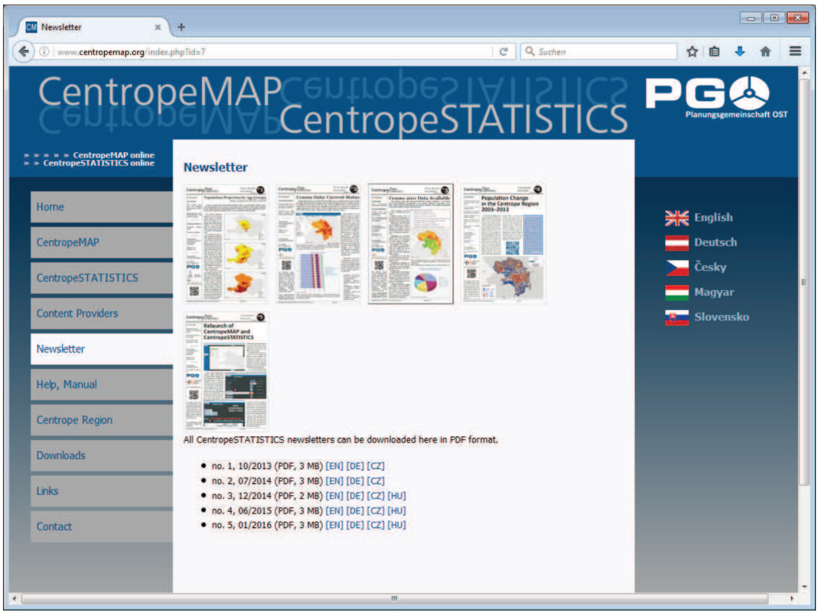

Fig. 1: The CentropeMAP website.

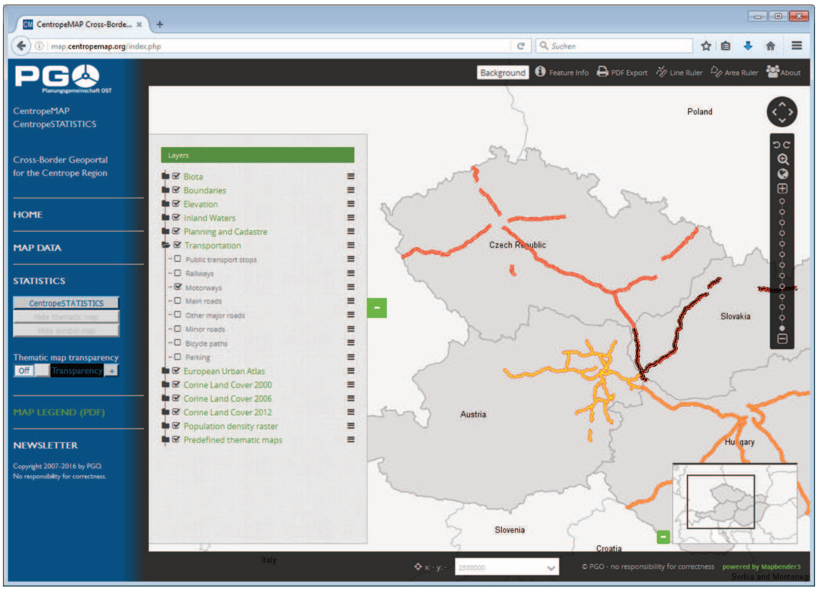

Fig. 2: The CentropeMAP geoportal. In this image the motorways layer is displayed. Note the different motorway symbols in all four countries.

4.2 The CentropeMAP geoportal

The geoportal features a background map with various boundaries (national, NUTS 3, municipalities) which automatically switches to a more detailed topographic map in deeper zoom levels. The user may switch on additional layers from the *ISO 19115 Geographic Information – Metadata* topic categories biota, boundaries, elevation, inland waters, planning and cadastre, and transportion. Further layer groups are European Urban Atlas (from EEA, the European Environmental Agency), Corine Land Cover (2000–2012), population density raster 2006 (from European Commission/Eurostat/Regio-GIS) and some predefined thematic maps.

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Most of the thematic layers are composed of content from the partner servers on the fly. Therefore, map images may look like the example in fig. 2 where the same content is symbolised differently for every country because CentropeMAP cannot influence the stylesheets of the external services. This issue will be solved at a later stage of the compulsory implementation of the INSPIRE (Infrastructure for Spatial Information in the European Community) guidelines by all EU member states.

4.3 CentropeSTATISTICS

CentropeSTATISTICS is a cross-border statistical database with tables from the topic categories population numbers, population indicators, population projection, citizenship, migration, education, economy/labour market, buildings, and land use.

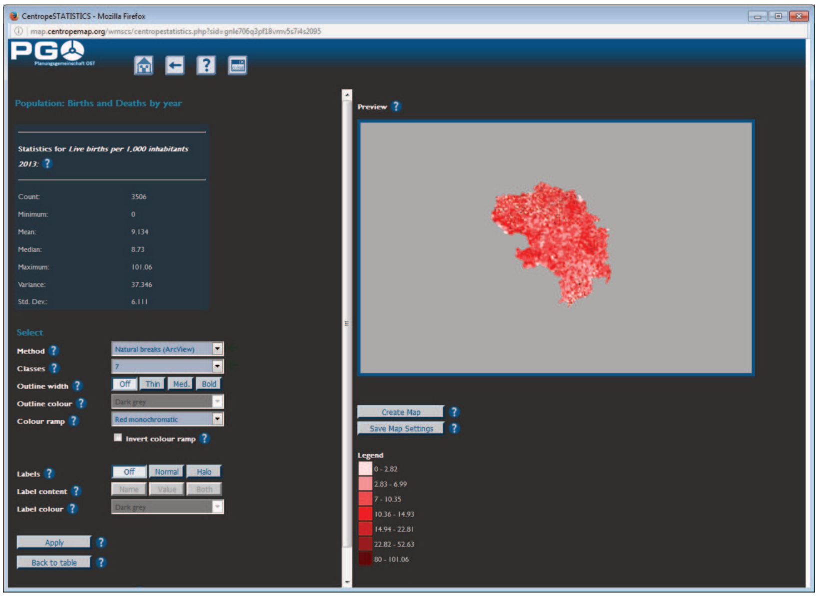

Fig. 3: Surface of CentropeSTATISTICS map creation engine.

These tables can be queried, viewed, exported to Excel, or used for map and chart creation. These features require some basic knowledge in cartography, mapping, and statistics. If someone has ever worked with any GIS (Geographic Information System) software like ArcView, ArcGIS, QGIS or others, they won't encounter any problems during map creation which is like setting up a legend for a GIS layer.

Chart creation is as easy as map creation. Only the selection of a topic and one or more municipalities are necessary to create chart output. All charts are image files which can be simply pasted into any other application. Charts are an important tool to visualise time series from the CentropeSTATISTICS database because for map creation only statistical indicators from single years can be used.

4.4 Technical infrastructure

All components of the geoportal CentropeMAP are realised with open source software. The website is powered by the content management system (CMS) Typo3 which allows the easy creation of a multi-language and barrier-free website according to the standards tof the Web Accessibility Initiative of the W3C.[2]

The geoportal is powered by the map viewing client Mapbender3 since the 2015 relaunch. In the background the cascading web map services are provided by UMN Mapserver and Geoserver . CentropeSTATISTICS is a PHP/Javascript application written by the CentropeMAP team using some freely available PHP classes like Pear Excel Writer to create MS Excel files for table export or FPDF to create various PDF files. The CentropeMAP server is running the latest version of Ubuntu Linux (server version).

5 WEBLINKS

CentropeMAP website: http://www.centropemap.org
Shortcut to CentropeMAP geoportal: http://map.centropemap.org

[2] https://www.w3.org/WAI/, last accessed 19 May 2016.

Monitoring von Smart-City-Strategien – Wiens Smart-City-Monitoring-Prozess

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1 HINTERGRUND

Hintergrund: Im Juni 2014 wurde die Smart-City-Wien-Rahmenstrategie (SCWR) vom Wiener Gemeinderat beschlossen. Im Zuge dessen wurde der Magistrat beauftragt, durch ein periodisch stattfindendes Monitoring die Umsetzung der Rahmenstrategie zu verfolgen. Um diesen Auftrag zu unterstützen, wurde das Forschungsprojekt Smart.Monitor erfolgreich in der 2. Ausschreibung des BMVIT Programmes „Stadt der Zukunft“ eingereicht.

Das Forschungsprojekt: Ziel des Projektes ist die Definition von Smart-City-Indikatoren und Monitoring-Voraussetzungen für die Messung der Zielsetzungen der Smart-City-Wien-Rahmenstrategie sowie die Festlegung des Monitoringprozesses. Im Zentrum steht die Entwicklung eines Monitoring-Ansatzes der auf bestehenden Daten aufbaut, bestehende Wiener Sektoralstrategien erfasst, praxistauglich und interdisziplinär ist. Das Forschungsprojekt läuft von September 2015 bis August 2016 und wird im Rahmen der 2. Ausschreibung des BMVIT Programmes „Stadt der Zukunft“ gefördert. (Projektpartner: Stadt Wien, MA 18 (Koordination), Austrian Institute of Technology GmbH, denkstatt GmbH, TINA Vienna GmbH, WWTF GmbH).

Ziele des Forschungsprojektes: SMART.MONITOR entwickelt Konzepte und Handlungsempfehlungen für das SCWR-Monitoring der Stadt Wien. Diese Konzepte und Handlungsempfehlungen widmen sich insbesondere den Themen SCWR-Indikatoren, Datenerhebungs-/auswertungs-/interpretations-, Steuerungs- und Governanceprozesse. Darüber hinaus untersucht SMART.MONITOR internationale Erfolgsfaktoren für ein Smart City Monitoring und integriert Erfahrungen der Referenzstädte Graz, Salzburg, München, Berlin und Hamburg.

Grundprinzipien:

- Die Indikatoren werden gemeinsam mit den Dienststellen der Stadt Wien definiert.
- Vorrangig werden Daten aus bestehenden Erhebungen und Monitoringprozessen verwendet.
- Es wird auf bestehende Monitoringansätze aufgebaut.

Das Projekt gliedert sich in drei Phasen:

1. Phase: Gespräche mit Mitarbeiterinnen und Mitarbeitern aus allen Geschäftsgruppen der Wiener Verwaltung werden geführt, um die Anforderungen an ein SCWR-Monitoringsystem zu erheben. Parallel dazu werden vorhandene Daten und bereits bestehende Monitoringprozesse in der Stadt Wien sowie internationale Ansätze bezüglich Smart-City-Monitoringsystemen analysiert.

2. Phase: Im Zuge von Workshops werden Indikatoren zu den SCWR-Zielen definiert.

3. Phase: Die Monitoringprozesse werden näher beleuchtet. In diesem Schritt soll das Zusammenspiel vom Sammeln der Informationen und Daten, der Analyse und Interpretation, der Berichtslegung und der darauf folgenden Steuerung zu einem Konzept verfasst werden.

Dieser Beitrag fokussiert auf die Ergebnisse von Phase 3 und geht vor allem auf das Design des SCWR-Monitoringprozesses, seine Einbettung in die Verwaltungsabläufe und seine Organisationsstruktur ein.

2 DER KONTEXT VON WIENS SCWR-MONITORING-PROZESS

2.1 Die Smart-City-Wien-Rahmenstrategie (SCWR) und ihre Ziele

Die folgende Abbildung zeigt grafisch die wesentlichen Themen der SCWR und ihre Zusammenhänge.

Die SCWR besteht aus drei zentralen Zieldimensionen Lebensqualität, Ressourcenschonung und Innovation mit den insgesamt zehn Zielbereichen (Soziele Inklusion/Partizipation, Gesundheit, Umwelt, Energie, Mobilität, Infrastruktur, Gebäude, Bildung, Wirtschaft, FTI)

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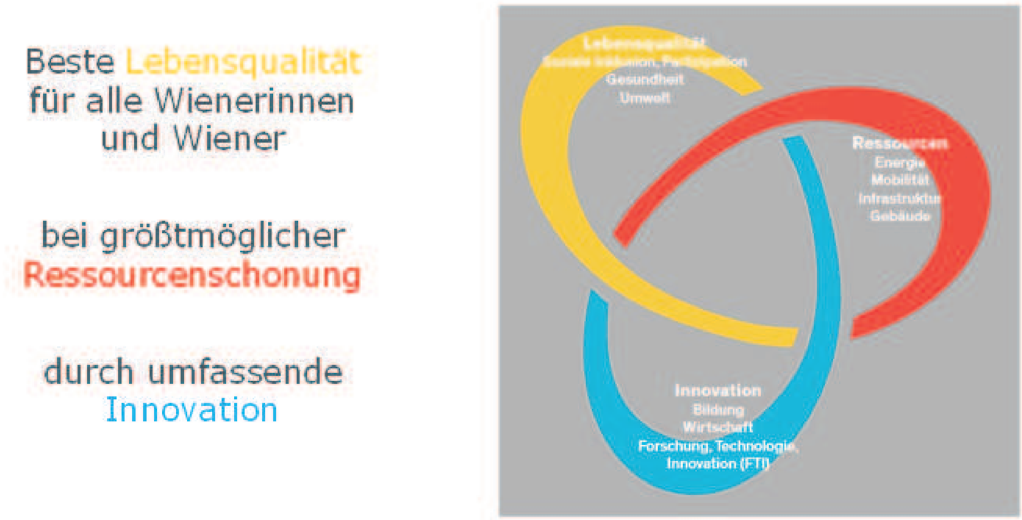

Abbildung 1: Darstellung der Smart-City-Wien-Rahemnstategie (SCWR); (Quelle: Stadt Wien, MA18)

Für jede Zieldimension mit ihren Zielbereichen wurden Ziele bzw. Teilziele festgelegt. Insgesamt enthält die SCWR 52 Ziele und Teilziele; 19 davon in der Zieldimension Ressourcen, 16 in der Zieldimension Innovation und 17 in der Zieldimension Lebensqualität. Die Ziele bzw. Teilziele sind in ihrer Ausprägung sehr unterschiedlich und reichen von klaren quantitativen Zielen mit Basisjahr, Basiswert, Zieljahr und Zielwert zu qualitativen Zielen mit sehr allgemeinen Aussagen.

2.2 Anforderungen an den Monitoringprozess

Die wesentliche Anforderung an den Monitoringprozess ist es nun, diese 52 SCWR-Ziele bzw. -Teilziele regelmäßig hinsichtlich ihrer Zielerreichung zu beurteilen. Das Ergebnis der Beurteilung der Zielerreichung soll als Basis für die strategische Steuerung der SCWR dienen.

Dazu wurden im Forschungsprojekt einerseits Indikatoren und Indikatorensets (für qualitative Ziele) entwickelt, andererseits wurden klare Beurteilungsregeln definiert, bei welcher Ausprägung der Indikatoren das Ziel erreicht bzw. nicht erreicht ist.

3 DER SCWR-MONITORINGPROZESS ALS TEIL DES SCWR-STEUERUNGSKREISLAUFS

Um einen wirkungsvollen und praktikablen SCWR-Monitoringprozess entwickeln zu können, muss das Monitoring im Gesamtkontext der strategischen Steuerung gesehen werden.

Das Monitoring der Smart-City-Wien-Rahmenstrategie folgt daher dem Urban Management Ansatz und ist in einen strategischen SCWR-Steuerungskreislauf eingebettet, der eine stetige Verbesserung ermöglicht.

Die folgende Grafik zeigt die wesentlichen Elemente des „Smart City Management Kreislaufs“.

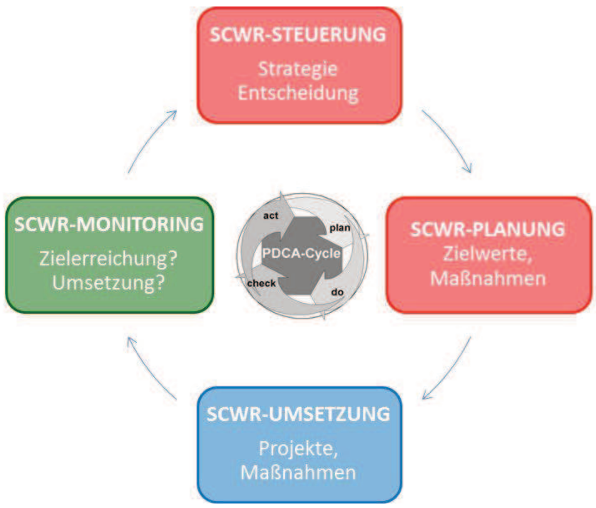

Abbildung 2: Elemente des Smart City Management Kreislaufs (Quelle: Handbuch Prozessmanagement der Stadt Wien – adaptiert von denkstatt GmbH)

Wie in Abbildung 2 zu erkennen ist, ist das SCWR-Monitoring ein Element im SCWR-Steuerungskreislauf, der für die Messung und Überwachung der Zielerreichung und der Maßnahmenumsetzung sorgt.

Für ein wirkungsvolles SCWR-Monitoring muss aber der gesamte Steuerungskreislauf funktionieren.

4 DER SCWR-MONITORINGPROZESS IM DETAIL

Für das Monitoringelement des SCWR-Steuerungskreislaufs wurde ein Prozess entsprechend den Prinzipien des Prozessmanagements entwickelt. Der SCWR-Monitoringprozess orientiert sich dabei an den Prozessmanagementansätzen der Stadt Wien.

Die folgende Grafik zeigt den SCWR-Monitoringprozess mit seinen Teilprozessen:

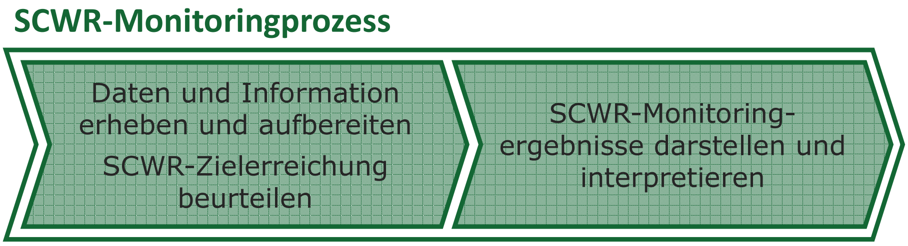

Abbildung 3: SCWR-Monitoringprozess mit Teilprozessen (Quelle: denkstatt GmbH)

Der SCWR-Monitoringprozess ist entsprechend Prozessmanagement ein Mess- und Analyseprozess.

4.1 SCWR-Monitoringprozesses - Teilprozesse1

„Daten und Informationen erheben und aufbereiten und SCWR-Zielerreichung beurteilen“

Für diesen Teilprozess wurde eine detaillierte Prozessbeschreibung entwickelt, die folgendes festlegt:

- Prozessverantwortung
- Zweck der Prozessbeschreibung
- Ziel des Prozesses
- Begriffsdefinitionen
- Prozessablauf und Verantwortung
- Wesentliche Schnittstellen
- Mitgeltende Dokumente und Datenaufzeichnungen
- Verteiler

Unter Punkt Prozessablauf und Verantwortung werden alle zur Erreichung der Prozessziele notwendigen Tätigkeiten mit Verantwortlichen eindeutig festgelegt. Zusätzlich werden die Dokumente und „Tools“ je Prozessschritt angeführt, die wesentlich für die Umsetzung sind; ebenso die Outputs je Prozessschritt.

Die folgende Tabelle zeigt einen Ausschnitt aus der Prozessbeschreibung von Teilprozess 1:

Kernstück dieses Teilprozesses ist die regelmäßige Erhebung der Daten und Informationen. In Indikatorensteckbriefen ist für jedes SCWR-Ziel im Detail festgelegt, wie und von wem die Daten und Informationen, die für die Beurteilung der Zielerreichung benötigt werden, zu erheben sind. Wie im Vortrag von Hans-Peter Martin, Pia Hlavna und Eva Pangerl genauer erläutert, wurden diese Indikatorensteckbriefe in enger Abstimmung mit den betroffenen Dienststellen der Stadt Wien erarbeitet.

Damit liegt aus dem Forschungsprojkt ein klarer Vorschlag für diesen Teilprozess vor, der sich an den Voraussetzungen in der Verwaltung der Stadt Wien orientiert.

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Nr.	Prozessschritte	Verantw.	Verweise
1.	***Jährlichen Auftrag zum SCWR-Monitoring an die SCWR-Zielbeauftragten erteilen***	***SCWR-Koordinator***	
2.	***Daten und Informationen erheben, die zur Beurteilung der SCWR-Zielerreichung notwendig sind***	***SCWR-ZB***	
2.1	Den Zahlenwert oder die qualitative Information zum Einzelindikator laut Indikatorensteckbrief erheben.	SCWR-ZB	< Indikatorensteckbriefe
2.2	Den Zahlenwert oder die Information in das vorgesehene Auswertungstool, entsprechend dem Indikatorensteckbrief, eintragen.	SCWR-ZB	< Indikatorensteckbriefe > befülltes Auswertungstools
3.	***Daten und Informationen als Grundlage für die Beurteilung der Zielerreichung darstellen***	***SCWR-ZB***	
3.1	Die erhobenen SCWR-Daten oder -Informationen in einer Darstellung aufbereiten, die die Beurteilung der Zielerreichung entsprechend dem Indikatorensteckbrief ermöglicht („händisch" oder automatisiert).	SCWR-ZB	< Indikatorensteckbriefe > Dargestellte Daten/Infos

SCWR: Smart-City-Wien-Rahmenstrategie, SCWR-ZB: Smart-City-Wien-Rahmenstrategie – Zielbeauftragte(r)

4.2 SCWR-Monitoringprozesses – Teilprozesse2

„SCWR-Monitoringergebnisse darstellen und interpretieren"

Der zweite wesentliche Prozessschritt ist die Beurteilung der Zielerreichung anhand der Informationen und Daten. Auch hier sind Verantwortlichkeiten und die Vorgehensweise genau festgelegt.

Im Forschungsprojekt SMART.MONITOR wurde für diesen Teilprozess ein Konzept für die Prozessbeschreibung entwickelt, die in einer Folgephase ausgearbeitet werden muss.

Wesentlich dabei ist die im Forschungsprojekt entwickelte einheitliche Darstellung der Zielerreichung aller Ziele, unabhängig vom Typ des Zieles in den folgenden Abstufungen:

- Ziel ist (aktuell) vollständig erreicht
- Ziel ist (aktuell) weitgehend erreicht
- Ziel ist (aktuell) teilweise erreicht
- Ziel ist (aktuell) nicht erreicht

Damit können die Ergebnisse des Monitoring aggregiert und entsprechend den Bedürfnissen der Steuergremien im SCWR-Steuerungskreislauf dargestellt werden.

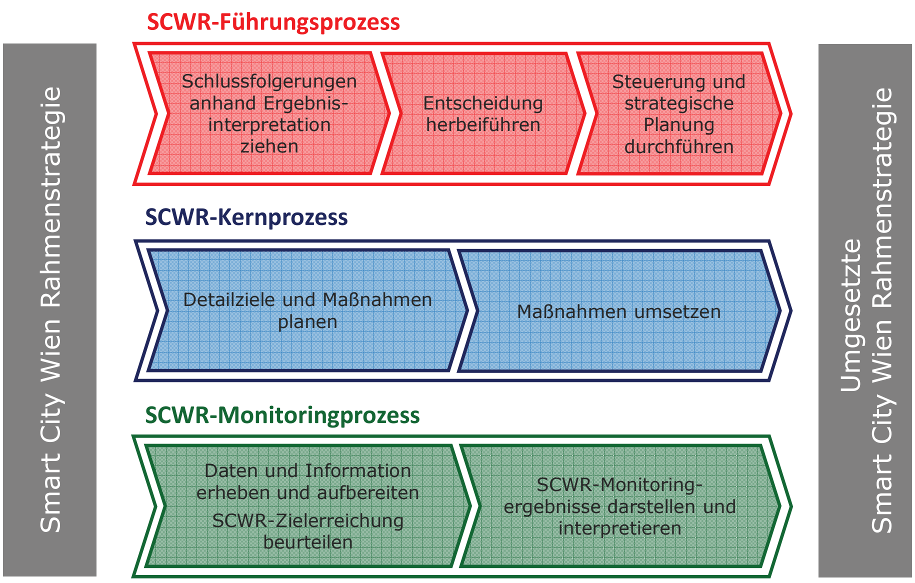

Abbildung 4: Prozessmodell für den SCWR-Steuerungsprozess (Quelle: denkstatt GmbH)

5 PROZESSMODELL FÜR DEN GESAMTEN SCWR-STEUERUNGSPROZESS

Der SCWR-Monotoringprozess lässt sich nun um die Führungs- und Kernprozesse zum SCWR-Steuerungsprozess erweitern. Die folgende Grafik zeigt den gesamten SCWR-Steuerungsprozess:

Die SCWR-Steuerung und die strategische SCWR-Planung sind Teil des Führungsprozesses, die operative Planung und die Umsetzung von Maßnahmen sind Teil des Kernprozesses und das Monitoring ist Teil des Monitoringprozesses.

6 SCHLUSSFOLGERUNGEN

Das vorliegende Prozessmodell für den SCWR-Steuerungsprozess ist eine Empfehlung für die Verwaltung der Stadt Wien, mit welchen Abläufen die Smart-City-Wien-Rahmenstrategie wirkungsvoll und systematisch in die Praxis umgesetzt werden kann; es ist aber auch eine gute Grundlage für andere Städte.

Durch die Einbettung des SCWR-Monitoringprozesses in den Gesamtprozess konnte klar herausgearbeitet werden, welche Anforderungen das Monitoring zu erfüllen hat um Wirkung zu erzielen. Zusätzlich zur sonst üblichen Fokussierung auf Indikatoren und Indikatorensets wurde hier ein Schwerpunkt auf die Beurteilung der Zielerreichung gelegt, die essentiell für die praktische Anwendbarkeit eines Smart City Monitoringsystems ist.

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Öffentliche Verkehrsmanagement-Strategien und private Mobilitätsservices: Lösungsinseln in Konkurrenz oder Synergien durch Kollaboration?

Stefan Kollarits, Ulrike Brocza

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1 VERKEHRSPROBLEME UND HERAUSFORDERUNGEN DER ÖFFENTLICHEN HAND

1.1 Ballungsräume an der Grenze der Belastbarkeit

In Ballungsräumen führen die großen Verkehrsmengen nicht nur zu Verkehrs- und Umweltbelastungen, sondern auch zu Produktivitätsverlusten bei Unternehmen und zu hohen Zeitaufwänden für Pendlerinnen und Pendler. Schon kleine Störungen können sich in einem hoch ausgelasteten und komplexen Verkehrsnetz zu lang andauernden Behinderungen ausdehnen. In der Zukunft wird sich die Situation weiter verschärfen, da Prognosen (vgl. för Österreich: BMVIT 2009) eine weitere Zunahme der Verkehrsmengen in Ballungsräumen vorhersagen und der Zuzug in Stadtregionen weiter anhält. Aus Sicht der Bürgerinnen und Bürger stehen die verkehrsbedingten Belastungen durch Lärm und Schadstoffe sowie staubedingte Zeitverluste im Vordergrund, aus Sicht der Wirtschaft ist es die Sicherstellung der Erreichbarkeit, sowohl der Güterlogistik als auch der eigenen Mitarbeiterinnen und Mitarbeiter

1.2 Unterschiedliche Taktung von System- und Lebenswelt

Die Tatsache, dass „die Lebenswelt und die politische Systemwelt nicht mehr synchron laufen" ist nach Habbel (2013) das zentrale Hemmnis bei der Lösung verkehrspolitischer Probleme.

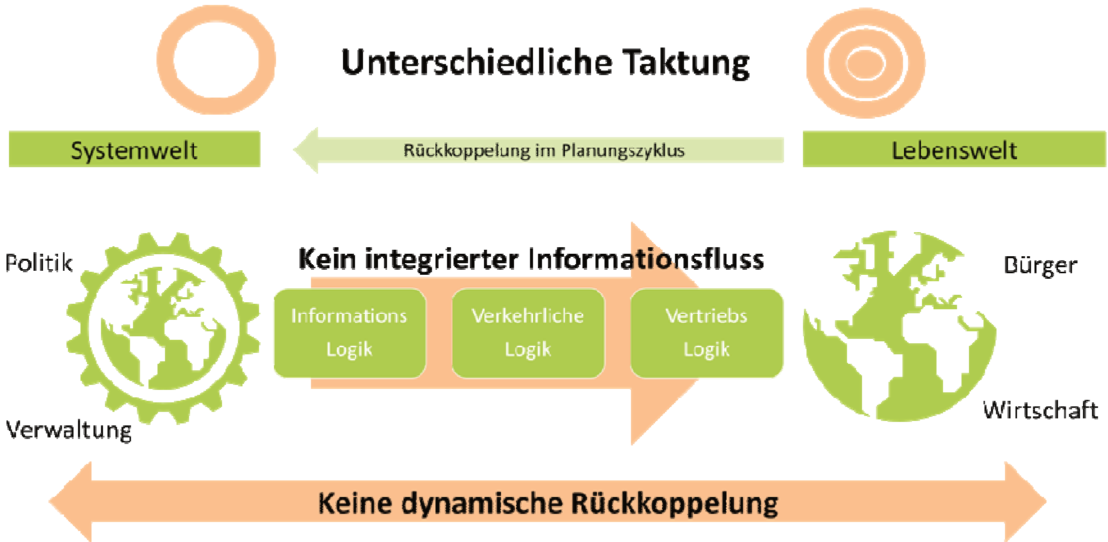

Abbildung 1: System und Lebenswelt im Kontext Verkehr und Mobilität

Die Systemwelt von Politik und Verwaltung ist mit den Aufgaben der Planung und Bereitstellung der Infrastruktur betraut. Die Planungen der Öffentlichen Hand und vieler Mobilitätsdienstleister laufen in Zeiträumen von 10 Jahren und mehr ab (wie Bundesverkehrswegeplanung, Erstellung von Verkehrs-Masterplänen). Auch die Evaluierung, wie weit die Ziele erreicht wurden, erfolgt in ähnlich langen Zeiträumen.

Hingegen ist die Lebenswelt der Bürgerinnen und Bürger deutlich schneller getaktet. So führen neue Informationsservices zu einer weiteren Beschleunigung von Verhaltensänderungen. Der Austausch über Social Media, die Nutzung von Angeboten der „shared economy" und technologiegetriebene Änderungen beeinflussen das Mobilitätsverhaltens unmittelbar.

Eine Rückkoppelung der Systemwelt von Politik und Verwaltung mit der Lebenswelt der Bürgerinnen und Bürger und der Wirtschaft erfolgt vielfach nur im Rahmen der rund 10-jährigen Planungszyklen. Eine kontinuierliche dynamische Rückkopplung jedoch fehlt zumeist.

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Die ungleiche Taktung zwischen Systemwelt und Lebenswelt führt im Bereich der Mobilität dazu, dass die von der Öffentlichen Hand bereit gestellten Informationen an den Mobilitätsbedürfnissen der Nutzerinnen und Nutzer vielfach vorbei gehen. Sie entsprechenden nicht mehr den sich dynamisch ändernden Anforderungen und haben somit kaum Einfluss auf das reale Verhalten. Da dynamische Rückflüsse von Mobilitätsdaten an die Planungsstellen fehlen, sind die vorhandenen Mobilitätsdaten als Planungsgrundlage oft bereits überholt und nur wenig aussagekräftig.

1.3 Strategien der Öffentlichen Hand zeigen nicht genug Wirkung

Politik und Verwaltung sind angehalten, die teilweise widersprüchlichen Problemsichten zu harmonisieren und wirksame Lösungsstrategien zu entwickeln. Die Ansätze im Verkehrsmanagement sind dabei breit gestreut. Sie reichen von der versuchten Beeinflussung durch Beratung (betriebliche Mobilitätsberatung und Mobilitätskonzepte), über gezielte Information (multimodale Verkehrsauskunftssysteme) bis zu verkehrsorganisatorischen Maßnahmen (Teilsperren etc.) und gezielter Verkehrssteuerung.

Die Wirksamkeit dieser Maßnahmen ist jedoch beschränkt, da sie meist isoliert eingesetzt werden. Die typischen Problemsutationen können wie folgt skizziert werden:

1.3.1 Kooperationsdefizite

Verwaltungen handeln primär im eigenen Zuständigkeitsbereich, oft reduziert auf die Abteilungssicht. Die Ursachen von Verkehrsproblemen sind jedoch nicht an Verwaltungsgrenzen gebunden, sondern verlangen nach kooperativen Lösungsansätzen. Verkehrsmanagementstrategien müssen daher über Abteilungs- und Verwaltungsgrenzen hinweg abgestimmt sein, um Wirkung erzielen zu können.

1.3.2 Informations- und Planungsdefizite

Städte und vor allem kleinere Gemeinden sind mit der Herausforderung konfrontiert, dass über das tatsächliche Mobilitätsverhalten der Bürgerinnen und Bürger nur ungenügendes und punktuelles Wissen verfügbar ist. Obwohl kommunale Mobilitätsdaten in der örtlichen und überörtlichen Verkehrs- und Raumplanung von hoher Relevanz sind und wesentliche Planungsgrundlagen bilden, gibt es kaum umfassende Erhebungen auf kommunaler Ebene. Liegen Daten vor, stammen diese meist aus Befragungen und Untersuchungen, die Jahre zurückliegen und daher zum heutigen Zeitpunkt kaum noch Aussagekraft haben. Zudem sind diese oft schlecht dokumentiert, fehlerbehaftet und unvollständig (vgl. BLEES 2004).

1.3.3 Wirkungsdefizite

In den letzten Jahrzehnten kamen zahlreiche neue Anbieter auf den Markt, die – im Vergleich zu verkehrspolitischen Zielsetzungen - konkurrierende oder sogar widersprüchliche Zielsetzungen verfolgen. So bieten Hersteller von Navigationssystemen, die Automobil-Industrie, Betreiber von Buchungs- und Mobilitätsplattformen unterschiedlichste Mobilitätsangebote und Dienstleistungen an, die zu einer massiven Steigerung der verfügbaren Informationen führten. Regionale Verkehrsmanagement-Strategien finden jedoch in den allgemeinen Verkehrs- und Auskunftsinformationen auf Internetportalen und Apps großer Anbieter keine Berücksichtigung.

Mittlerweile verfügen die globalen Anbieter von Informationsdiensten über einen massiven Wissensvorsprung gegenüber Politik und Verwaltung – sowohl in Bezug auf das tatsächliche Verhalten der Bürgerinnen und Bürger als auch in Bezug auf deren (möglichen) Wünsche und Anforderungen. Der Öffentlichen Hand fehlen damit zentrale Ansatzpunkte für eine wirkungsorientierte Planung von Mobilitätsservices.

1.4 Wie sind diese Herausforderungen zu bewältigen?

Die Komplexität der verkehrlichen Situation in Ballungsräumen erfordert ein umfassendes Gesamtkonzept. Statt innovative Einzellösungen mit geringer Wirkung auf das Gesamtsystem verpuffen zu lassen, müssen die Lösungsstrategien zum Verkehrsmanagement in ein durchgängiges Informationsmodell eingebunden werden. Informationsdienste und Mobilitätsservices für alle Verkehrsteilnehmerinnen und Verkehrsteilnehmer ermöglichen es, das Mobilitätsverhaltens im Sinne öffentlicher Verkehrs- und Umweltstrategien zu beeinflussen. Neben intermodaler Informations- und Vertriebslogiken können auch Gamification-Ansätze und Belohnungssysteme zum Einsatz kommen. Dabei ist von zentraler Bedeutung, dass die Abbildung der „Systemwelt" in den bereitgestellten Informationen den konkreten

Mobilitätsanforderungen der „Lebenswelt" entspricht. – Die Verkehrsteilnehmerinnen und Verkehrsteilnehmer (z.B. Autofahrer) müssen in der jeweiligen Situation (z.B. Stau auf Einfallstraße) durch die angebotenen Vorschläge (z.B. Regionalzug nutzen) einen individuellen Nutzen (z.B. Zeitersparnis) erkennen.

Im Folgenden werden die wesentlichen Aspekte beleuchtet, die für die Anwendung von Strategien der Öffentlichen Hand und für die Beeinflussung von Mobilitätsverhalten zur Erreichung verkehrspolitischer Ziele erforderlich sind.

2 LÖSUNGSBAUSTEIN – INFORMATIONSLOGIK UND INTERMODALE VERKEHRLICHE LOGIK

Die regionale Vernetzung der öffentlichen Partner und Aufgabenträger zum Aufbau eines regional abgestimmten dynamischen Verkehrsmanagements bildet die Basis für eine digitale Vernetzung der jeweiligen Teilsysteme. Die Organisation des regionalen Verkehrsmanagements ist somit ein wesentliches Handlungsfeld zur betreiberübergreifenden Definition von Verkehrsmanagement-Strategien. Das Ziel dabei ist aufbauend auf der aktuellen Verkehrslage und Umweltbedingungen Verkehr zu vermeiden, zu verlagern (zeitlich, modal und räumlich) sowie den Verkehrs¬ab¬lauf zu steuern.

Seit den 1990er Jahren befassen sich Forschung und Praxis mit Aspekten des regionalen Verkehrsmanagements in Ballungsräumen.[1] [2] Insbesondere durch die Förderungen des BMBF „Mobilität in Ballungsräumen" (1998-2002) wurden wichtige Grundlagen und Erkenntnisse geschaffen. Zum damaligen Zeitpunkt war die Vernetzung von Systemen der öffentlichen Hand und Service-Providern noch nicht weit fortgeschritten. Ein erster Ansatz zur Integration von öffentlichen/kollektiven Strategien in individuelle Informationssysteme wurde im Projekt MOBINET[3] im Großraum München erforscht. Hier wurden sowohl Verkehrsinformationen und Netzsteuerungen über unterschiedliche Endgeräte sowohl ans Handy als auch in Fahrzeuge übertragen.

Die Technologien waren zum damaligen Zeitpunkt nicht so leistungsfähig, dass im Online-Betrieb eine Vernetzung von Online-Daten und Informationen sowie Bezahlfunktionen von unterschiedlichen Mobilitätsservices möglich war. 14 Jahre später – also in 2016 – setzen sich Schlagworte wie Internet der Dinge (IoT), mit der Verkehrsinfrastruktur vernetzte Fahrzeuge (Car2X) sowie „Mobility as a service" auch in der Praxis durch.

Dies ermöglicht die Bereitstellung situativer, individualisierter Services für Kunden entlang ihrer Mobilitätsbedürfnisse. Neben einer erhöhten Akzeptanz von öffentlichen Strategien erhöht es auch die Nachfrage beim Kunden. Daher sind individualisierte Lösungen bereitzustellen, die die individuelle Strategien der Zielgruppen nicht mit den öffentlichen Strategien in Widerspruch stellen.

Zentrale informationstechnische Grundlage ist ein integriertes Vekehrsnetz, das unterschiedliche Bestandsnetze (wie kommerzielle Netze, ATKIS und regionale Verkehrsmodelle) multimodal integriert und als Ortsreferenzierungsbasis dient. Dadurch können auch Vekehrsmeldungen aus unterschiedlichen Quellen einheitlich referenziert werden und über unterschiedliche Kanäle mit spezifischer Ortsreferenzierung kommuniziert werden. Als ein derartiger Kanal dient in Deutschland der Mobilitätsdatenmarktplatz (MDM), wobei die Verkehrsmeldungen dort als Ortsreferenz jedenfalls eine OpenLR Kodierung erhalten.

Ein zentraler Bestandteil der Informationslogik ist weiters ein POI- und Adressservice, das alle punktbezogenen Informationen wie Adressen, Standorte von Sharing-Angebote, Haltestellen, Parkgaragen / P+R, Ladestationen etc. in einem einheitlichen Datenbestand integriert.

Im Bereich der Verkehrsmanagementstrategien wird den Akteuren der Systemwelt (Politik - Verwaltung - Planung) erstmals eine Schnittstelle für Verkehrsmeldungen und Strategien des dynamischen Verkehrsmanagements geboten, die auch kleinen und mittelgroßen Kommunen eine Informationsweitergabe erlaubt. Mit diesem Ansatz können die Akteure der Systemwelt, die an der Datenplattform (Informationslogik) angeschlossenen sind, ihre Verkehrslage, Umleitungsempfehlungen und intermodalen

[1] Andree, R., Boltze, M., Jentsch, H. (2001): Entwicklung von Strategien für ein dynamisches Verkehrs-management, in: Straßenverkehrstechnik Heft 12/2001. Köln

[2] Hessische Straßen- und Verkehrsverwaltung (2001): ISM – Intermodaler Strategienmanager (Broschüre). Wiesbaden

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Steuerungsstrategien, aber auch alle in deren Zuständigkeitsbereich geplanten Ereignisse wie Baustellen oder Veranstaltungen an beliebige Informations- und Vertriebskanäle liefern können. Damit können die Verkehrsträger auf alle Zielgruppen vor, während und nach der Fahrt einwirken, um sie im Sinne der öffentlichen Ziele zu informieren und zu motivieren.

Die verkehrliche Logik verknüpft diese Datenbestände zu optimierten Reiseketten, welche nutzerspezifische Präferenzen sowie unterschiedliche Verkehrsmittel berücksichtigen, zu berechnen und diese Informationen in vergleichbarer, integrativer und nachvollziehbarer Weise den unterschiedlichen Zielgruppen zur Verfügung zu stellen. Die Zielgruppen werden über regionale und globale Service-Provider angesprochen (z.B. globale und lokale Vertriebssysteme, Fahrzeughersteller, sonstige Service-Provider). In der intermodalen Logik werden die aus der Nutzerschnittstelle übergebenen Parameter sowie externe regionale Datenschnittstellen (z.B. Fahrplanauskunft / Tarifauskunft, Verkehrsmeldungen und Steuerungsstrategien öffentlicher Partner) integriert. Aus den regionalen Daten und Verkehrsmanagementstrategien werden auf den Verkehrsnetzen Streckenwiderstände modelliert, die die Grundlage für das modale und intermodale Routing sind. Bei der Aktivierung einer Strategie (z. B. Umleitungsempfehlung oder P+R-Nutzung) werden die relevanten Netzelemente des strategischen Netzes in der Routenberechnung attraktiver gewichtet.

Im Gegensatz zu traditionellen, monolithischen Ansätzen, werden in diesem Ansatz die Ergebnisse von Informationslogik und intermodaler Logik als Service zur Verfügung gestellt. Über eine Web-Service-Schnittstelle entsteht so ein offenes Mobility-API, das in einer Vielzahl von regionalen und globalen Diensten genutzt werden kann. An die Mobility-API können unterschiedliche Serviceanbieter angebunden werden. Besonders hervorzuheben ist die Anbindung der Mobility-API an den Mobilitätsdatenmarktplatz MDM[4] der Bundesanstalt für Straßenwesen (BaSt). Dadurch wird es möglich, dass beispielsweise Verkehrsmeldungen und Strategien der öffentlichen Hand an den MDM weitergeleitet werden.

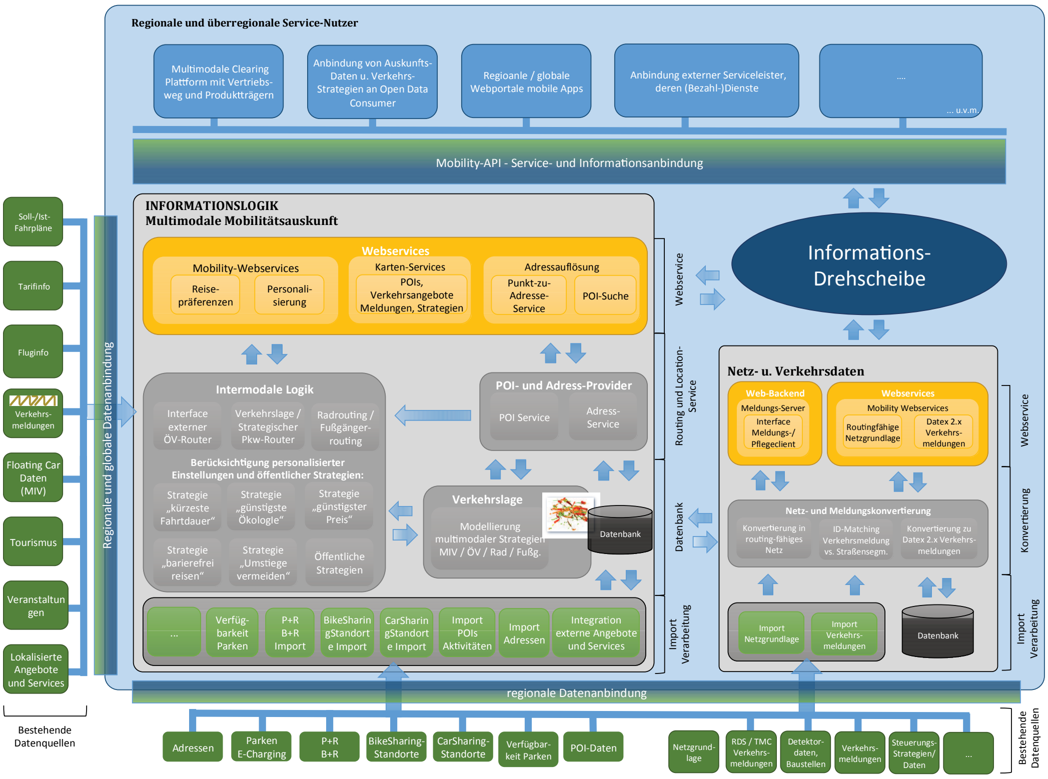

Abbildung 2: Informationsdrehscheibe unter Einbeziehung regionaler Daten und Steue-rungsstragien sowie individueller Nutzerpäferenzen.

3 LÖSUNGSBAUSTEIN – ÖFFENTLICHE VERKEHRSMANAGEMENTSTRATEGIEN NUTZEN

Um Verkehrsmanagementstrategien der Öffentlichen Hand erfolgreich in privatwirtschaftliche Mobilitätsservices einzubinden, sind Kooperationen zwischen den beteiligten Akteuren erforderlich. Nur

[4] http://www.mdm-portal.de/

durch die Vereinbarung von standardisierten Schnittstellen, Formaten und Prozessen funktioniert der Datenaustausch zwischen den zuständigen Verkehrsbehörden, den Kontrollzentren der Straßenverwaltungen und den privaten Anbietern von Informationsservices.

Dieses Ziel verfolgt auch die Plattform TM 2.0 ERTICO. Gegründet im Juni 2014 während des ITS-Kongresses in Helsinki umfasst sie aktuell mehr als 25 Mitglieder aus allen ITS-Sektoren. Die Interessensvertreter entlang der gesamten Wertschöpfungskette zwischen Verkehrsmanagement und den online verbundenen Verkehrsteilnehmern (und retour) erarbeiten Win-Win-Szenarien und Kooperationskonzepte zur Bereitstellung von umfassenden Informationsservices. Zentral dabei ist ein Ausgleich zwischen den unterschiedlichen Prioritäten, Rollen und Verantwortlichkeiten der Akteure. Die entwickelten Geschäftsmodelle bauen auf Kooperation und haben zum Ziel, die Wirksamkeit und den Erfolg der Informationsdienstleistungen zu erhöhen.

Um den Datenaustausch zwischen Verkehrsmanagement und Anbietern von Informationssystem en in Fahrzeugen zu fördern, wurden folgende Empfehlungen formuliert:

Verkehrsmessdaten sollen frei zugänglich sein. Allgemein anerkannten Methoden in der Da-tenbearbeitung sollen eine hohe Qualität der Daten gewährleisten. Sowohl Verkehrsmessdaten also auch Schnittstellen zum Datenaustausch zwischen Navigationssystemen erfordern einheitliche Standards, insbesondere bei intermodalen Verkehrsinformationen. Besonderes Augenmerks ist auf die Wahrung der Persönlichkeitsrechte der Nutzer zu legen.

Die bestehende Infrastruktur von Verkehrsmanagement-Zentralen ist zu aufzurüsten, um die Interoperabilität zwischen Fahrzeugen unterschiedlicher Hersteller und Verkehrsservice-Anbieter zu gewährleisten. Der Nutzen dieser Investitionskosten ist gegenüber den Entscheidungsträgern nicht nur mit monetärem Rückfluss zu argumentieren, sondern umfasst Chancen zur Bewusstseinsbildung und Beeinflussung des Verhaltens der Verkehrsteilnehmer.

4 LÖSUNGSBAUSTEIN – MOBILITÄTSEMPFEHLUNGEN UND INCENTIVIERUNG

Die Kapazität des Straßennetzes ist beschränkt – nicht nur in den Städten, auch auf vielen Autobahnen und Landstraßen geht zu bestimmten Tageszeiten nichts mehr. Aus wirtschaftlichen wie auch aus ökologischen Gründen erscheint daher eine Reduktion des motorisierten Individualverkehrs geboten. Andererseits ist Autofahren, trotz länger werdender Staus, im Vergleich zum ÖPNV immer noch sehr bequem, sodass selbst in Städten und Regionen mit gut ausgebautem öffentlichem Verkehrsangebot nach wie vor nur eine Minderheit das eigene Auto in der Garage lässt.

Vielversprechend erscheinen als Lösungsansatz zur Verhaltensänderung eine Ergänzung der klassischen Ansätze (restriktive Maßnahmen und verkehrssteuernden Maßnahmen) durch „weiche“ Maßnahmen. Dabei soll insbesondere die Belohnung gewünschten Verhaltens im Vordergrund stehen. Vielversprechend erscheint dabei der „Zeitmeilen“-Ansatz, der aus folgenden zentralen Elementen:

- Autofahrten in Abhängigkeit vom aktuellen Verkehrsaufkommen zeitlich entzerren und so Staus vermeiden sowie die Gesamtkapazität des Straßennetzes optimieren.
- Am Smartphone intermodale Fahrtstrecken aus Bahn, Bus, Car- oder Bikesharing zu-sammenstellen und – ohne weitere Recherchen zu den Tarifen der beteiligten Anbieter – sofort ein gültiges Ticket für die gesamte Wegekette kaufen.
- Zeit sparen, Staus umfahren: Verkehrsoptimierung mit Incentivierung
- Die Zeitmeilen-App zeigt Empfehlungen an, verwaltet die Bonuspunkte und schafft den Nachweis, dass eine Empfehlung zu einer Verhaltensänderung geführt hat

Die Autofahrer sollen zu einem flexibleren Mobilitätsverhalten angeregt werden, das ihnen persönlich Zeit spart und das zugleich die Auslastung des Straßennetzes optimiert. Über die Zeitmeilen App erhält der Nutzer Voraussagen für eine individuelle, staufreie Fahrt auf Basis seiner persönlichen Präferenzen. Die individuellen Routenempfehlungen werden auf Basis aktueller öffentlicher Verkehrsdaten sowie der Bewegungsdaten der anderen Zeitmeilen-Teilnehmer im selben Verkehrsgebiet generiert. Dabei werden auch geplante Baumaßnahmen und Umleitungen berücksichtigt, sodass sehr präzise Vorhersagen nicht nur für den aktuellen Zeitpunkt, sondern auch für Folgetage getroffen werden können.

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Hinzu kommt der ökologische Effekt: Schadstoffe wie CO2 und Stickoxide werden durch ver-miedene Staus reduziert. Wer sich an die Routenempfehlungen hält, kommt nicht nur schneller ans Ziel, sondern erhält zusätzlich – sozusagen als Belohnung für die Flexibilität im Mobilitätsverhalten – Bonuspunkte, die in ideelle, virtuelle oder geldwerte Prämien eingetauscht werden können. Dieses integrierte Incentive-Programm ermöglicht vielfältige Geschäftsmodelle zur Unterstützung der Akzeptanz seitens der Nutzer. Denn je mehr Autofahrer das Systemnutzen, umso präzisere Vorhersagen kann das System machen. Zugleich kann ein solches Programm zur Stärkung der regionalen Wirtschaft beitragen.

Ein wesentlicher Unterschied zu anderen Mobilitäts-Applikationen: Es werden keine persönlichen Benutzerprofile erstellt – der Fokus liegt nicht auf dem Verhalten einzelner Nutzer, es werden lediglich momentane Bewegungsmuster des gesamten „Benutzerschwarms" registriert. Diese Bewegungsdaten werden um aktuelle und historische Verkehrsdaten ergänzt, sodass valide Vorhersagen auch über längere Zeiträume möglich sind. Alle Prozesse laufen anonymisiert und verschlüsselt über deutsche Server und Netze.

Für Verkehrs- und Transportbehörden ist dies ein flexibles Instrument zur Inwertsetzung eigener Daten, zur Verkehrsbeeinflussung und -optimierung sowie zur Einhaltung der gesetzlichen Schadstoff-Grenzwerte. So ermöglicht das vom System gelieferte Nutzer-Feedback, verkehrssteuernde Maßnahmen flexibel und dynamisch umzusetzen.

5 FAZIT: EFFIZIENTE VERNETZUNG SENKT EINTRITTSBARRIEREN ZUM ÖPNV

Eingefleischte Autofahrer auf der einen Seite und überzeugte ÖPNV-Nutzer auf der anderen – der Trend zur Multimodalität wird diese Trennung immer mehr verwischen. Im Interesse einer lebenswerten Umwelt soll und muss eine Verlagerung vom Individualverkehr hin zum Umweltverbund – ÖPNV, Fahrrad, Fußgänger – erfolgen. Die Voraussetzung dafür, dass immer mehr Autofahrer gewillt sind umzusteigen, kann nur durch eine effektive Vernetzung und einfache Nutzbarkeit alternativer Mobilitätsangebote geschehen. Der Nutzer einer solchen universellen Mobilitäts-App erhält dann nicht nur Empfehlungen, einen überfüllten Autobahnabschnitt zu meiden, sondern zugleich einen alternativen Routenvorschlag mit Umstiegsmöglichkeit auf Bus oder Bahn. Gibt es einen unvorhergesehenen Stau, kann er auf einen Park & Ride- Platz umgeleitet werden und seine Fahrt mit dem ÖPNV fortsetzen. So oder so kommt er schnell und staufrei zum Ziel – und wenn jeder Weg für ihn gleich komfortabel ist, kann er sich jeden Morgen auf einen neuen Routenvorschlag freuen.

6 DIE LÖSUNGSBAUSTEINE IN KOMBINATION

Die integrierte Nutzung der oben skizzierten Lösungsbausteine bietet deutliche Vorteile gegenüber den derzeit üblichen Lösungsansätzen.. Es können damit die wesentlichen Teilprozesse der Verwaltungssicht, der Mobilitätsdienstleistersicht und der Verkehrsteilnehmer in einem dynamischen Rückkoppelungsprozess verknüpft werden und es kann die informationstechnische Durchgängigkeit sichergestellt werden.

Die wichtigsten Vorteile können so den Begriffen Smart Planning, Smart Data, Smart Mobility und Smart Community zugewiesen werden.

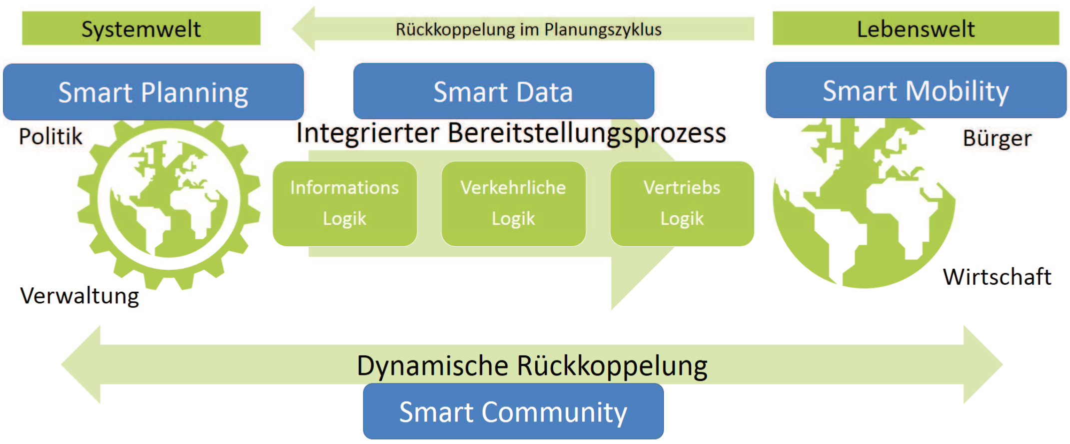

Abbildung 3: Dimensionen der Wirkung der integrieten Lösungsbausteine

Ein integrierter Prozess der Informationsbereitstellung, von der Planung der Verkehrsinfrastruktur bis zur eigentlichen Verkehrsteilnahme, bietet als wesentliche Innovationen:

- die systematische Erfassung und Nutzung von Verkehrsmanagementstrategien der öffentlichen Hand,
- die Rückkoppelung von Maßnahmen mit ihrer verkehrlichen Wirkungen sowie
- eine integrierte Informationsbasis für die Vertriebslogik.

Das systematisches Feedback zwischen Lebenswelt und Systemwelt erfolgt bi-lateral,

- einerseits in Form der Incentivierung von „gewünschtem" Mobilitätsverhalten,
- andererseits aber als (potenziell) kontinuierliches Feedback vom Bürger an Verwaltung und Politik ermöglicht werden, sowohl hinsichtlich tatsächlichen Verhaltens als auch hinsichtlich Wünschen und Anforderungen der Bürgerinnen und Bürger.

Die zentrale Neuheit des Ansatzes ist damit die intelligente Verknüpfung von Technologien, die in Teilbereichen bereits eingesetzt werden – Smartphone, Big data, Incentivierung - zu einem kooperativen Gesamtsystem. Dies unterstützt erstmals die direkte Interaktion von Bürgerinnen und Bürgern, Verwaltung und Wirtschaft und bietet als Plattform allen Beteiligten Zusatznutzen.

Diese Verknüpfung erfolgt dabei durch intelligente Schnittstellen (Feedback-Zyklen) sowie ergänzenden Komponenten, die einen durchgängigen Werkzeugkasten für Intelligente VerkehrsSystem(IVS) Anwendungen bieten.

7 VON DER FORSCHUNG ZUR PRAXIS

Die skizzierten Lösungsbausteine stellen in Kombination zukunftsweisende Mobilitätslösungen dar, die in Teilen und vor allem in der kombinierten Wirkung, über den state-of-the-art hinausgehen. Die rasante technologische und gesellschaftliche Entwicklung wirft jedoch immer wieder neue offene Fragen und Forschungsthemen auf. Damit stellt sich die Frage, wie neue innovative Ansätze in Zukunft rasch(er) genutzt und integriert werden können.

Damit innovativen Mobilitätslösungen der Sprung auf den Markt gelingt, ist es unbedingt erforderlich, die Sicht der Nutzerinnen und Nutzer in den verschiedenen Entwicklungsphasen zu berücksichtigen. Denn auch das mit größtem Aufwand konzipierte Produkt, die innovativste Dienstleistung werden Ladenhüter, wenn die Bedürfnisse der Zielgruppe nicht erfüllt werden, sich das Handling im Alltag als nicht praktikabel erweist oder das Erscheinungsbild unattraktiv ist.

Urbane Mobilitätslabore als „Living Labs" sollen diese Lücke zwischen Entwicklung und erfolgreicher Umsetzung überwinden. Im Jahr 2014 hat die österreichische Forschungsförderungsgesellschaft Sondierungen zu Urbanen Mobilitätslaboren ausgeschrieben, um einen Wissenspool zur Machbarkeit aufzubauen. Von den insgesamt acht geförderten Sondierungsprojekten waren zwei im Großraum Graz angesiedelt. Ein Jahr lang erprobten beide Forschungsprojekte in der Stadt Graz und seinen Umlandgemeinden unterschiedliche Methoden zur Einbindung der Nutzerinnen und Nutzer: Veranstaltungen mit Aktionsforschung, Mobilitätsexkursionen und Innovationsgruppen ermöglichten es den Teilnehmerinnen und Teilnehmer, sich mit ihren persönlichen Wahrnehmungen und Wünschen für die Zukunft einzubringen. Im Zuge dieser Aktivitäten gelang es, wichtige Partner, wie das Land Steiermark, die Stadt Graz, Umlandgemeinden, Bürgerinnen und Bürger und Unternehmern aus dem Mobilitätsumfeld für die Idee eines Urbanen Mobilitätslabors im Großraum Graz zu begeistern.

Die positive Resonanz ermutigte die beiden Konsortien, bei der nächsten Ausschreibung die Umsetzung eines Urbanen Mobilitätslabors gemeinsam einzureichen.

Das konzipierte Mobilitätslabor „Graz grenzenlos" verfolgt die Vision, Innovationen zu unterstützen und damit die vielfältigen Herausforderungen im Zusammenhang mit Mobilität in Agglomerationen zu bewältigen. Die Forschungsaktivitäten orientieren sich am Ziel, die täglichen Verkehrsströme des motorisierten Individualverkehrs zu verringern und den Modal Split zugunsten des Umweltverbundes zu verändern. Besonderes Augenmerk wird dabei auf den Stadtgrenzen-überschreitenden Verkehr gelegt.

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Das Mobilitätslabor versteht sich als unabhängige Innovationsplattform, die Rahmenbedingungen schafft, um Forschungsergebnisse, neue Lösungen und Entwicklungen schneller am Markt zu etablieren und in der Gesellschaft zu integrieren. Der Innovationsbegriff umfasst technische ebenso wie soziale Innovationen im Bereich Mobilität. Dabei nehmen die Zusammenhänge zwischen objektiver Information, subjektiver Wahrnehmung und individuellem Mobilitätsverhalten eine zentrale Rolle ein.

Unterschiedliche Akteure des Mobilitätsumfelds werden eingeladen und dabei unterstützt, neue Produkte, Dienstleistungen und Konzepte zu entwickeln, zu testen und die Einführung in die reale Umgebung voranzutreiben. Dabei sind die Nutzerinnen und Nutzer bzw. Bürgerinnen und Bürger immer involviert – als kreative Ideengeberinnen und Ideengeber, als Beteiligte an der (Weiter-)Entwicklung oder als kritische Testerinnen und Tester von Prototypen. Die starke Orientierung auf die praktische Anwendung fördert eine hohe Qualität der Ergebnisse und deren erfolgreiche Umsetzung.

Sowohl für die öffentliche Hand als auch für die Privatwirtschaft stellt das Urbane Mobilitätslabor eine große Chance dar, die ungleiche Taktung zwischen Systemwelt und Lebenswelt zu überwinden. Lösungsansätze, um das individuelle Mobilitätsverhalten zu beeinflussen und für Umwelt und Gesellschaft verträglicher zu machen, können mit unterschiedlichen Zielgruppen getestet werden. Welche Mobilitätsempfehlungen bringen einen erkennbaren Mehrwert für die Verkehrsteilnehmerinnen und Verkehrsteilnehmer? In welchen Situationen ist die Bereitschaft, festgefahrene Mobilitätsmuster zu ändern am größten? Welche Anwendungsfälle zeigen die größten Auswirkung auf das Verkehrssystem und somit das höchste Potenzial zur Anwendung von öffentlichen Strategien? – Mit seinem umfassenden Methodenpool bietet „Graz grenzenlos“ beste Voraussetzungen, um Antworten auf diese zentralen Fragen zu finden und die Akzeptanz der Anwenderinnen und Anwender in ihrer jeweiligen Lebenswelt sicherzustellen.

8 IVS-REFERENZARCHITEKTUREN – EINE CHANCE ZU KOOPERATION ALLER AKTEURE ALS AUSBLICK

Mit der Umsetzungspflicht der IST-Direktive der EU[5] in nationales Recht ist auch Deutschland aufgefordert, geeignete Maßnahmen zu ergreifen, um die in der Direktive formulierten Ziele zu erreichen. Im Wesentlichen sind dies:

- Die diskriminierungsfreie Bereitstellung aller Mobilitätdaten (Referenz-, Echtzeit-, Tarif- und Metadaten) der öffentlichen Hand an privat- oder gemeinwirtschaftliche Dienstbetreiber und Dienstanbieter von Informations- und Vertriebswegen (WEB, APP, Online und Offline Reisebüros, Autonavigation, usw.) über eindeutige Übergabepunkte (single point of access).
- Die Sicherung der Wertschöpfungskette für alle Akteure durch eine intelligente Vernetzung aller Systeme und Prozesse der Akteure.

Insbesondere das letzte Ziel stellt für ein föderal geordnetes und autorisiertes Gebiet wie Deutschland eine besondere Herausforderung dar, welche nur erfolgreich bewerkstelligt werden kann, wenn für

- Koordination und Synchronisation der ITS-Aktivitäten ein klar verständliches und von den Akteuren anerkanntes Regelwerk zur Verfügung steht und wenn
- autorisierte „Kümmerer“ für die Umsetzung des Regelwerks vorhanden sind.

In Deutschland ist das Bundesministerium für Verkehr und digitale Infrastruktur (BMVI) mit der Umsetzung der ITS Direktive betraut und setzt seit 2013 auf Basis einer Gesetzgebung[6] unter dem Begriff „Intelligente Verkehrssysteme“ (IVS) mit dem IVS-Aktionsplan „Straße“ bis 2020 IVS-Maßnahmen um. Der IVS-Aktionsplan definiert dabei

„ ... die mit allen Beteiligten abgestimmte Vorgehensweise bei der koordinierten Weiterentwicklung bestehender und der beschleunigten Einführung neuer IVS zur Erhöhung der Verkehrssicherheit, Verbesserung der Verkehrseffizienz und Verringerung der negativen Auswirkungen des Verkehrs auf die Umwelt.“ (BMVI)

[5] Richtlinie 2010/40/EU zum Rahmen für die Einführung Intelligenter Verkehrssysteme im Straßenverkehr und für deren Schnittstellen zu anderen Verkehrsträgern (IVS-Richtlinie).

[6] Das Intelligente-Verkehrssysteme-Gesetz (IVSG) wurde am 20. Juni 2013 im Bundesgesetzblatt Jahrgang 2013 Teil I Nr. 29, Seite 1553, veröffentlicht und ist am 21. Juni 2013 in Kraft getreten.

In erster Linie also Wertschöpfungen, die den Nutzen für Reisende und Öffentliche Hand betreffen; indirekt aber auch Chancen für die Privatwirtschaft, mit geeigneten IVS-Lösungen an dieser Wertschöpfung teilzuhaben.

Damit rückt mit dem Aktionsplan „Straße“ insbesondere die Vernetzung von öffentlicher Hand und Privaten in den Vordergrund der Koordinations- und Synchronisationsaufgabe des „Kümmerers“.

Das BMVI als erstrangiger „Kümmerer“ in Deutschland hat daher im Aktionsplan „Straße“ strukturierte Entwicklungsstufen (Regelwerk) definiert, die den Übergang von Zielen und Aufgaben (Visions and Missions) der ITS-Direktive in übergeordnete und vertiefende Empfehlungen und Vorgaben zur Umsetzung von realen IVS-Projekten in einem föderalen Raum Deutschland unterstützt. Hierzu zählen die:

- IVS-Rahmenarchitektur,

welche zum einen verlangt, dass die Entwicklung und Vernetzung der Akteure und ihrer bestehenden und zukünftigen Systeme in den Kontext einer ganzheitlichen Betrachtung von „Rollen & Geschäftsmodellen“, „Regeln & Rahmenbedingungen“ sowie „Informations- & Kommunikationstechnologien“ (Betrachtungsebenen) gestellt werden,

zum anderen Domänen (Themenbereiche wie z.B. „Multimodale Reiseinformation“, „El. Fahrgeldmanagement“ usw.) definiert, zu denen im Rahmen einer

- IVS-Referenzarchitektur,

entlang der drei Betrachtungsebenen pro Domäne dezidierte Empfehlungen zur Um-setzung von realen IVS-Projekten bei zuständigen Akteuren formuliert werden.

Mit der Verabschiedung der IVS-Rahmenarchitektur ÖV (für den Öffentlichen Verkehr) in 2014 und der Erweiterung dieser Rahmenarchitektur auf den IV (Individualverkehr) seit 2015 beginnt auch die Umsetzung der ersten IVS-Referenzarchitekturen. Hierzu zählen:

- Multimodale Reiseinformation
- Verkehrsinformation Individualverkehr (inkl. C2X)
- Zuständigkeitsübergreifendes Verkehrsmanagement
- (ab 2017) Fahrgastinformation im ÖV, Qualitätsmanagement, weitere

Mit den Empfehlungen der IVS-Referenzarchitekturen wird der Bund seine Finanzierungs- und Förderpolitik in Hinblick auf eine wirksame Vernetzung der gemein- und pri-vatwirtschaftlichen Akteure im föderalen Deutschland neu ausrichten und damit die Kollaboration der öffentlichen Hand und der Privaten maßgebend beeinflussen.

Anhand aktueller IVS-relevanter Projekts kann gezeigt werden, wie gut die Akteure der Öffentlichen Hand in Deutschland (z. B. moveBW in Baden-Württemberg) im Vergleich zum Ausland (z. B. VAO in Österreich und mLive im Großherzogtum Luxemburg) auf die kommenden Empfehlungen von IVS-Referenzarchitekturen auf die Aufgabe vorbereitet sind, die neutrale Rolle des Inhalteanbieters für ein Territorium wahrzunehmen und wie bewusst sie mit privatwirtschaftlichen Mobilitätsdienstleistern in der Informations- und Vertriebslogistik kooperieren, um ihre öffentlichen Strategien über alle Kanäle zu den Reisenden zu bringen.

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Positioning Urban Labs – a New Form of Smart Governance?

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1 ABSTRACT

In the current era, in which cities are considered key arenas for coping with a number of societal challenges, there is also renewed interest in the mobilisation of experimental practices within urban planning. A growing interest in innovative intiatives emphasising co-creation, exploration, experimentation, and evaluation, such as urban living labs must also be understood in relation to the uncertatinity regarding the modern growth paradigm and its institutional arrangements: "the pragmatist heritage of urban laboratories gains renewed strength in the current era in which the belief in modernity, progress and development is in crisis" (Karvonen & van Heur, 2014, p. 387). This paper provides a sympathetic critique of the notion of urban living labs and related expeimental practices from an urban planning and governance persepective. In this light, we argue that the core principels of urban living labs (i.e. co-creation, exploration, experimentation, and evaluation) offer a useful theortical frame to understand and position different informal self-organizing initiatives in contemporary urban development. Furthermore, we assert that, considered as a planning practice (or methodology), urban living labs can be construed as a temporary mode of soft governance which include a number of merits in terms of definig new innovative pathways for urban planning beyond business as usual thinking. However, caution must be taken due to the urban living lab's inherent shortcomings in terms of demorcractic legitimacy, tendencies towards exclusiveness, and extreme temporality. In conclusion, we argue that urban living labs can be an environment for exploring new forms of smart urban governance through critical engagments with communicative planning theory and an explict focus on actor-relations.

Keywords: co-creation, communicative planning , experimentation, urban governance, urban living lab

2 INTRODUCTION

Urban living labs are offering both a methodology and an environment for social as well as technical innovations (Veeckman et al., 2013). Through public-private-people partnerships the intention is to overcome institutional lock-ins and to utilise multi-disciplinary collaboration. The idea is to mobilise individual stakeholders as experts of their experiences and enable them to advance from participants to co-creators of knowledge. In doing so, unexpected outcomes are anticipated and can even be embraced through an emphasis on process, whereby these urban laboratories are expected to provide strategies of experimentation within prescribed boundaries. In pursuing this logic, urban laboratories are anticipated to inform the manner in which actors approach the specifics of the case, increasing the likelihood that the outcome, expected or otherwise, reflects the content and approaches deployed during the activity.

Research on (urban) living labs has (so far) mainly focused on the tools, methods, processes and assessments of the generated technical and social innovations (cf. Veeckmann et al, 2013; Juujärvi & Pesso, 2013; Bergvall-Kåreborn & Ståhlbröst, 2009) instead of criticaly investigating the quality of governance of (urban) living labs and how they inform, or are engaged with, policies and politics (but see Evans & Karvonen, 2014). We are, instead, especially concerned with the how urban living labs can be understood as informal 'soft mode of temporary governance' (Boonstra & Boelens, 2011) and how to position them in the framework of various activities that try to complement formal planning practices, which themselves are often labelled as new forms of urban governance. Therefore, we want to offer a framework in which we can analyse the emergence of urban living labs as informal and temporary soft spaces of urban governance, which enables us to discuss and relate them to formal urban planning practices. In doing so, we distill a few core principels of urban living labs (i.e. co-creation, exploration, experimentation, and evaluation) and discuss their usefulness as a theortical frame for understanding these informal self-organizing initiatives in the light of contemporary urban planning theories and practices. We also consider how this could be further developed through critcial engagments with communicative planning theory and an explict focus on actor-relations.

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3 URBAN LIVING LAB DYNAMICS AND PRINCIPLES

"A forum for innovation, applied to the development of new products, systems, services, and processes in an urban area; employing working methods to integrate people into the entire development process as users and co-creators to explore, examine, experiment, test and evaluate new ideas, scenarios, processes, systems, concepts and creative solutions in complex and everyday contexts." (JPI Urban Europe, 2015, p. 59, orginial emphasis)

In contrast to other living labs, urban living labs do not only add "the urban component to the conceptual design, but also a range of topics including societal, political, and technological questions" (Franz et al., 2015, p. 48). This is clearly evident in the above defintion of urban living labs provided by the Joint Programme Inntiatives (JPI) Urban Europe within their The Strategic Research and Innovation Agenda. As Franz (2014, p. 105) notes, "evidence shows that European research strategies are more recently fostering the inclusion of new paths of social innovation". Thus, the aim of urban living labs in this context is not centrally focused on technological innovation, but rather on fostering social innovations through the involvement of various stakeholders for a carefully defined project in an urban area.

In fact, the JPI Urban Europe has had an important influence on this social turn, and they emphasise that urban living labs are particularly important instruments for dealing with the multi-dimensional challenges in urban areas that "will be strategically used for testing and validating research results, involving relevant urban stakeholders; to prepare for full scale implementation of new solutions" (JPI Urban Europe, 2015, p. 53). However, this is not to say that urban living lab research activities focus solely on civic engagement and social innovation (Bergvall-Kåreborn & Ståhlbrost, 2009). Rather, the European Commission sees urban living labs as a valuable tool for sustaining engagement with end-users and innovations within the ICT sector (European Commission, 2008).

While an emphasis on openness and inclusiveness is desired, it can be challenging to engage actors that reflect the given societal spectrum (Bergvall-Kåreborn and Ståhlbrost, 2009; Franz, 2014). Going further in regards to the dovetailing foci on social and technological issues, Franz (2014) suggests that a paradigm shift from technological to social science-guided terminology might be needed to shift the perception of future living lab participants to 'citizens' rather than 'users'.

According to Juujärvi and Pesso (2013), today at least three types of urban living labs can be identified. With the first type, urban areas can serve as 'technology-assisted research environments', where users provide feedback on services or products through digital platforms or sensor-based methods. These urban living labs may aim to improve an urban environment or service, such as public transportation, waste management or housing. The co-creation of local spaces, services and/or objects, including underused or abandoned buildings, daycare services or public spaces, is a second type of lab. An urban living lab can also result in new or enhanced forms of urban planning that use new tools or processes. Here, facilitating local vision-making and planning procedures and/or greater opportunities for stakeholders to meet and learn from one another are the central objectives. In doing so, the lab can serve as a platform for stakeholders to take part in planning initiatives and decision-making processes. However, urban living labs should not be conflated with traditional planning projects, since they do not necessarily result in a plan or development project.

3.1 Co-creation

Socially-oriented living labs evolved from the notion of co-developing cities, with a view that defined spaces of the city can be sites for open experimentation. Given the emphasis on socio-spatial co-development, approaches for these labs tend include terms like 'co-creation', 'empowerment' and 'participation', and offer an inclusive, participatory and do-it-yourself setting that engages citizens and local actors in the processes of shaping the city (Franz, 2014). In an era of declining civic involvement, societal fragmentation and demands for greater institutional flexibility, urban living labs seem to be a tool to foster social, political and economic innovation, development, and cooperation in cities. Offering a new forum for interaction with a diversity of actors, or in a sense, a new mode or form of (urban) governance, urban living labs can be used to establish a defined space for experimentation where users can become "co-creators of values, ideas and innovative concepts" (Hakkarainen & Hyysalo, 2013, p. 21).

Situated in a social environment, urban living labs can be used to identify relevant urban issues and to engage a diverse group of people, often aiming for a wider cross-section of society than is typically involved in processes of urban change. Using contextually and socially appropriate methods, urban living labs can also be used to translate research into applied uses in civic society and to enhance data collection within a defined, often local, scale (Franz, 2014). However, one needs to add critically that urban living labs offer a structure for enlarging the scope of associative as well as participative democracy, in parallel with other urban planning activities in a city that are related to formalised participative procedures of representative democracy. In other words, urban living labs are comprised of a specific club; the rules of inclusion and exclusion have to be critically questioned.

3.2 Exploration and Experimentation

Emphasising the exploratory nature of the approach can familiarise urban living lab actors with the notion that an urban development process can be undertaken without a predefined aim. This plays a number of key roles in encouraging participation, engagement, and co-creation. First, it reduces the likelihood that any single actor is able to claim jurisdiction or achieve an overt dominance over the content of an urban living lab during the process, as it is difficult to achieve this position without having a clearly defined aim or outcome. The experimental nature of urban living labs also encourages open discussions, fostering the idea that 'there are no stupid questions, only stupid answers'. This may enable actors who may otherwise not feel confident enough to express their views or challenge those of a traditionally dominant actor. Furthermore, the overtly exploratory nature of urban living labs helps to familiarise actors with uncertainty, while the notion of using urban living labs to test ideas can encourage more creative or provocative initiatives without the fear of long-term negative consequences should an idea fail to deploy as expected. As Karvonen and van Heur (2014, p. 387) note, "One of the key strategies of uncertainty reduction is the labelling of particular sites as urban laboratories." Pursuing this approach, ideas can be proposed, tested and evaluated without significant long-term commitment. Should an idea prove successful, however, it can subsequently be applied more broadly or scaled up (cf. JPI Urban Europe, 2015).

However, it is also important to note that there is considerable variation among urban living labs in the way in which the concepts of 'laboratory' and 'experiment' are employed. In some cases, urban living labs may use these notions as a way to further establish and reinforce dominant patterns of urban development. Other urban living labs might adopt more progressive and open approaches, where cooperative and communicative initiatives are undertaken to foster change, with a recognition of the transformative potentials (and inherent complexity) of contemporary urban issues (Karvonen & van Heur, 2014). Be this as it may, one needs to carefully question the way in which the notion of a laboratory can be applied, since it might imply a regulated and controlled 'environment for experimentation' instead of claiming 'openness' and 'dealing with complexity'. The discrepancy between labs can be problematic, as it risks creating a situation where the urban living lab concept becomes so broad and ubiquitous that it loses meaning.

3.3 Evaluation

The diversity of settings, scales and approaches to urban living labs can furthermore make evaluations, challenging. The flexibility to select methods and tools tailored to the aims and approaches of a particular urban living lab can increase the contextual place-based relevance of the urban living lab concept, but might limit the capacity to compare, contrast, and consolidate findings from a diversity of urban living labs. These issues could limit the potential of urban living lab development. Furthermore, with the emphasis on processes, co-creation, experimentation, and exploration, the impacts (and evaluations) of urban living labs are not straight-forward issues and are not similar to more result-oriented initativies. More specifically, impacts are seen within incremental change throughout the project rather than in a single end-product or outcome. While the issues outlined above are problematic, they do not have to be insurmountable. In seeking to distil the breadth of urban living lab approaches into a measurable and comparable concept, Karvonen and van Heur (2014, p. 381) focus on the experimental nature of the labs: "We argue that the emphasis on experimentation leads to three achievements of urban laboratories: situatedness, change-orientation and contingency." They continue by arguing that these three urban living lab aspects can serve as 'normative benchmarks' through which initiatives and practices that claim the urban living lab banner can be evaluated and critiqued. This evaluative approach shows promise; however, more research is necessary to refine and strengthen urban living lab evaluation and comparison.

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4 COMMUNICATIVE PLANNING AND ACTOR-RELATIONS

The core principles of urban living labs, outlined above as co-creation, exploration, experimentation, and evaluation, offer a useful theortical frame for understanding informal self-organizing initiatives in contemporary urban development. Urban living labs as a planning practice, or methodology, include a number of merits in terms of defining innovative pathways for urban planning beyond business as usual. However, caution must be taken because of the inherent shortcomings of urban living labs construed as soft modes of governance. These shortcomings can be understood in terms of demorcractic legitimacy, tendencies towards exclusiveness, and extreme temporality, which are also key concerns in communicative planning theory (i.e. Fainstein, 2000; Forester 1989; Healey, 2003; Sager, 1994).

A key aspect of communicative planning theory is providing concerned public stakeholders with a legitimate role in the decision-making process and a general wariness of expert or elitist manipulation (Sager, 1994). Conversely, communicative planning theory has been critiqued for ignoring how to deal with the fact that open processes may produce unfair results, and for losing its critical edge once the theory is applied in reality (Fainstein, 2000). Practitioners should remain mindful of these challenges during the deployment of urban living labs.

Furthermore, much like the concept of urban living labs, communicative planning theory stresses the importance of the process in ensuring the successful outcome of projects (Fainstein, 2000; Forester 1989). That is not to say that the process is only valuable in itself or as a mere effort towards democratic inclusivity. Rather, its value is partially derived from the manner in which the process serves as a focus on relational interactions which can help to create the basis for action (Healey, 2003). In communicative planning theory, there is considerable agreement that the outcome of a project is heavily contingent on the actors who take part in the process. The actors are recognized as creative individuals and groups whose differing aims and needs will affect the trajectory of a project, ensuring a unique outcome. The outcome is also affected by a range of other actor-specific factors, including the commitment they make to the project, the intensity with which they enter the discussion and their openness to differing visions. However, planning is to a large degree shaped by leading actors and power relations, be they within or outside government, i.e. those who have the capacity and incentive to use and invest their resources into planning processes and/or their material outcomes. This encapsulates questions of the motives and rationales for engagement in urban living labs; or more fundamentally – what sorts of actors take part in such 'self-organised experiments'?

Communicative planning theory also stresses that planners are faced with the inherently political decision to foresee and partially counteract the distortion of information from powerful stakeholders. Alternatively, planners can submit to these stakeholders and take a complicit role in obscuring information from the public (Forester, 1989). In this vein, the planner is expected to navigate through the political context in which planning takes place, with the 'ideal' desire to provide all stakeholders with an equal standing on which to negotiate. This requires an "inclusionary ethic" that emphasizes the planner's moral duty to ensure that the negotiations take place on a level playing field (Healey, 2003). As Forester (1989, p. 3) argues, "Planners do not work on a neutral stage […] they work within political institutions on political issues, on problems whose most basic technical components […] may be celebrated by some, contested by others. Any account of planning must face these political realities."

These central claims within communcactive planning theory can be related to urban living labs in order to ask how they are related to the larger political context, since they work, as Boelens (2010, p. 42) puts it in his proposal for an actor-relational view of planning, "beyond the confines of government". They can be interpreted as a temporary, self-organised additional layer and mode of urban governance. So one central issue is to question how political urban living labs are, which addresses rather purely public issues within urban development (in comparision more technological labs, which are often influenced by the economic interests of the involved companies). Several questions arise related to the associative forms of democracy suggested by urban living labs. Although they deal with public concerns, to what extent can urban labs seek legitimacy or even accountability? In addition, power relations, domination, and exclusion develop in unique forms that are contextually dependent, and the results from the communicative planning process (and urban living labs as planning practices) are inherently locally specfic (Healey, 2003) In this vein, it seems valuable to consider the urban living labs in the context of other urban development settings and processes working in parallel. It is also important to question the relations between these settings and processes in terms of, e.g., discursive power, institutional decisions, or even long-term material impacts.

5 CONCLUSIONS

Through this paper, we want to initiate a critical debate and research engagement with the quality of governance in (urban) living labs and how they inform, or are engaged with, policies and politics. Urban living labs can be seen as an additional form of 'experimental' governance, since the rules of the game are often not defined in order to avoid restricting innovative and visionary thinking. However, they also bear the risk, as other forms of governance, to become arenas of unequal expectations, power games, and conflicts. For future research it is thus vital to investigate how these informal soft modes of governance relate to formal hard modes of government. However, the explorative nature of urban living labs offers, in principal, a promising method for balancing power within the context of participative urban development.

Urban living labs can be a creative environment for exploring new forms of smart urban governance, beyond simply presenting a new environment to apply established theory. By aiming to promote equal opportunities for all stakeholders, communicative planning theory seeks to ensure that those who have been traditionally ignored have the same possibilities as more powerful actors to make their voices heard in the process. This relates well with urban living labs, which aim to foster creative unsettlement by harnessing the innovative energies of a wide array of actors in shaping urban development processes. Urban living labs might thus function as an empirical environment to develop communcative planning theory and practices. Nonetheless, this needs to be explored in practice, particularly in regards to balances of power and stakeholder influence.

Another issue demanding attention involves the actors and their network relations, particularly since in urban living labs the planner is increasingly called on to serve as a connector and coordinator. In other words, it is planners who are meant to bring together all of the concerned stakeholders for a series of communicative activities as 'agents who help build the network' (Innes & Booher, 2014). Such efforts are well-suited to urban living labs. This defined role for planners, facilitator who build up partnerships, needs to be critically explored. An actor-relational approach (Boelens, 2010) can be fruitful in order to understand and identify the emerging relations and networks. An actor-relational approach can also aid in understanding alliances and confrontations between actors, along with the extent to which their acting translates into materialisation.

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Prioritization of Urban Green Infrastructures for Sustainable Urban Planning in Ploiesti, Romania

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1 ABSTRACT

Urban green infrastructures are increasingly being used as instruments for achieving a sustainable urban planning due to their multifunctionality represented by the numerous economic, social and environmental benefits. Selecting the most appropriate type of urban green infrastructure to be developed in a certain city is most of the times an important challenge for planners.

In our analysis, we developed a model for a multi-criteria evaluation of the components of urban green infrastructures using structural, functional, administrative and economic criteria. We used as a case study the city of Ploiesti, an industrial city of Romania, focused on oil processing. Ploiesti is one of the main engines of the Romanian economy with a tradition of over 100 years of oil industrial activity being characterized by a significant expansion of the build-up areas (especially industrial and technological site) in the outskirts of the city and a decrease of urban green area per capita. Policies and strategies to increase the density of the existing urban green infrastructure and to sustainably manage the existing ones represent a challenge for local authorities and other local actors and stakeholders as the balance between economic development and the city's livability has to generate a proper quality of life for its inhabitants.

Our results can drive to a more efficient urban planning and the use of the correct and appropriate urban green infrastructures elements in improving the quality of life and the environment. The analysis can be used for sustainable planning of urban green infrastructures in other cities lacking a proper amount of green areas.

Keywords: industrial city, Ploiesti, quality of life, sustainability, urban green infrastructures

2 INTRODUCTION

In the context of continuous expansion of urban areas, often manifested through urban sprawl (Bruegmann 2005), the demand of green areas is constantly increasing, therefore the need of an efficient urban green infrastructure (UGI) network has become an important challenge. A planned and systematized urban expansion drives a natural expansion of the existing UGI, but in the case of the sprawling cities, UGI planning may face some difficulties. Sprawl is defined in terms of "undesirable" land-use patterns—whether scattered development, leapfrog development (a type of scattered development that assumes a monocentric city), strip or ribbon development, or continuous low-density development (Ewing 2008).

In the context of sustainable city policy it should be recognised that cities are not passive spatial units victimised by anonymous global environmental developments, but may play an active role in producing sustainable development in a multiplicity of relevant fields, such as housing, employment or environmental quality (Camagni, Capello, and Nijkamp 1998). The achievement of sustainable urban development requires tools to assess the current status of an urban issue (Gavrilidis et al. 2016; Van Herzele and Wiedemann 2003; Iojă et al. 2014) but also tools to assess the potential effects of a certain urban policy or strategy (Ducom 2005; Jabareen 2013).

The aim of the current study is to develop a methodology to assess what types of UGI are the most efficient and sustainable in different urban fabrics using a multi-criteria analysis. Multi-criteria analysis can be useful for supporting a strategy team tasked with designing and selecting strategic options (Zopounidis and Pardalos 2010). Sustainable UGI planning in sprawling urban areas represents an issue that can be tackled using a multi criteria analysis. The study focused on achieving three main objectives: 1) weight attribution for the selected criteria, 2) calculating the suitability degree of different UGI and 3) selecting the best UGI for several urban areas based on their function or socio economic aspects.

3 METHODOLOGY

The methodological steps coincide with the study's objectives, meaning there were three methodological steps needed to be fulfilled in order to complete the study. The first one was to attribute weights to all of the nine criteria selected for the potential planning of an UGI, the second one was to establish a suitability score for the 27 UGI chosen, based on the criteria selected and the Romanian patterns and planning tradition and, in the end, it was established which of the selected UGI are proper for different urban areas and functional zones. The first criteria used to analyse the urban areas was the functional zones of the city and the second one was based on socio economic aspects of the city's districts. The analysis was conducted using the Delphi method in which were involved experts working in research project and universities in domains related with geography, urban planning, environmental assessment, biology, landscape ecology, green infrastructure planning and remote sensing analysis.

3.1 Study area

For this study it was chosen an urban area from south-east Romania, the city Ploiesti. Ploiesti is one of the biggest cities in the country, being an important industrial centre focused on oil processing. It has been permanently developing since the mid-19th when Ploiesti and its surroundings was one of the world's leading oil production centres. The planning policies of the cities were very much influenced by specific principles of the political regimes that ruled the country (Gavrilidis et al. 2015) leading to a lack of green infrastructures and a surplus of industrial sites and infrastructures, from which some of them, not related with oil processing activities, became brownfields after 1990 (Gavrilidis, Ioja, and Saghin 2011). Therefore the city's build up areas expanded in the suburban areas of Ploiesti, mainly by commercial sites, industrial sites and residential sites. The former industrial units that were closed are representing a valuable resource for future green infrastructure (Saghin et al. 2012) but there is a need of proper planning of these infrastructures in order for them to be efficient and respond to the current need of life quality and environmental challenges.

3.2 Criteria selection

A number of nine criteria were taken into consideration for the potential planning of an UGI. Each criteria is explained in table 1.

Criteria	Acronym	Explanation
Management costs	man	The total expenses required to mantained the UGI at a proper level of quality, including wages, required suplies for maintenance, costs in case of accidental degradation etc
Building easiness	bld	How easy is to build a certain UGI, refering to: if it requires a long time to build and high costs to build, if it requires a large surface of land and complicated bureaucratic procedures to start the building of the UGI
Popularity of the infrastructure in Romania	pop	It refers to how popular is the certain UGI in Romania; if there are exemples of particular UGI in other urban areas
Climate change combat eficency	cce	If the UGI is an efficient infrastructure in the combat of climate change issues
Air quality improvement efficency	aqi	If the UGI is an efficient infrastructure to improve the local air quality
Economic profitability	epr	The UGI can generate income for the local authorities or for a private actor
Biodiversity benefits and conservation	bdb	The UGI contributes or improves the bidoviersity conservation levels
Social network stimulation	sns	The UGI stimulates outdoor activities, stimulating human interaction
Specificity	spf	The UGI can be built or managed only in specific cases (depending on natural or cultural condition) or it can be built or managed wherever no mater the case

Table 1: Criteria explanations

The "management costs" were selected as criteria because it is an important aspect in UGI planning due to the low amounts of funds allocated by public authorities to this sector (Iojă, Nita, et al. 2011). "Building easiness" its however complementary with "management costs" but it was treated separately because land availability is a high valuable resource in urban areas and the accessibility to unused land is often scarce, especially for UGI development (Grădinaru et al. 2015). The "popularity of a certain UGI in Romania" was selected because the local decision makers usually follow a similar known pattern when planning UGI for their cities (Cicea and Pirlogea 2011). “Climate change combat efficiency” and “air quality improvement efficiency” were selected because global climate changes and urban air quality represent important environmental issues and many studies and public reports emphasized the role of UGI in the combat of these issues (Carter 2011; European Commision 2012; EEA 2012). Most of the local authorities avoid developing the local UGI network as there is not a type of land use that generates immediate income to local budget as the commercial, industrial or other built infrastructures do (Sýkora and Ourednek 2007; Ioja et al. 2011). That’s why “economic profitability” was chosen as a criterion. Biodiversity has been an important issue in the last decades due to species vulnerability towards extinction. Therefore the need to create friendly urban areas for species of plant and animals represent a challenge to be responded by planners and policy makers (Hostetler, Allen, and Meurk 2011; Jabareen 2013). UGI, especially large ones such as parks or urban forests have a great contribution to social inclusion and networking, thus UGI’s can combat segregation and bring together in one place people from different social categories, different religion or ethnicity (Iojă, Rozylowicz, et al. 2011; Wolch et al. 2011; Thompson, Roe, and Aspinall 2013). Some UGI are strictly dependent on some natural characteristics. For instance watershed forests or riparian vegetation is dependent on the presence of a water course. Thus, the “specificity” criterion was selected to cover the situations which some UGI can face.

3.3 UGI selection

In order to establish what UGI are proper to be developed in different urban fabrics a list of 27 infrastructures were chosen. The infrastructures were chosen in accordance with the UGI typology proposed by the European Environment Agency (2011) in the technical report Green Infrastructure and territorial cohesion.

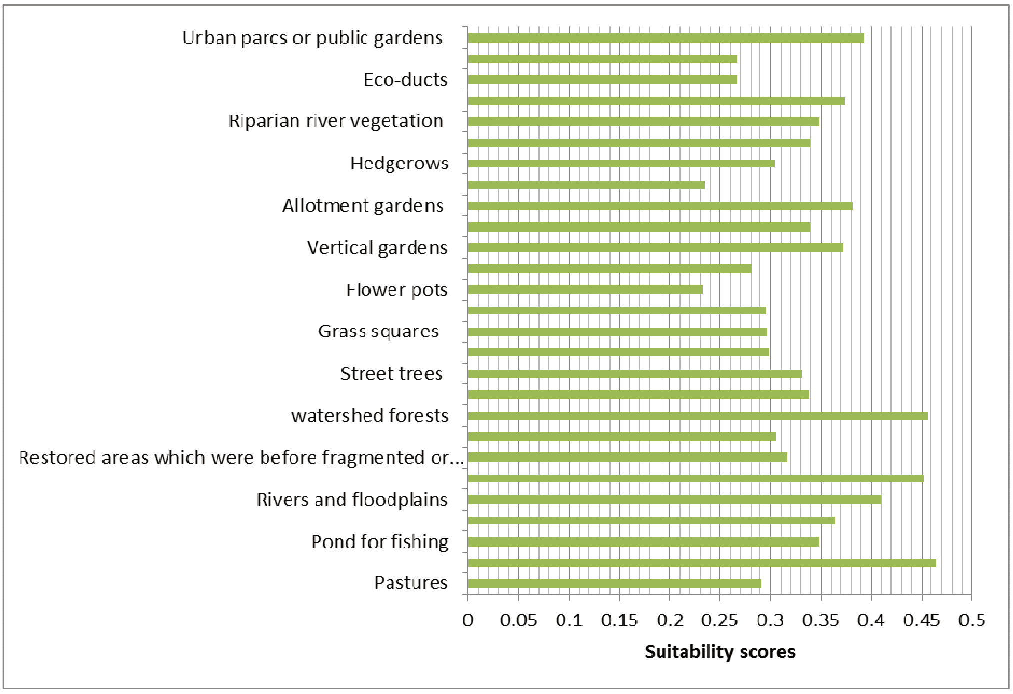

Fig. 1: Suitability scores for the 27 selected UGI in Romanian urban areas

4 RESULTS

After the weight attribution process the “pop” criterion recorded the lowest values and the “bdb” criterion recorded the highest value. Also “cce” and “aqi” criteria recorded high scores. When establishing the suitability of the UGI types, urban forests, rivers and floodplains, local nature reserves and watershed forests proved to be the most suitable UGI for the Romanian cities (fig.1). The analysis to establish wich UGI is proper for different urban functional zones showed that for the urban areas with agricultural characteristics the best UGI are rivers with floodplains, high nature farmlands, orchards and transitional ecosystem from cropland, grassland and forests. For the industrial areas of the cities the proper UGI are protection forests and street trees. For comercial urban areas the best UGI were considered the street trees, singular trees and urban parcs or public gardens. The residential areas were divided in multidweling housing and individual housing.

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In best cases the proper UGI resulted to be urban parcs and public gardens and street trees. The socio economic analysis concluded with the fact that in neighbourhoods populated by poor people with social problems, the best UGI to be planned are street trees, allotment gardens and parcs, and on the other side, in the neighbourhoods populated by rich people with high income and wealth, the best UGI are urban forests and public parcs.

After the analysis was completed, a map of potential UGI was procesed for Ploiesti, taking into consideration the availability of land. It emphasized what UGI are proper to be planned by local authorities using the multicriterial analysis results.

5 DISCUSSION AND CONCLUSION

The main finding of the study was the ability to make a hierarchy of the UGI that can be implemented in a Romanian city and a Romanian context (legal aspects, traditional planning, funds availability etc). In order to confirm the results of the curent study future researched are going to be focused on public perception towards UGI mixed together with the assessment of local authorities perception and companies representatives' perception. After that we will be able to have the entire picture of UGI planning in Romania and we will be able to deliver the best solution for this issue.

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Seniorengerechte Kommunikation von Geoinformationen in Nationalparks am Beispiel senTOUR

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1 ABSTRACT

In den österreichischen Nationalparkgesetzen ist als einer der wichtigsten Grundsätze die Erlebbarkeit und Zugänglichkeit von Nationalparken mit Möglichkeiten bzgl. Bildung und Erholung festgelegt. Die Zugäng¬lichkeit soll zudem für alle Menschen möglich sein, was aufgrund der teilweise schwierigen natürlichen Gegebenheiten dieser Gebiete und der fehlenden Barrierefreiheit ihrer naturräumlichen und baulichen Infra¬strukturen eine große Herausforderung darstellt, vor allem für ältere Menschen. Eine durchgehend barriere¬freie Mobilitätskette ist jedoch vor allem für Menschen mit Beeinträchtigungen notwendig, weil diese Nationalparke sonst gar nicht erst besuchen können. Das Projekt senTOUR versucht mit der seniorenge¬rechten Kommunikation von Geoinformationen Hilfestellungen zu bieten und gleichzeitig auch für andere Personengruppen Services zu bieten und somit die Forschung im Bereich der Barrierefreiheit weiter voranzutreiben.

Keywords: Open Data, Navigation, Barrierefreier Stadtplan, Assisted Living, Smartphone

2 THEMENAUFRISS

Erholung in der Natur hat positive Effekte auf die körperliche Verfassung, das psychische Wohlbefinden, die Integration und den familiären Zusammenhalt (IMMOOS & HUNZIKER 2015). Auch zu beobachten ist, dass Besucherinnen und Besucher immer mehr erlebnisorientiert handeln und dabei das Erlebnis das Haupt¬ziel ist (ENGENTER 2006).

Eine wichtige Zielgruppe für den naturbezogenen Tourismus sind Seniorinnen und Senioren. Untersuchun¬gen zeigen, dass deren Interesse an Reisen in Gebiete mit unversehrter Natur stetig zunehmend ist (ENGEN¬TER 2006). Gleichzeitig schrumpft der Tourismusmarkt im Bereich der Jugendlichen, während dieser im Bereich der Seniorinnen und Senioren wächst. Die Reiseinentensität von älteren Menschen steigt aufgrund deren ökonomischer Ressourcen, ihrer Mobilität und Reiselust ebenfalls an (TROBISCH 2007).

Zudem steigt auch die Lebenserwartung kontinuierlich an, sodass auch die potentielle Zielgruppe der Seniorinnen und Senioren wächst. Im Jahr 1990 lag der Anteil der über 65-jährigen bei 14,9% und stieg bis zum Jahr 2014 auf 18,4% (Statistik Austria 2015).

Aufgrund von altersbedingten Veränderungen und körperlichen Beeinträchtigungen (z. B. Seh- oder Gehbe¬einträchtigung) sind Seniorinnen und Senioren darauf angewiesen, dass eine gute Vorbereitung auf den Besuch des Nationalparks bzw. Unterstützung vor Ort möglich ist, was in besonderen Bedürfnissen mündet. Seniorinnen und Senioren sind jetzt schon eine wichtige Zielgruppe für den naturbezogenen Tourismus, der oftmals in Nationalparken erfolgt (DÖRRZAPF et al. 2015; TRACHSEL & BACKHAUS 2011).

Eines der Ziele von Nationalparken ist „die Erlebbarkeit des Gebietes für den Menschen zum Zweck der Bil¬dung und Erholung“ (vgl. z. B. § 2 Abs. 1 Z. 5 Nationalparkgesetz Gesäuse 2002) zu ermöglichen. Gleich¬zeitig ist auch gesetzlich verankert, dass die „gleichberechtigte Teilhabe von Menschen mit Behinderungen am Leben in der Gesellschaft zu gewährleisten und ihnen eine selbstbestimmte Lebensführung“ (§ 1 BGStG 2005) ohne besondere Erschwerniss, in der üblichen Art und Weise und grundsätzlich ohne fremde Hilfe ermöglicht werden muss (GRUNDNER & SCHMIED-LÄNGER 2014). Die Anforderungen an die Infra¬struktur sind aufgrund der im Vordergrund stehenden Natur- und Körpererfahrung aller Besucherinnen und Besucher sehr komplex (REISSMANN 2004).

Bisher sind Nationalparke aber für gewisse Bevölkerungsgruppen aufgrund ihrer körperlichen Vorausset¬zungen schwierig zugänglich, bzw. benötigen diese Personen besondere Hilfestellungen.

Ein Gebiet, das im Bereich der Barrierefreiheit sehr aktiv ist, ist der Nationalpark Gesäuse (im Norden der Steiermark in Österreich). Der Nationalpark hat in diesem Bereich schon viele Aktivitäten gesetzt, wie zum Beispiel die Anlage von barrierefreien (Themen-)Wegen und den Verleih von Rollstuhlzuggeräten

(NATIO¬NALPARK GESÄUSE o. J.). Hinsichtlich der Bereitstellung von relevanten Informationen für die Ziel¬gruppe – sowie der geeigneten Weise – besteht alerdings noch ein Defizit. So müssen z. B. die Anforde¬rungen an digitale Karten (ein zentrales Informationsmedium im Kontext naturbezogene Erholung) für ältere Menschen definiert werden (NEUSCHMID et al. 2012). An diese Herausforderung knüpft das Projekt senTOUR an.

SenTOUR steht für Seniorengerechte inklusive Toureninformation im Tourismusbereich. Ziel ist barrierefrei aufbereitete geographische Informationen über das Web und eine mobile App (Prototyp) für Seniorinnen und Senioren abrufbar zu machen. Die Herausforderung in diesem Projekt ist einerseits die Anforderungen der Zielgruppe zu erforschen und andererseits die geographischen Gegebenheiten des Nationalparks zu berück¬sichtigen. Die benötigte Barrierefreiheit ist in einem alpinen Nationalpark aufgrund der natürlichen Gelände¬eigenschaften und Bodenbeschaffenheit besonders schwer herzustellen. Durch diesen Umstand müssen Angebote geschaffen werden, die das kompensieren können (PORZELT 2012).

Das Projekt senTOUR wird vom Bundesministerium für Verkehr, Innovation und Technologie (BM VIT) im Programm benefit (abgewickelt von der Österreichischen Forschungsförderungsgesellschaft (FFG)) gefördert. Es wird von Seiten des Fördergebers davon ausgegangen, dass sich die Gruppe der über 65-jährigen bis 2050 massiv vergrößern wird, was unter anderem zu notwendigen Anpassungen von Dienstleistungen, Technologie-Produkten, Informationsvermittlung und Geschäftmodellen führen kann. Mit der Forschung und Entwicklung im Rahmen dieses Förderprogramms „soll zur Erhaltung bzw. Steigerung der Lebensqualität der Endanwender" (FFG 2016) beigetragen werden.

3 ZIELGRUPPE UND ANFORDERUNG AN DIE INFORMATIONEN

3.1 Zielgruppe

Das Projekt senTOUR addressiert primär Personen über 65 Jahre. Die primäre Zielgruppe besteht aus Senio¬rinnen und Senioren. Dabei handelt es sich aufgrund der individuellen Anforderungen der Personen, die unter sehr unterschiedlichen und unterschiedlich stark ausgeprägten altersbedingten körperlichen und menta¬len Veränderungen leiden können, sehr heterogen.

Die primäre Zielgruppe (d. h. Seniorinnen und Senioren) hat aufgrund von individuellen altersbedingten Veränderungen besondere Anforderungen an Barrierefreiheit (siehe Abbildung 1). Dabei gilt, dass für jeden Besucher, d. h. auch für Personen, die nicht von altersbedingten Veränderungen betroffen sind, Maßnahmen der Barrierefreiheit positiv bewertet werden, sie tragen in jedem Fall zu höheren Komfort und Benutzbarkeit bei. Für die Informationsbereitstellung gilt, dass Technologien wie mobile Apps auf Smartphones oder Tablets auch bei Seniorinnen und Senioren immer beliebter werden und daher großes Potential besitzen (HENNIG 2014).

Zudem ergeben sich durch Initiativen der Barrierefreiheit für andere Nutzergruppen, die ebenfalls das Bedürfnis nach Barrierefreiheit aufweisen, Synergien. Die Vorteile betreffen vor allem Personen mit körper¬lichen und psychischen Beeinträchtigungen, sowie deren Begleitpersonen (siehe Abbildung 1). Entsprechend leistet senTOUR auch Hilfestellungen für jene Personen die weder in die primäre Zielgruppe des Projektes (Seniorinnen und Senioren) fallen, noch für die direkte Synergien bestehen, wie zum Beispiel durch wichtige Informationen zu Wegen oder Echtzeitinformationen, die zusätzlich für mehrere Sinne (z. B. visuell und auditiv) ausgegeben werden können.

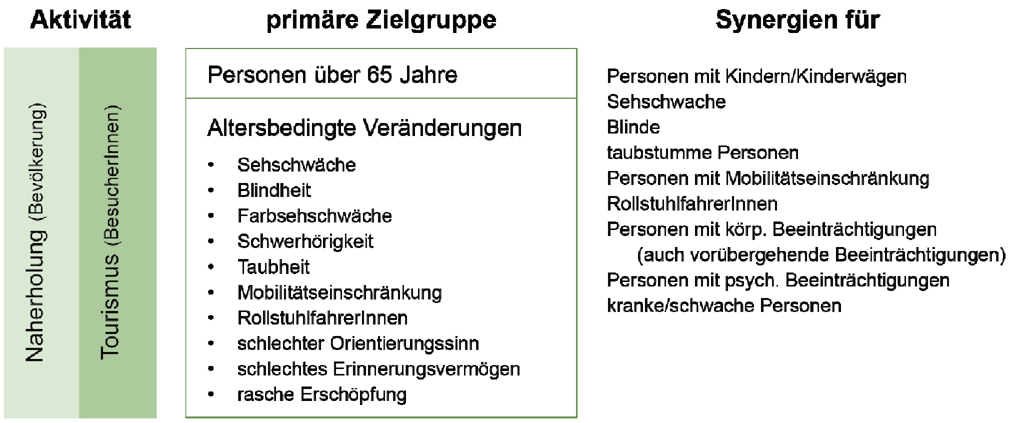

Abbildung 1: Zielgruppen von senTOUR. Quelle: eigene Darstellung.

3.2 Grundsätzliche Anforderungen

Alle Informationen, die an Menschen mit Behinderungen kommuniziert werden sollen, müssen das Mehr-Sinne-Prinzip berücksichtigen (DÖRRZAPF et al. 2015).

Neben den Informationen vor Ort, die jeweils auf unterschiedliche Weise (für die individuellen Bedürfnisse) verfügbar sein müssen, ist es auch unumgänglich, dass das Angebot an barrierefreier Infrastruktur nicht nur für die An- und Abreise sondern auch für die Destination vorab beurteilbar ist (BERDEL et al. 2003).

Bezüglich der bereitgestellten Informationen im Web/in der App müssen die gängigen Standards und Richt¬linien wie zum Beispiel WCAG 2.0 berücksichtigt werden.

3.3 Ergebnisse des Stakeholdertreffens im Nationalpark Gesäuse

Bei einem Stakeholdertreffen im Nationalpark wurde mit einer Gruppe Seniorinnen und Senioren ein Rund¬gang entlang eines barrierefreien Weges gemacht und dabei mit den Betroffenen die Bedürfnisse und Proble¬me erörtert.

Mit einer Gruppe von zwölf Personen im Alter von 60 und mehr Jahren wurde ein flacher Weg entlang der Enns begangen. Darunter befanden sich Personen mit leichten Einschränkungen ebenso wie Rollstuhlfahrer und durchtrainierte Seniorinnen und Senioren.

Neben Orientierungsfragen wurde insbesonders nach Entfernungen besonders gefragt. „Wie weit ist es noch?“ ist wahrscheinlich die häufigste Frage, unabhängig davon, ob diese auf das Ziel, die nächste Rast¬möglichkeit oder bei Umkehr zum Ausgangspunkt, bezogen wird. In zweiter Linie wird häufig nach der Oberflächenbeschaffenheit des bevorstehenden Weges sowie dessen Schwierigkeitsgrad gefragt. Erst in dritter Linie wurde nach Informationen zu den Points of Interest gefragt.

Probefahrten mit dem Swiss Trac (Rollstuhlzuggerät) zeigten die Möglichkeiten, aber auch die Schwierig¬keit beim Befahren mit (elektrischen) Rollstühlen auf (siehe Abbildung 2).

Abbildung 2: Stakeholdertreffen im Nationalpark Gesäuse und Swiss Trac (Rollstuhlzuggerät). Fotos: W. Wasserburger, C. Beyer.

Interessant war auch, dass bisher mit einer Ausnahme keine der Testpersonen den Nationalpark besucht hatte, obwohl alle in unmittelbarem Umkreis wohnen. Dies wurde durchwegs mit der „schwierigen“ Anreise sowie vermuteten Orientierungsproblemen begründet. Neben der Beantwortung der oben angerissenen Fragestellungen ist also vor allem ein Verringern der Zugangshemmschwelle ein zentraler Punkt um den Nationalpark für ältere Personen nutzbar zu machen.

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4 USE CASES

4.1 Zweck

Die Use Cases (Anwendungsfälle) sollen Eventualitäten bei der Bedienung des senTOUR-Informations¬portals samt Karte erläutern (siehe Abbildung 3). Darüber hinaus soll ein gewisses Ziel erreicht werden (z. B. Nutzer ist an gewünschter Zieldestination angekommen). Anwendungsfälle hängen natürlich stark von der jeweiligen Zielgruppe und deren Bedürfnissen ab. Die Use Cases sind auf die primäre Zielgruppe (vgl. Kapitel 3.1) abgestimmt.

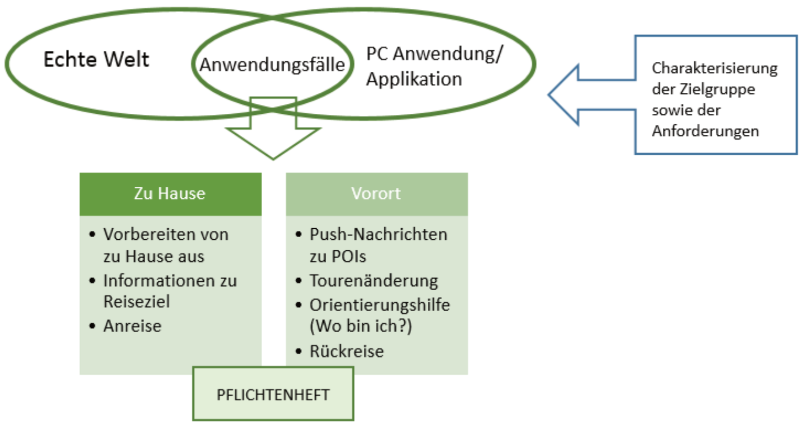

Abbildung 3: Use Cases (Anwendungsfälle). Quelle: eigene Darstellung.

4.2 Aufbau

Die Use Cases beschreiben verbal in detaillierten Schritten Verhalten und Interaktion des Benutzers mit senTOUR (Webportal bzw. mobile App). Für jeden Use Case werden die Rahmenbedingungen beschrieben:

- Voraussetzungen,
- beteiligte Akteurinnen und Akteure,
- Vorbedingung, Auslöser (was passiert, damit dieser Use Case eintritt?),
- mögliche Szenarien,
- Nachbedingung, Erfolg,
- wichtige barrierefreie Anhaltspunkte.

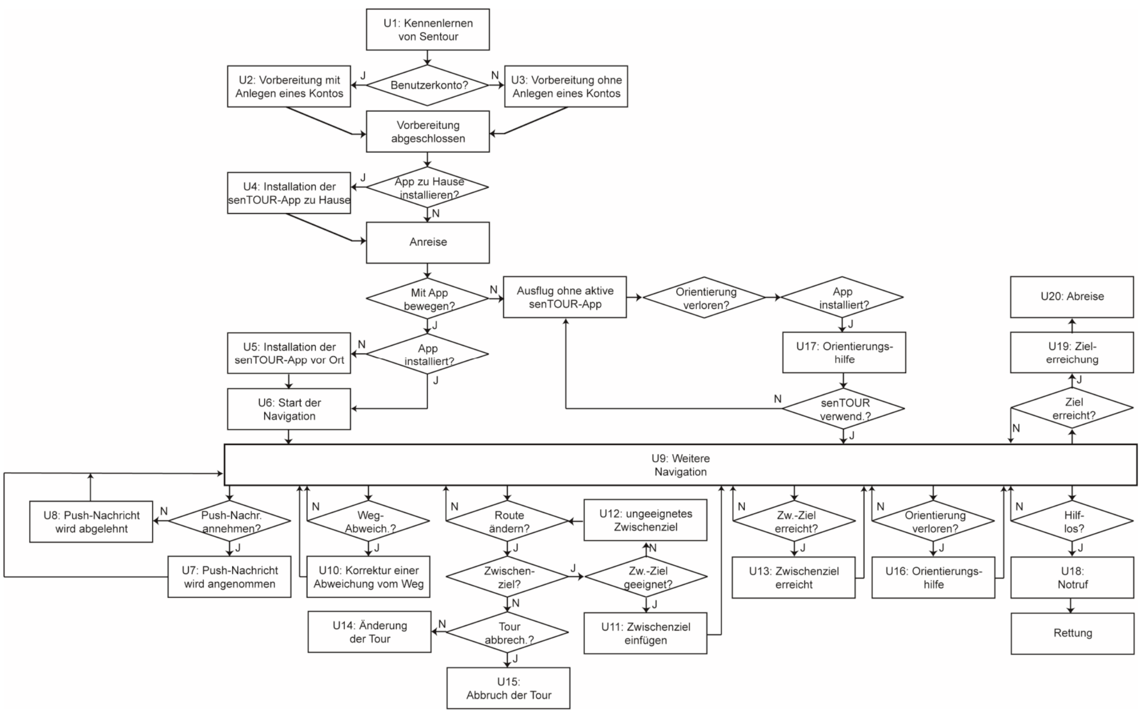

Abbildung 4: Ablaufdiagramm eines Ausflugs mit der senTOUR-App, unter Berücksichtigung der Use Cases. Quelle: eigene Darstellung.

Danach folgt eine Ablaufbeschreibung für das am wahrscheinlichsten bzw. typischsten angenommene Sze¬nario. Es werden nur jene Abläufe berücksichtigt und dargestellt, denen eine Interaktion mit der senTOUR-Plattform zugrunde liegt. So ist beispielsweise die dargebotene Information zu einer gastronomischen Ein¬richtung als Anwendungsfall erfasst, ebenso die Entscheidung, die gastronomische Einrichtung zu besuchen, nicht jedoch jener Zeit- und Tätigkeitsbereich, der sich vom Erreichen der gastronomischen Einrichtung bis zu deren Verlassen erstreckt. Sämtliche Use Cases münden in ein synoptisches Ablaufdiagramm (vgl. Abb. 3).

Somit entsteht ein Gesamtmuster der Beziehung zwischen senTOUR und seinen Benutzerinnen und Benut¬zern, das um den zentralen Punkt – die Navigation – herum aufgebaut ist.

5 CONCLUSION

Die Ergebnisse aus den Anforderungen der Zielgruppe sowie den Verwendungsfällen ergibt im weiteren Verlauf die benötigten Funktionen für das Kommunikations- und Informationsmedium. Die jeweiligen zu kommunizierenden Informationen jedoch zu erzeugen und auf geeignete Weise wiederzugeben, ist Hauptteil des Projektes senTOUR.

In allen Lebensbereichen spielt Barrierefreiheit eine immer größere Rolle, so auch in Nationalparks. Wäh¬rend bisher versucht wurde das Gelände möglichst für alle Personen (auch mit Hilfsmitteln wie Rollstuhl¬zuggeräten) zugänglich zu machen, wurde hingegen die barrierefreie digitale Kommunikation von Informa¬tionen und Hilfsmitteln weniger forciert. Die Mobilitätskette darf auf beiden Wegen nicht unterbrochen sein, weil sonst mobilitätseingeschränkte Personen oftmals vorab gar nicht erst beurteilen können, ob sie die Reise uneingeschränkt antreten können. Diese Barriere spiegelt sich auch darin wieder, dass die befragten Senioren und Seniorinnen aus der Region ebenfalls den Nationalpark nicht besuchten, weil sie fürchteten, dass der Besuch bzw. die An- oder Abreise aufgrund von fehlender Barrierefreiheit nicht möglich wäre.

Neben der Frage nach der barrierefreien Vermittlung von Geoinformationen bzw. Karten, müssen auch alle anderen weitergegebenen Informationen zumindest über zwei Sinne wahrnehmbar sein.

Abschließend ist noch zu erwähnen, dass das Projekt nicht nur touristische Zielgruppen anspricht sondern auch die regionale Bevölkerung, insbesonders die Naherholung spielt hierbei eine große Rolle. Somit bieten Projekte im Bereich der Barrierefreiheit für viele (vor allem auch periphere) Regionen große Chancen im Hinblick auf die Anziehungskraft von Destinationen und die wirtschaftliche Entwicklung.

Gezeigt hat sich während des Projektes auch, dass meist vordergründig sehr banale Anforderungen von Seiten der Zielgruppe an ein derartiges Informationssystem gestellt werden, wie zum Beispiel die Frage „Wie weit ist es noch?“. Komplexe technische Berechnungen sind daher in einer entsprechend einfachen und verständlichen Form zu präsentieren. Synergien für andere Nutzergruppen ergeben sich besonders dadurch, dass sich rasch auch eine gewisse körperliche Einschränkung auch für junge und körperlich fitte Menschen ergeben kann (z B. durch einen Unfall).

Die Forschung im Bereich der Barrierefreiheit gewinnt in Zukunft, vor allem für ältere Menschen aufgrund der diagnostizierten demografischen Veränderung, an Bedeutung, auch um Angebote in der Natur weiterhin attraktiv halten zu können bzw. für alle Bevölkerungs- und Nutzergruppen zugänglich zu machen.

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Smart Cities and Standards – the Approach of the Horizon 2020 Project ESPRESSO

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1 ABSTRACT

A Smart City integrates physical, digital and human systems to deliver a sustainable, prosperous and inclusive future for its citizens. Many of these innovative solutions will be based on sophisticated information and communication technologies. However, technological complexity, as well as the complexity of the various sectoral services involved within a Smart City, require a system approach to standardisation. Such an approach must promote the greatest possible reuse of existing open standards to accelerate the Smart City deployment. In an effort to leverage the promise of a system approach, the Horizon 2020-project ESPRESSO (systEmic standardisation apPRoach to Empower Smart citieS and cOmmunities) will focus on the development of a conceptual Smart City Information Framework based on open standards.

A further goal of ESPRESSO will be to envisage the impact of those technologies for urban planning and also in societal terms. The partner cities will be engaged to analyse how their services can be streamlined and improved through large-scale use of standards. This will be done by analysing the downstream changes from the new scenarios enabled by large-scale interoperability and what this could bring for a future Smart City. Based on a detailed requirements-engineering campaign executed in close cooperation with cities, standardisation organizations, administrative bodies, and private industry, the project will identify open standards matching the elicited requirements and will establish a baseline for interoperability between the various sectoral data sources and the Smart City enterprise application platform. In a comprehensive set of coordination, support and networking activities, the project will engage a very large number of stakeholders, such as Smart Cities (both existing and those with aspirations), European Standardisation Organizations (ESOs), National Standardisation Bodies (NSBs), Standards Development Organizations (SDOs), public administrations, industries, SMEs, and other institutions. ESPRESSO's approach emphasises cost reduction and will foster an open market for many actors, avoiding lock-in to proprietary solutions.

Keywords: Framework, Horizon2020, Interoperability, Smart Cities, Standards

2 INTRODUCTION

Over the next decade, the way we live, work and use energy, transportation and other city resources and services will progressively change thanks to a range of innovative 'Smart City' solutions. A Smart City integrates physical, digital and human systems to deliver a sustainable, prosperous and inclusive future for its citizens. Many of these innovative solutions will be based on sophisticated information and communication technologies. However, technological complexity, as well as the complexity of the various sectoral services involved within a Smart City, require a system approach to standardisation. Such an approach must promote the greatest possible reuse of existing open standards to accelerate Smart City deployment and exploit the enormous potential deriving from the use of distinct interoperable technologies and from re-use of interoperable applications and services among cities. In an effort to leverage the promise of a system approach, ESPRESSO will focus on the development of a conceptual Smart City Information Framework based on open standards.

3 THEORETICAL FRAMEWORK

The topic of Smart Cities is increasingly discussed in urban planning though there is no sharp definition from a scientific point of view. An embracing explanation is a city, in which „ICT is merged with traditional infrastructures, coordinated and integrated using new digital technologies. These technologies establish the functions of the city and also provide ways in which citizen groups, governments, businesses, and various of agencies who have an interest in generating more efficient and equitable systems can interact in augmenting their understanding of the city and also providing essential engagement in the design and planning process" (Batty et al., 2012, p. 492).

The greatest potential in the use of networked and often centralized ICT solutions in urban areas is thus seen in the context of increased efficiency through innovative technologies (less energy consumption, lower emissions, less CO2 pollution, etc.). This is often promoted as a contribution for the urban quality of life. In addition to that, a common and open urban information platform to share the gathered data is also regarded as very promising for companies and citizens – an ideal-typical vision of such a central urban monitoring and simulation system in real-time (Exner, 2015). Due to this, the Smart City topic found its ways on the agendas of big corporations like IBM, Cisco Systems, Siemens, Accenture, Ferrovial and ABB. They are setting their sights on the urban market and are foreseeing a multi-billion dollar market (Ratti & Townsend, 2011, p. 45). It is considered as a big future business field in the ICT-sector for developing tools which could improve the competitiveness and the quality of life for the citizens because. However, „a Smart City is something more than 'just' a digital or an intelligent city, where the attention is mainly drawn on the ICT components, as enabling connection and exchange of data and information within an urban environment" (Murgante & Borruso, 2013, p. 630). Smart is an adjective that is currently declined in different acceptation. Smart is the growth expected through the EU2020 strategy, smarts are the communities, the territories and of course the multiple aspects of the urban dimension: the concept of the smart city as next stage in the process of urbanization has been, and it is, quite fashionable in the policy arena in recent and current years. As stated, the smart city concept works as distinct concept from the digital city (referring to connected communities and innovative services) or intelligent city (all intelligent cities are digital cities, but all digital cities are not intelligent) which is shown by Komninos (2002).

Finally, the urban space has become a cross-breed place in which phenomenal experience and virtual experience are combined together to create a socio-technological environment based on the combination of place, networks as well as institutions. Continuous interaction between physical locations and information flows[1] made even more intense by the recent dissemination of geo-referenced applications for cutting-edge devices (Location Based Social Network, Geoblogs…). Shortening drastically, depending on the priority given to the different forms of communication and involvement, we can isolate the following "prototypes" of/for smart cities (Dimitriu & Elisei, 2014):

- The open city: It is the city model that operates with transparency. The communication of its activities is straightforward: decision-making processes in streaming, online publication of all acts, easier access to the file. The adoption of open data model has plenty of space and urban development in this philosophy of government.
- The cloud/platform city: In cities cloud / platform technology becomes a facilitator of the use of the potential of public spaces. Urban space as a software permitting between ideas. A city that °creates an ecosystem that enables both transparency and also economic growth.[2]
- The creative city: The Creative City, according to Charles Landry (2012), identifies, nurtures, attracts and sustains talent so it is able mobilize ideas, talents and creative organizations. The built environment – the stage and the setting- is crucial for establishing the milieu. A creative milieu is a place that contains the necessary requirements in terms of hard and soft infrastructure to generate a flow of ideas and inventions. A milieu can be a building, a street an area, a city or a region.
- The wiki city: The communication between citizens and institutions is oriented to promote and facilitate the involvement of citizens in the management of the res publica. From the first experiments of e-democracy, in the late 90s, to the recent experience of politics and policies generated through interactions with bloggers. Citizens are called upon to take an active part in decisions that affect the city. Under many aspects Bologna could be considered on the way to be a wiki-city.
- The resilient city: "A Resilient City is one that has developed capacities to help absorb future shocks and stresses to its social, economic, and technical systems and infrastructures so as to still be able to maintain essentially the same functions, structures, systems, and identity."[3] We can even say that a resilient city is the one capable to change its identities and structures in order to assure to its citizens the same or a better level in quality of life.

[1] The Space of flows is a high-level cultural abstraction of space and time, and their dynamic interactions with digital age society. The concept was created by the sociologist and cybernetic culture theoretician Manuel Castells to "reconceptualize new forms of spatial arrangements under the new technological paradigm"; a new type of space that allows distant synchronous, real-time interaction.

[2] Rachel Sterne, chief digital officer of New York

[3] Definition provided by resilientcity.org

International studies from the World Bank (Guasch, Racine, Sánchez, & Diop, 2007) shows that standards can increase productivity and innovation and "will provide the foundation for long term advances in the way software is built, bought and deployed". The 2011 update on the DIN study on "The Economic Benefits of Standardisation"(Blind, Jungmittag, & Mangelsdorf, 2011) quantifies the contribution of standards to the growth rate, which in each country is equivalent to 0.9% in Germany, 0.8% in France and Australia and 0.3% in the UK. EC studies also found that the two largest factors explaining economic growth are 1) increased stock of capital goods, and 2) availability of a stock of standards. ESPRESSO pursues an integrative approach that understands Smart Cities and Communities as a system of interlinked processes, components, workflows, legal and administrative constraints, or organizational guidelines. Data is provided by many sectoral and heterogeneous systems that need to be made interoperable in order to enable sustainable and economically powerful data integration and processing. ESPRESSO considers open standards as a necessary prerequisite for any such system-oriented approach and reflects all of these aspects in the structure of both its work packages and its consortium. The latter consists of standardisation organizations, private industry (both large integrators and SMEs), cities as final users and customers. The consortium also links to strong user engagements, and research-oriented organizations to ensure embedding of standardisation and reference architecture concepts in applied research studies.

4 PROJECT APPROACH

The proposed ESPRESSO consortium to tackle these issues consists of 16 partners that provide an excellent combination of the necessary competences to achieve the project's objectives. ESPRESSO has an assembled and interdisciplinary team, consisting of Smart City cities, large scale integrators, governmental owned organizations, SDOs and industry consortia, SME's, and applied research organizations. Within this group, there is a unique combination of crosscutting skills and experiences suited to the concept of Smart City and Communities and standardisation. In order to ensure social acceptance of developed solutions, ESPRESSO sets up a stakeholder communication network that enables an early dialogue between standards development organizations, technology providers, and technology consumers (cities and citizens as end users) to avoid a mismatch between the design of technology solutions and cities' and citizens' needs. ESPRESSO guarantees the inclusion of end-users in terms of planning; design and knowledge transfer along the lifetime of the project. Training material and sustainable platforms will further help to ensure social acceptance in the long run. ESPRESSO includes a dedicated work package to understand the impact of the proposed solutions and technologies, with a specific task focusing on social and organizational aspects. ESPRESSO is based on the assumption that cities will develop and provide a city platform on which most city applications and services will run. This platform will be the main IT backbone that will vertebrate many existing sectoral systems (e.g. energy efficient buildings, smart grid, intelligent transport systems, eHealth systems) and many new applications and systems specifically designed for Smart Cities and running on the city platform. Similar ambitions and efforts to define a Smart City platform have been reported from other parts in the World (such as South Korea or China and some proprietary solutions exist on the market (IBM, Cisco, etc.) (Kitchin, 2014; Ratti & Townsend, 2011).

Standardisation efforts and results are already available in 'vertical' domains like eHealth, Building Energy Management Systems or Building Information Systems, Smart Grid, or Intelligent Transport Systems. These efforts should not be redone or even revised for the case of Smart City, at least at the beginning, but should be analysed and used as they are. What is already available today provides most of what is required. Nevertheless, ESPRESSO acknowledges that in some areas (such as e.g. Internet of Things - IoT) standardisation efforts are on-going and may extend the current standardisation base relevant for Smart City. The horizontal interoperability of applications and services running on top of Smart City platforms is not feasible at this first stage and hence is a long term objective. Horizontal interoperability would result in lots of interoperability dimensions that need to be analysed. Therefore, ESPRESSO avoids crosssectoral standardisation analysis, but takes initiatives such as FIWARE into account that prevent silos and ensure creating bridges towards interoperability between systems that are nowadays defined as silos. The direct involvement of Smart City cities and other relevant stakeholders from on the beginning to ensure reliable and real-world-need-driven development of requirements for open standards for Smart City with the goal to bring as efficiently as possible to the market the greatest number of SCC solutions. It is the aim to integrate business perspectives and relevant means, such as the development of a strategic growth map, which traces a long-term strategy to monitor the effects of standardisation in the Smart City domain, the proposition of a fast-track standardisation pipeline to increase business and competitiveness, or the development of training material. A further aim is to cross-fertilise and cooperate with on-going actions under topic SCC-1 – 2014/15 and reuse existing networks and alliances to avoid replication of efforts.

- WP 1: Aim is to identify global stakeholders (industry, SDOs, etc.) and geographical clusters in the domain of Smart City (including "lighthouse" initiatives and their potential replicators and Smart City innovation zones) published as an online Interactive Atlas of Smart City and relevant stakeholders. To promote capacity building among the stakeholders in order to create a large eco-system (called the SmaCStak network), reaching out to hundreds of stakeholders, gathering a community, around ESPRESSO, made of local European and global stakeholders from both public and private sectors. The task will ensure the pooling of stakeholders for later activities (collection of requirement and validation of results), the creation of a large ecosystem on themes relevant for the project among local EC stakeholders, the understanding of the landscape associated to Smart City (incl. regulations and trends at local level) and the facilitation of liaising with relevant international initiatives (standardisation community, international organisations and associations, EC projects).
- WP 2: An additional aim lies in providing a consistent and shared definition of what a Smart City is today in terms of sectoral services and how this may evolve in the medium to long term. This will help select representative use cases, in terms of Smart City standards, for the pilot cities of ESPRESSO, to single out requirements for Smart City standardisation aspects, to define a conceptual standards interoperability framework for Smart City and to map existing standards from various SDOs on top of the conceptual standards framework. Also to carry on a comprehensive SWOT analysis related to future standardisation landscape and to define all aspects related to later interoperability testbeds (e.g., stakeholders to be involved, software modules required or available, different datasets to be harmonized and integrated, hardware or technologies to be supported, specific regulatory requirements, privacy and security requirements) is an aim of the project.
- WP 3: This work package uses the results from WP2 to identify standardisation priorities based on a standardisation criteria matrix and develops in close cooperation with CEN, CENELEC as well as international standardisation organizations fast track recommendations that will be handed over to the corresponding SDOs for future consideration and implementation. In detail, WP3 has the objectives to analyse and document: Overlapping and subsequent harmonization potential of standards across different SDOs, Coordination requirements on new standards or components between European bodies CEN-CENELEC-ETSI, Priorities for standardisation activities within the various SDOs (OGC, ISO, etc.) and development of aligned roadmaps for SDOs and associated organizations, Developments of fast-track guidelines for various SDOs.
- WP 4: Work package 4 has the objectives to satisfy the technical objectives within ESPRESSO, i.e. the development of a shared vocabulary, the definition of reference architecture, the city information and indicator platform, certification program, and execution of pilots. WP4 takes the results from WP2 as its technical baseline and uses results from WP3 that help optimizing WP4 products.
- WP 5: Aim of work package 5 is to identify long-term strategic market implications of standardisation in the Smart City domain brought by technological as well as societal evolution as well as to identify new economic, financial and procurement models which can suit emerging Smart City scenarios and to promote a range of marketing opening actions targeted to standards in the domain of Smart City.
- WP 6: The goal of this work package is to understand and assess the legal, administrative, and societal impacts of Smart City platforms, applications, and workflows enabled by new information technology solutions.
- WP 7: To ensure maximum awareness of the projects activities and achievements through liaisons with other initiatives, through dissemination activities and through web-based publishing initiatives and to organise a wide range of events addressed to a variety of different audiences.
- WP 8: To ensure that all the objectives of the project are met in line with the project schedule and with the highest quality standards, in terms of technical achievements as well as pilot and awareness activities. To deploy a management structure that can ensure the necessary control over the project activities. To ensure monitoring of the project from a technical, operational, financial, administrative point of view.

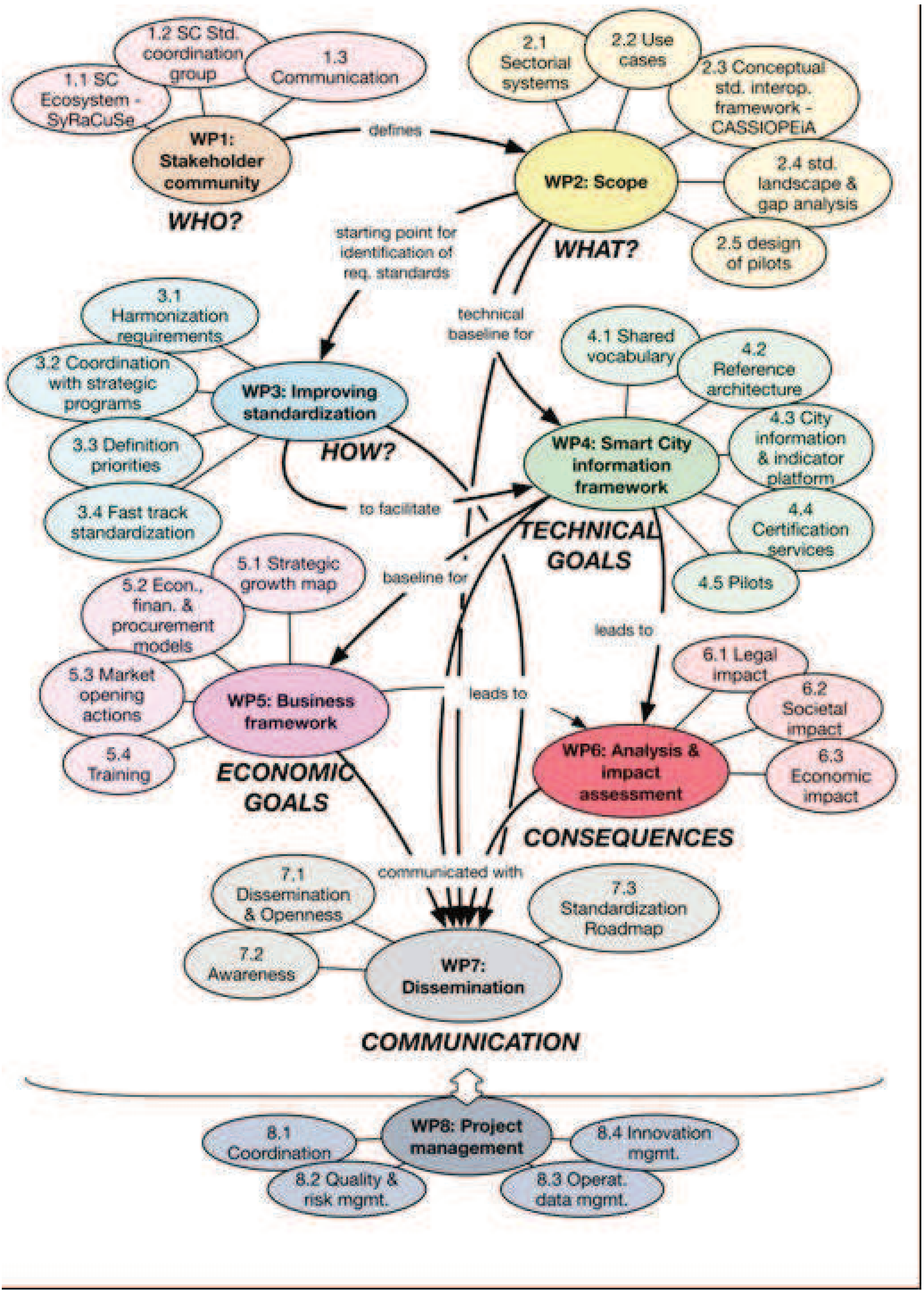

Fig. 1: The ESPRESSO Approach

5 DISCUSSION

Activities carried out within the ESPRESSO framework have the aim to ensure interoperability of Smart City solutions, as well as avoiding entry barriers or vendor lock-in through promoting common meta-data structures and interoperable (open) interfaces instead of proprietary ones. In addition, it is foreseen making relevant data as widely available as possible – including to third parties for the purpose of applications development – whilst using common, transparent measurement and data collection standards to ensure meaningfulness and comparability of performance/outcome measurements.

From a technological perspective, there has to be a specific degree of standardisation in the urban ICT networks. These have to be chosen so that they are not proprietary and prevent innovative Bottom-Up-solutions and equally open to city administrations, companies and citizens. The required interoperability of services implies a certain degree of standardization in urban ICT networks. To build reliable and secure ICT

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structures, cooperations with the private sector are necessary. From an institutional point of perspective, the governmental requirements from a streamlining of processes are manifold and enhance potential for implentations of standardisation approaches. These issues will also be tackled with the close cooperation of our urban partners oft he project as well as cooperation partners within the Smart City Stakeholder (SmaCStak)-Network. Therefore, it is important that they are not proprietary and prevent innovative bottom-up software solutions. Thus, the democratic legitimacy through full participation is essential in these standardization processes and thus part of a complex planning and city development process (Lojewski & Munziger, 2013). The dependences between Smart Cities, standards and social aspects are far more complex. The potentials of a networked ICT city are important, but also the dangers have to be taken in mind. Especially for public participation, there will be a complex potential, because, “design is a social process and not only a paternalistic process” (Klosterman, 2008, p. 98). The ethical aspects have to take in account that Smart City approaches are not non-transparent "Black boxes" planned in to p-down manner by a small group of "specialists" (Exner, 2014). An important contribution to smarter cities is to foster innovation and creativity in the light of the knowledge-society. This includes also civic bottom-up movements. For example "Civic Hacking" is thereby described as the movement in which united citizens develop their own ICT solutions to urban problems (Townsend, 2013). In the light of these developments, ethical considerations are highly relevant, because “the thoughtful use of smart technologies is a challenge for cities and their future citizens” (Kunzmann, 2014, p. 18). There are many critical considerations regarding Smart City concepts in the scientific discourse (Greenfield, 2013), so these issues also have to be tackled in projects such as ESPRESSO . Most of the well known Smart Cities have concepts, which focus on optimization and efficiency, organized in a top-down manner and regarding the urban area simply as machine, which is controllable and adjustable though the social impacts of Smart Cities and the respective standardization approaches have to be considered and will be part of the work for ESPRESSO, too. In order to ensure social acceptance of developed solutions, ESPRESSO sets up a stakeholder communication network that ensures an early dialogue between standards development organizations, technology providers, and technology consumers (cities and citizens as end users) to avoid a mismatch between the design of technology solutions and cities’ and citizens’ needs. ESPRESSO ensures inclusion of end-users in terms of planning; design and knowledge transfer along the lifetime of the project.

6 CONCLUSION

Smart cities have, above all, a vision – they know what smart services have to be implemented at which point, and they know that through the shared knowledge, increased administrative capacity and the voice of the stakeholders. At the very least, the technology developed has to be understood, valued and integrated in the daily use of the targeted stakeholders, and for this education and capacity-building plays a key role. If it comes to the question if standards could help to empower Smart Cities, this question can be answered with a “yes” from a technological perspective, but this has to be seen in context of the given restrictions. From an institutional and social perspective, the interdependencies are far more complex. One of the most important questions will be, how the Smart City of the future should look like and how to develop a common understanding for these issues. This problem will be tackled by ESPRESSO in order to develop Smart Cities for Europe, which are especially beneficial for its citizens. This embracing understanding of the topic is important, because the transformation towards Smart Cities requires thus a fundamental change in behaviour, both in what concerns the citizens and the local governments. Openness and dissemination activities are essential in order to provide citizens with information on the stakes and benefits of smart solutions, as well as to involve them as future users and even co-designers of smart services – and that is primarily a responsibility of the administration bodies, which need to think in new, integrated long-term policies and citizen-centric initiatives.

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Smart City for Smart People

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1 ABSTRACT

Korneuburgs way2smart started in the year 2011, when the municipality of the town decided to start a big participation-project to define a Vision Statement and a Master Plan for its urban development.

Smart people – citizens, politicians and administration - planned Korneuburgs way to 2036: with ambitious objectives in terms of energy and CO_2 saving and concentration on "social interaction". 2036 onwards, the municipality of Korneuburg wants to be energy-self- sufficient and carbon-neutral. With the Smart City demo-project "way2smart" measures of the Master Plan will be implemented evaluated regarding their feasibility and adapted if necessary.

Smart technologies: The municipality of Korneuburg intends to rehabilitate two municipality-owned residential buildings, densify the area by way of superstructures and annexes and equip them with energy-generating areas – not for building nice penthouses for rich people, but covering young tenants' demand for affordable small apartments.

As accompanying measures, communications programs involving the buildings' existing and new tenants as well as the further development – because neighbourhood is a big impact for the quality of lifestyle. Last, but not least, mobility measures like e-carsharing, a hitch-hiking-station, good cycle-parking-facilities etc. create the possibility to be mobile without a private car.

Ultimately, the endeavours to achieve the ambitious objectives in terms of energy and CO_2 saving in Korneuburg by 2036 are to be documented in a database in order to make the individual measures available as models and stimuli for comparable projects in the town.

Keywords: energy, Korneuburg, mobility, social interaction, way2smart

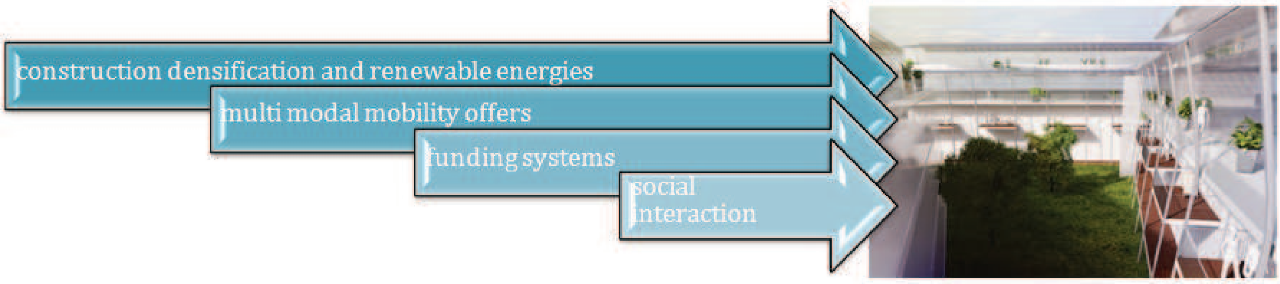

Fig. 1: Korneuburgs way2smart – technics, financing systems and social interaction

2 INTRODUCTION

Korneuburg wants to become a smart city.

Maybe the expression "city" is not the perfect word for a town with about 12.000 inhabitants, but Korneuburg is growing - forecasts say, about 50 % rise in population until 2036. Many people, mainly from Vienna, like to come and live here because of the high quality of lifestyle – the "green area" next to Austria's capital. But the community area is rather small, densification is the only way to increase - so the small town will become a small city.

From 2036 onwards, the municipality of Korneuburg wants to be energy-self-sufficient and carbon-neutral. In order to follow up on its "Korneuburg 2036" vision statement and master plan with concerted measures, a demonstration project was launched to demonstrate that energy-sufficiency and carbon-neutrality measures can be definitely reconciled with socially-compatible, affordable housing and living space as well as with eco-efficient mobility.

In "way2smart" two approaches shall be followed: the top down and the bottom up approach.

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3 TOP DOWN: WAY2SMART SHALL DEMONSTRATE, HOW LIVING 2036 CAN BE

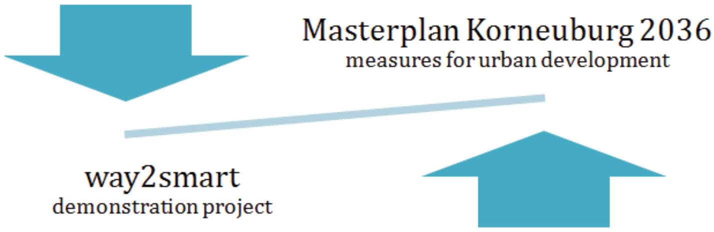

Fig. 2: Korneuburgs way2smart shall demonstrate, how living 2036 can be

The Masterplan2036, Korneuburgs urban development concept, created with public participation, is based upon 3 pillars: social interaction, education and water. Public participation and energy-self-sufficiency are the foundation, on which these pillars are built. Various of the derived measures for the development of the town were included in the research-project way2smart.

Way2smart shall demonstrate, how energy-self-sufficiency and high quality of life is affordable also for small budgets.

Low-energy-constructions and passive-houses already became usual standards in Austria – at least for new single-family-houses. The photovoltaic-plant on the roof of the house in the country is some kind of status symbol. Also e-mobility becomes chic – a status symbol for the environmental engaged middle-class. People with low income have to economise. Rents are high, energy-efficiency and renewable energies seem to be a luxury, they cannot afford. In the sector of renovation, particularly in the low-price-sector of community-housing, the decision of the energy-standard mainly depends on the costs of construction. The payback-period of investments in energy-efficiency is fixed on the credit-period (about 20 years) - low energy-prices at least are not helpful for a booming energy-efficiency in social-housing projects.

For reaching the goal of energy-self-sufficiency and carbon-neutrality we have to go one step further: Climate protection has not only to "become sexy", as Arnold Schwarzenegger promoted this in Vienna 2013 – it also has to become affordable for anybody.

The project way2smart combines proven and new technical, social and funding systems with one goal: making the energy-self-sufficient living favourable – and prove, that carbon-neutrality is not a luxury, we cannot afford. Way2smart is made to show, how living in "Korneuburg2036" shall be possible for everybody.

3.1 Construction and technologies

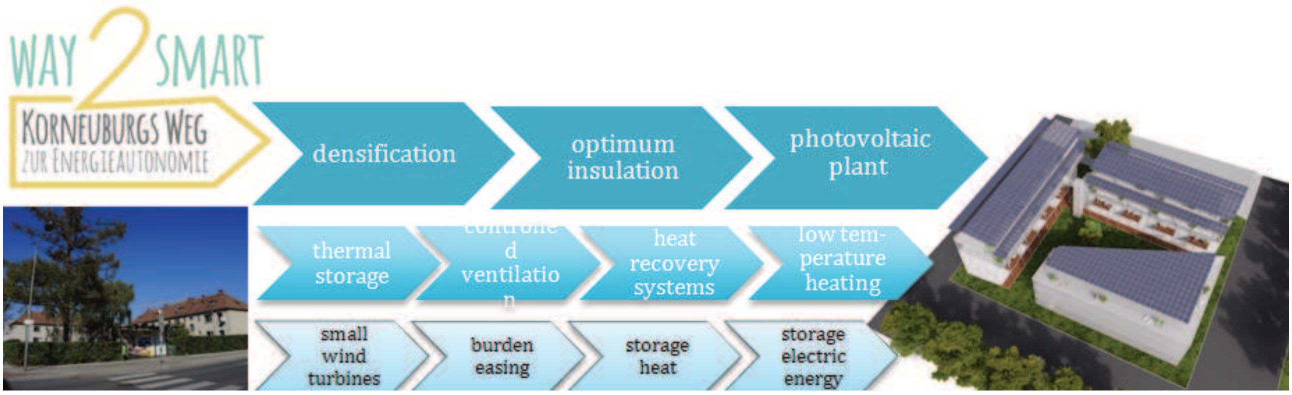

Fig. 3: Constructions densification and solar energy are the technical keys to Korneuburgs way2smart

The technologies for high-efficiency-standards and the generating of renewable energy used in the project way2smart are mostly well-approved: building densification, optimum insulation, central low-temperature-heating systems, thermal storage, controlled domestic ventilation and heat recovery systems will reduce the energy-demand to a minimum. Last but not least a big photovoltaik-system will supply the renewable energy for housing and mobility in the residental project of way2smart.

Also the application of new technologies is part of the way2smart: Small wind-turbines, systems for easing the burden of higher level grids and for the storage of heat and electric energy will be examined.

The technical key-innovation of the project way2smart is the „photovoltaic roof-landscape“, a system of optimized photovoltaik-surfaces especially for hightening buildings. On buckled and folded roofs solar-energy for up to 7 floors can be provided. The „photovoltaic roof-landscape“ plays also an important role for shadowing and daylight-utilisation. The combination of hightening buildings and optimizing the roof-landscape for solar production will be replicable to other buildings.

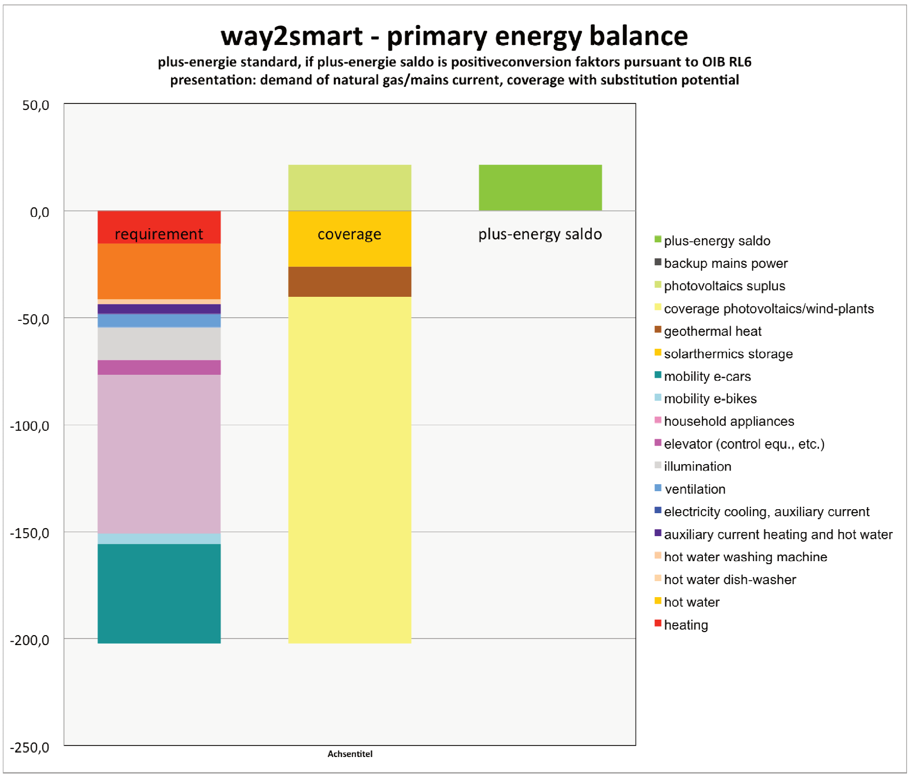

Fig. 4: primery energy balance way2smart

Korneuburgs way2smart is also following old rules: the small flats will be renovated but

not increased. Living in compact, small and smart flats is in principle energy-efficient (and affordable). Quality proves its value – the common use of technical equipment can help saving energy (and money)

3.1.1 Smart mobility projects

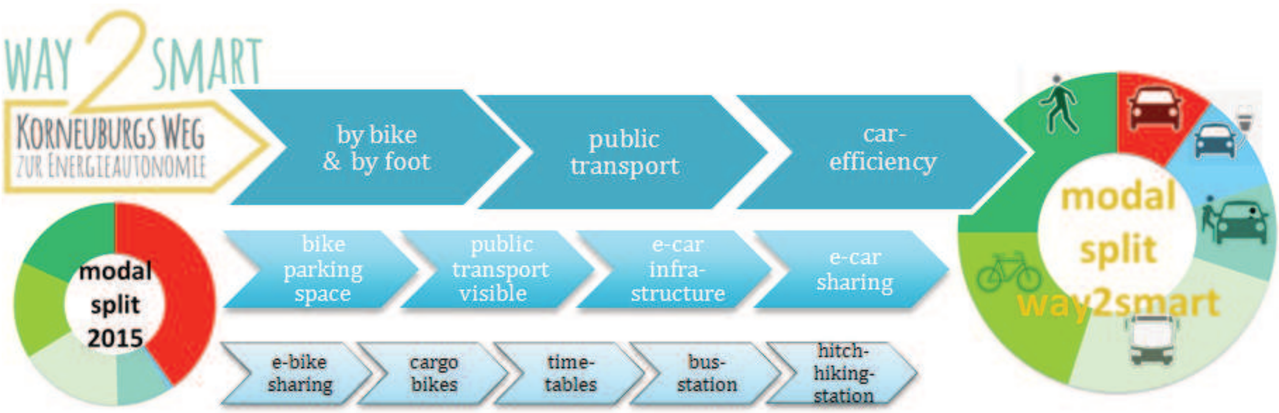

Fig. 5: Korneuburgs way2smart also includes mobility-measures

Growing population in a small and limited area requires mesures for smart mobility – not only because of the insufficient infrastructure and environmental impacts caused by further rising motorised privat transport. It is also responsible for nearly one third of the towns greenhouse gas emission.

That’s why the goal of energy-self-sufficiency and carbon neutrality in the project way2smart also includes the mobility of the tenants. Mobility costs will be an important argument for the use of alternative mobility offers – by comparison to the use of “the own car” about € 1.000 per person and year can be saved by

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accepting these offers. information and creating awareness is part of the buddy-programm (see „social interaction and communication).

Last but not least it will not be possible to build the whole amount of required parking spaces at the construction-area of the residental building, the goundwater level is to high for 2 underground-parking levels. Building regulation of lower Austria prescribes 1 parking space per residental unit, the city-council of Korneuburg rised the requirements to 1 ½.

There are many reasons to keep the amount of "own cars" as small as possible – at least the costs for parking space in urban areas.

Way2smart offers intermodal mobility instead:

- optimizing bicycle parking space: higher amount (1 per person instead of per flat), higher quality (save locking, easy acessible)
- e- and cargo bikesharing
- better information about public transport offers (make public transport „visible")
- electricity filling station
- e-carsharing
- hitch-hiking-station

The mesures will be testet and optimized in the project way2smart and shall than be spread over the town's area.

3.2 Funding systems – keeping rents affordable

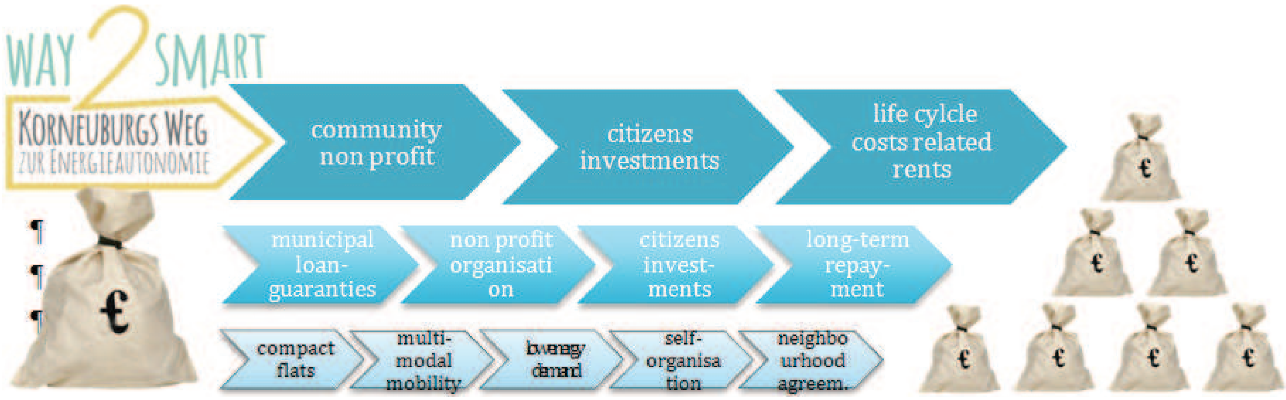

Fig. 6: Funding systems keep the rents affordable

Community housing can be offerd at affordable rents, because they are not built to rise profits, but to increase the social wellfare of the citizens. For Korneuburgs way2smart further measures are planned, to keep the rents affordable: New financing-systems like citizens investments and life-cycle-cost-relatet financing ensure, that tenants pay fair rents and energy-prices. Other mesures allow the tenants to safe money, like the multimodal mobility-offers and self-organisation and neighbourhood agreement (see social interaction).

3.2.1 Citizens investments

Investments in producing renewable energies will be financed autonomous by citizens investments. People are invited to invest in a regional project – the loan is paid back with the energy-sales revenues. To rise the economical benefit of these invetstments different methods to rise the energy-consumption on-site the residental-building will be analysed: on one hand financial incentives for tenants to use the produced energy in-time, on the other hand the use of micro-storage systems (also battery-storage in e-cars).

3.2.2 Life cycle costs - related rents

Way2smart goes one step further to ensure fair rents also for high-quality buildings: life cycle costs – related rents means to split and finance the costs in accordance with the lifetime of the investment. Different parts of the new building will be evaluated according to their expected lifetime. On this basis the credit period for the investments in the renovation shall be adapted. So every tenant pays only for the part of the investment he oder she uses - and the value of investments in high quality becomes visible.

This would be rather easy with the public funding system of former times. There is still a loan to be payed back for the construction of the original building we work with – its credit period is 102 years, the annual rate is about € 220,--. And as you can see, there is still a building and its value is higher than the € 6.000 that still has to be payed back until 2040.

But on todays credit market you hardly find loans with a repayment-period longer than 30 years. Also the public funding for renovating residental buildings in lower Austria occurs via interest subsidys for credits running for 15 or 20 years. That means, with the usual financing system the complete renovation and construction has to be payed back in about 20 years – even though the benefit of parts of the investment remains up to 80 or 100 years.

The credit rates for the investments in a renovation have to be payed back by the tenants via the rents, so the tenants during a period of about 20 years after the renovation partially pay for the tenants living there during the next decades. On one hand this system is not fair. On the other hand it prevents investments in high quality and long living components and materials, because the benefit of their added monitary value becomes tangible years after the envestment. Tentants of community residental buildings have to economize.

The solution might be a mixture of bonded and amortisising loans relativly to the life cylce costs. The local council will have to decide about the funding system and also the tenants will have to agree. Although long-term financing for construction-projects is a wellknown and logical justified method it is not applied anymore, so the benefits have to be proven to politicians and tenants. Therefor the calculations have to be transparent and comprehensible and long-term evaluable.

3.3 Social interaction and communication

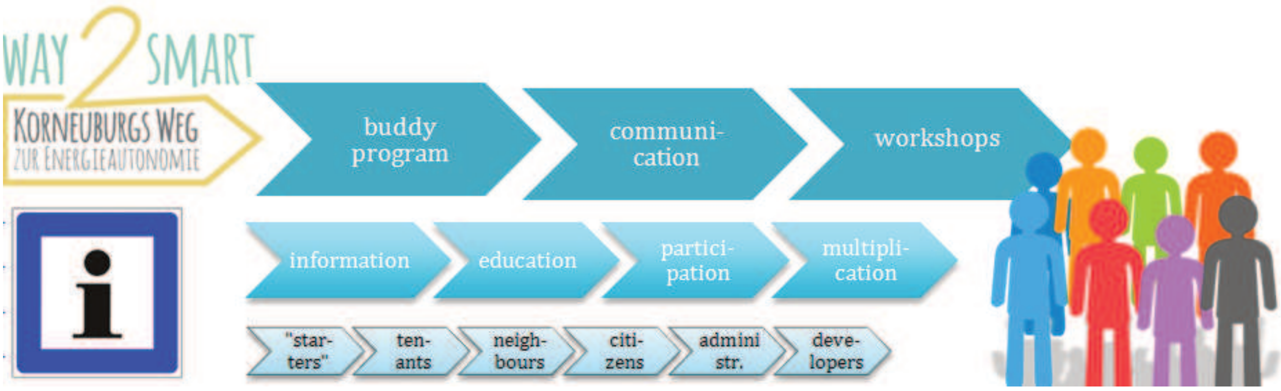

Fig. 7: social interaction and communication for better acceptance

It’s not only the technical equipment, that makes living smart. Social interaction and communication play a key role in our project. The residential building with up to 50 flats is also meant to be a model for best practice housing community. We want the tenants to be inspired by the lifestyle in an energy-self-sufficient building with a housing community that supports self-organisation and invites to participate and engage.

It’s a small town’s advantage, that neighbours know each other, learn to respect each other and finaly help each other. Especially if the monetary income is not too high (there are income-limits for getting a community housing in Korneuburg), the value of a good neighbourhood should not be underestimated.

3.3.1 The “buddy program”

The way2smart includes a special offer for young people searching for their first own housing. „Starter flats“ can be hired for a limited time (3 years) for a lower rent. The first step to independence and a possibility to find out, what is important for the own lifestyle.

That’s why a so called „buddy program“ will be installed. It includes information and education at eye-level on topics like the correct use of the technical equipment, possibilities for self-organisation (person of trust as representing the tenants, management of car sharing and common rooms, and so on). Speakers and teachers come from relief organisations as well as „ordinary citizens“ from Korneuburg, sharing their special knowledge. That „at eye level“ plays a key role for the way2smart communication. It’s easier to accept or

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believe, to discuss and finally be inspired from a message, if it is delivered from someone, you can identify with. The buddy-program reaches it's goal, when „the starters" are inspired by the lifestyle of way2smart and carry their experience to their next housing community.

On the one hand, users training is important to gain the full efficiency of the technical equipment. If tenants understand the technical background of users-instructions it's easier to act accordingly. On the other hand neighbourhood-assistance helps saving money, strengthens the self-confidence and supports cooperation, respect and good relation between tenants.

3.3.2 Early communication with neighbours and tenants

Last, but not least, communication with tentants and neighbours will take place as early as possible, at a time, when the extentions and plans of the building are not fixed. So the wishes and worries of tentants and neighbours can be taken in consideration, if they are useful and sustainable.

Korneuburg is a small town with limited construction area and a high population growth. Building densification and its (non-)acceptance in public and particulary in the neighbourhood plays an important role in the Masterplan2036. Many construction-projects of the last years lent to controverses with the neighbours, some of them were temporary stopped by the protests. The solution for this problem provided in the Masterplan is earlier and better communication between building owners and affected citizens.

The possibility to participate in design-developement of a building creates satisfaction with the living environment – for tenants and neighbours. Not every wish can be fullfilled – but if some negative impacts and worries can be cleared out in advance, we expect a higher acceptance of the project in the neighbourhood.

3.3.3 Property developers' workshops

How to motivate property developers to build smart?

Experiences made in the realisation of the construction project, the mobility measures and the participation-process will be shared and discussed in property developers workshops. Possibilities for local councils promotion and support of smart-city measures in further construction projects will be the result of these workshops. Of course the workshops shall also motivate the property developers to take smart measures.

4 BOTTOM UP: EVALUATION OF THE WAY TO ENERGY SELF SUFFICIENCY

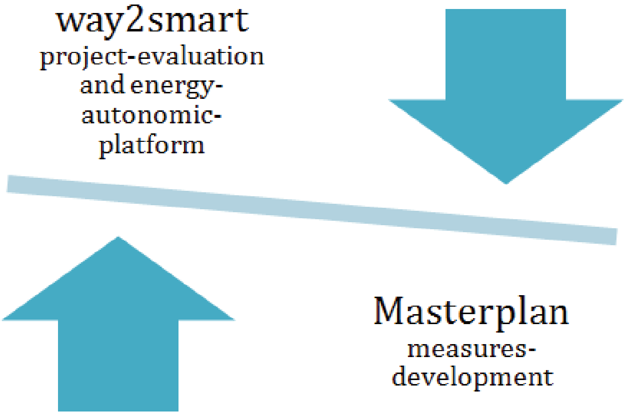

Fig. 8: bottom-up: evaluation

The municipality of Korneuburg decided the town to be energy-self-sufficient and carbon-neutral in 2036. The energy-autonomic-platform visualizes the necessary measures, describes smart projects and their contribution to reaching the goals also as the implementation level of energy-autonomic in Korneuburg.

150 micro-districts are defined, spatially mapped and partially filled with basis-data like extension, age of building and modernisation, building type (e.g. single-family-house) and its current energy performance. In a first step community-owned buildings will be recorded, in a second step it will be usable also for private buildings. Data protection and privacy plays a key-role in this part of the project.

5 CONCLUSION

Fig. 9: Sustainable livestyle is not a privilege for rich people

Korneuburgs way2smart is a project with many various approaches playing together for reaching one goal: to demonstrate, that sustainable lifestyle is not a privilege for rich people but possible for everyone. Ideas from citizen participation as well as new and „old" technologies will be examined to find out the ecological, economical and social optimum combination for a smart city.

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Smart, Green and Inclusive Urban Growth: Visualising Recent Developments in European Cities

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1 ABSTRACT

Cities are expected to play a key role in delivering the Europe 2020 strategy for smart, green and inclusive growth. Concerning smart growth, cities are at the forefront of innovation. Moreover, the physical concentration of people, capital and business opportunities means that cities are more productive than other places. In relation to green growth, healthy, compact and energy-efficient cities are key to achieving sustainability in Europe. Many European cities are currently developing or expanding their networks for walking, cycling, public transport, waste management, district heating and green infrastructures. Finally, cities can contribute to inclusive growth. For example, by combating social polarisation and poverty, by providing affordable housing and by integrating refugees and migrants.

In the context of the Urban Agenda for the EU and the Dutch EU presidency in the first half of 2016, the PBL Netherlands Environmental Assessment Agency has recently published ‘Cities in Europe’ (PBL, 2016), a publication that visualises facts and figures concerning recent urban developments in relationship to smart, green and inclusive growth in the European Union.

Based on the harmonised definition of urban areas by Eurostat and the OECD (OECD, 2012), European cities are compared with each other and recent trends are described, such as those in migration, risk of urban poverty and urban-rural divergence in employment growth. Furthermore, the following questions are being explored: which cities have shown strong growth in population, GDP and employment? Are the growth rates related to the size of the agglomerations? In which cities is the population showing high levels of satisfaction about quality of life? And which cities are falling behind? What types of territorial patterns can be distinguished? This paper summarises the main findings of the publication and presents a number of infographics that give insight into the scale, dimension and relationships of urban developments in Europe.

Keywords: Comparing metropolitan areas, Data visualisation, Europe 2020 strategy, European Cities, Urban Agenda for the EU

2 INTRODUCTION

European cities are vital to the future of Europe. As stated in the Leipzig Charter on Sustainable European Cities (European Union, 2007), cities ‘possess unique cultural and architectural qualities, strong forces of social inclusion and exceptional possibilities for economic development’. Moreover, cities are centres of power, knowledge, innovation and integration. It is also in cities that great strides towards sustainability can be made, as their density allows for more energy-efficient forms of housing, transport and service provision. Many cities in Europe show serious ambitions and efforts to reduce greenhouse gas emissions. At the same time, however, these same cities often lack affordable housing and suffer from concentrations of unemployment and poverty. Furthermore, many cities have difficulties in dealing with traffic congestion, poor air quality and the effects of climate change (e.g. heat and heavy rainfall).

2.1 Urban Agenda for the EU

Cities are expected to play a key role in delivering the Europe 2020 strategy for smart, green and inclusive growth (European Union, 2015). Therefore, the EU’ s cohesion policy for the 2014–2020 period seeks to support towns and cities through a range of European investment priorities, such as urban mobility, economic and social regeneration, the digital agenda, improvements in research and innovation capacity, and the low-carbon economy.

In the past years, the European Commission, EU Member States and European cities have collaborated to develop an Urban Agenda for the EU. The core objective of this Urban Agenda is to involve cities in the design of EU policy, to mobilise cities for the implementation of EU policies, and to strengthen the urban dimension in these policies. Under the 2016 Dutch EU Presidency, the Urban Agenda for the EU aims to strengthen the urban dimension in EU policies by: (1) improving the development, implementation and evaluation of EU legislation (‘better regulation’); (2) ensuring better access to and utilisation of European funds; and (3) by improving the EU urban knowledge base and stimulating the sharing of best practices and cooperation between cities.

In 2016, the Urban Agenda for the EU is focussing on 12 priority themes (see Figure 1), as well as aiming to promote stronger cooperation between the European Commission, EU Member States and cities in order to stimulate smart, green and inclusive growth in the cities of Europe.

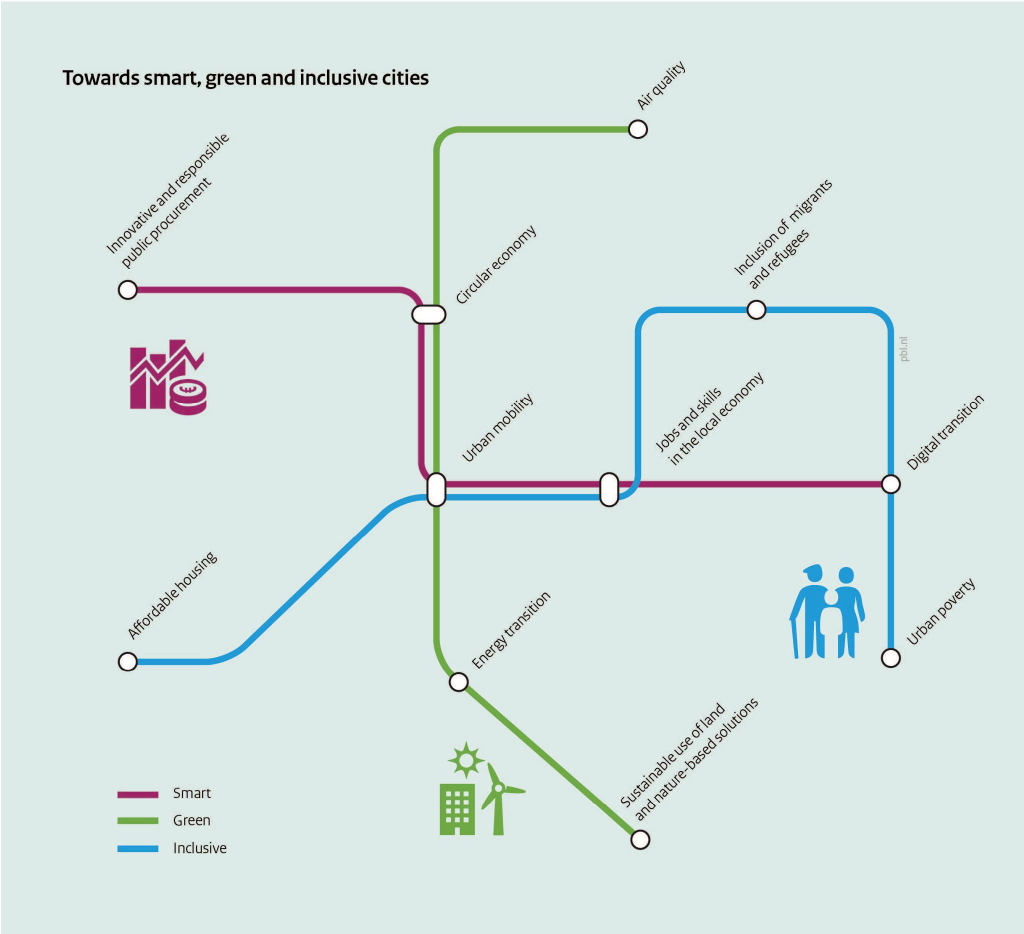

Fig. 1: Twelve themes of priority featured in the Urban Agenda for the EU, 2016.

2.2 Visualising data and using infographics

Eurostat and the OECD provide comprehensive databases on urban developments in European cities and urban areas that are accessible by internet. In many cases, however, the data is complex, not easy to find and not always easy to read. The publication 'Cities in Europe' (PBL, 2016) contains 13 infographics that show facts and figures on recent urban developments in a compact and comprehensible way. Using infographics is a powerful medium to communicate information and share knowledge with citizens, urban and regional planners and policy makers.

3 SMART GROWTH

The 2020 strategy aims to stimulate the transition towards an economy based on knowledge, research and innovation (European Union, 2015b). Cities are centres of knowlegde and innovation, and engines of the economy. Metropolitan regions contain 59% of the EU population, but they hold 62% of its jobs and represent 67% of GDP (European Commission, 2014). The concentration of people, capital and business opportunities means that cities are more productive than other places. It is therefore not surprising that cities figure prominently in the EU strategy for jobs and growth. The Urban Agenda for the EU, in particular, aims to include cities in the coordinated growth strategies of Member States and the European Commission. It aims to ensure maximum utilisation of the growth potential of cities.

Many of Europe's largest cities are also its most affluent (see Figure 2). The megacities of Paris and London rank among those with the highest GDP per capita ratios of the EU, such as Munich, Stockholm and

Frankfurt. Still, there is not a clear linear relationship; Helsinki is smaller than Naples, but shows a higher GDP per capita and a stronger economic growth rate. Bigger is therefore not always better. There is much more at stake, such as the national economy of the country in which they are situated. To a large extent, the geographical distribution of GDP per capita of cities reflects that of regions and countries in Europe.

Cities also differ in growth rate; just as real engines, they are running at different speeds. Again, size not necessarily matters – although Paris and London appear to perform above average – as much as geographical location. In the 2000–2010 period, a north–south divide could be seen, with northern cities generally outperforming those in the south. The most significant growth, however, occurred in central and eastern European cities, particularly in Poland. Some of this difference can be attributed to a lower starting point, but also to the EU's Cohesion Policy, under which especially new recipients are eligible to receive high European subsidies.

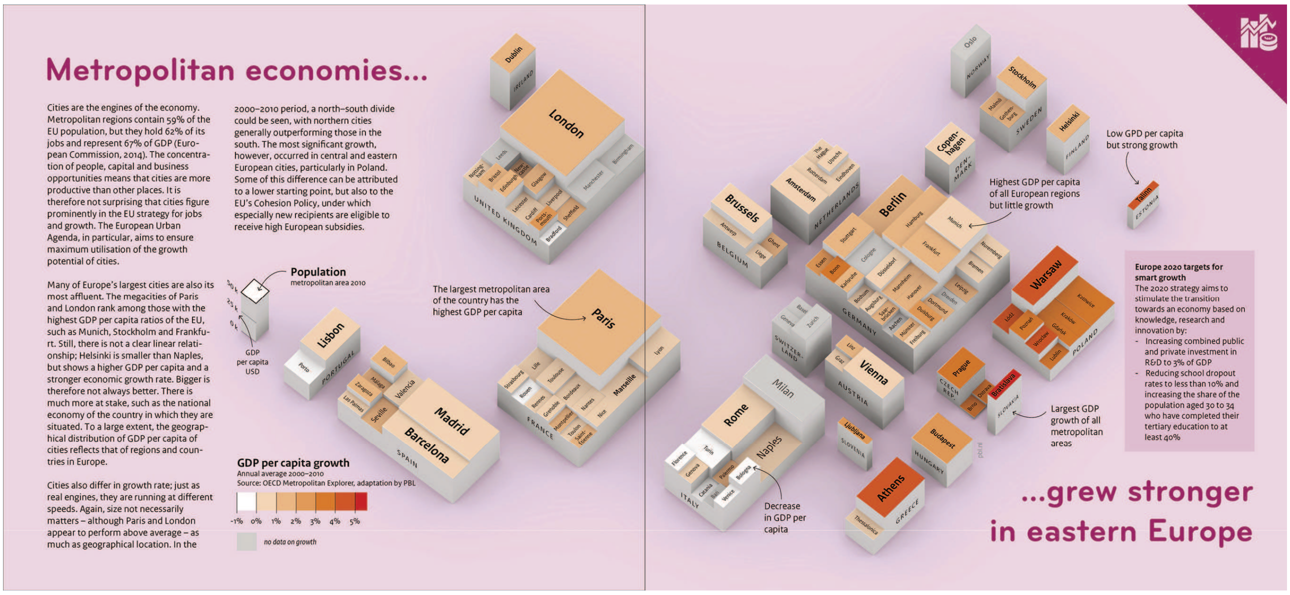

Fig. 2: Infographic on GDP per capita growth in European metropolitan areas (source: OECD, adaptation by PBL)

4 GREEN GROWTH

With the growing awareness of the consequences of climate change, the EU has committed itself to limiting greenhouse gas emissions and reducing the consumption of fossil fuels (European Union, 2015b). The Europe 2020 strategy has renewed the EU's commitment to become a 'low-carbon' economy where, by 2050, greenhouse gas emissions will be 80% to 90% lower than they were in 1990. Among other initiatives, European Cohesion Policy funding is being reallocated to support the production of renewable energy and improve energy efficiency.

Cities can be instrumental in the transition towards a low-carbon economy. They are significantly more efficient in terms of energy use and land use than other areas (European Commission, 2014). Household energy consumption in cities tends to be lower because a larger proportion of people live in apartments or terraced housing, both of which are more efficient in terms of heating than freestanding houses. Cities are also more energy efficient as regards transportation. Due to the shorter distances, walking and cycling are more attractive options in towns and cities than in other areas. There is also a higher demand for public transport which makes it more cost-effective to offer high-quality services, such as underground rail. A growing number of European cities and urban regions are already making serious efforts to reduce their greenhouse gas emissions; for example, by implementing more renewable energy or expanding their district heating networks (see Figure 3).

Despite the lofty ambitions of Europe's cities to become greener, simply reducing emissions in urban areas will not be sufficient to stop global warming. Cities provide fertile ground for innovation and creativity (UNEP, 2013), but because large-scale energy infrastructures are interconnected and government and governance structures are interdependent, coordinated multi-level innovation strategies are needed so that lessons can be shared with other metropolitan regions and across national borders.

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Fig. 3: Infographic on CO2 emissions and policy ambitions in six European metropolitan areas (source: OECD, adaptation by PBL)

5 INCLUSIVE GROWTH

Europe's population is growing, not only as a result of natural processes (more births than deaths), but also because of immigration (from outside Europe). Over the last few years, Europe has experienced a large influx of people. As a consequence of the geopolitical instability in the Middle East and Africa, immigration and refugee flows into Europe have increased, and this has had a significant impact on European countries and cities. People also migrate within the EU. For example, because of disparities in employment and income levels, inhabitants of central and eastern Member States have moved to those in the west (Espon, 2015; European Commission, 2014).

Migration, in general, and the current refugee flows into Europe, in particular, have clear territorial and urban dimensions. The main cause of the EU's population growth is net immigration (see Figure 4). Between 2001 and 2011, the EU's total population (EU-28) increased by 3.8%, with net immigration accounting for 3% of this. Natural population change was only 0.7% (European Commission, 2014).

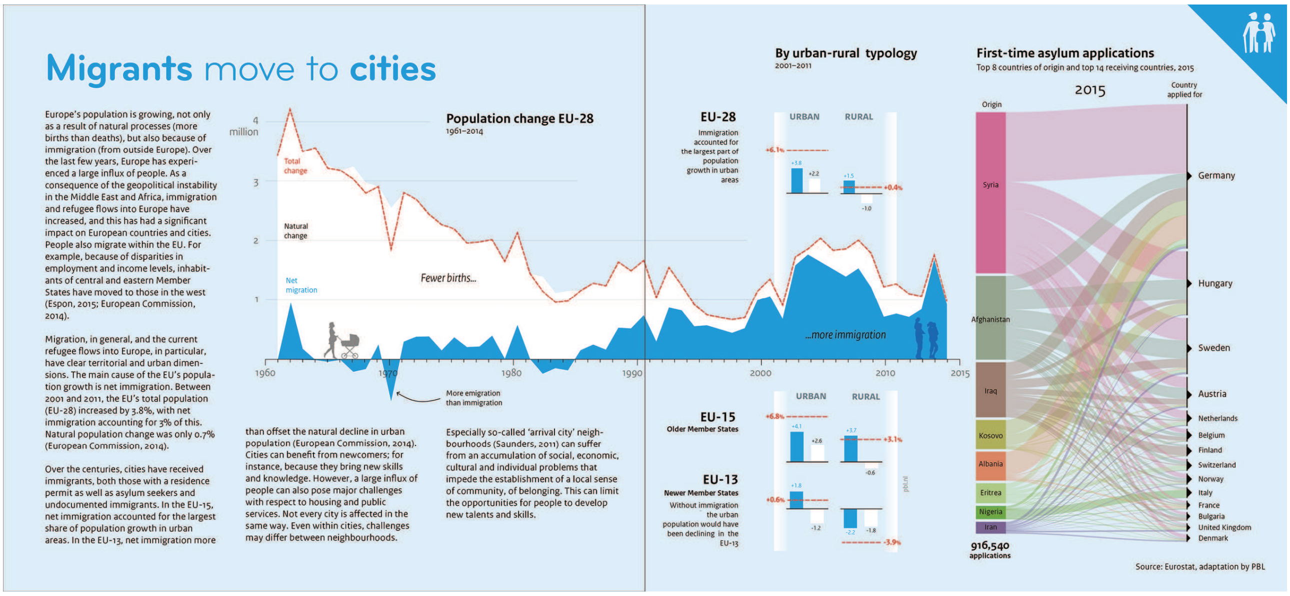

Fig 4. Infographic on population change and flows of refugees in Europe (source: Eurostat, adaptation by PBL)

Over the centuries, cities have received immigrants, both those with a residence permit as well as asylum seekers and undocumented immigrants. In the EU-15, net immigration accounted for the largest share of population growth in urban areas. In the EU-13, net immigration more than offset the natural decline in urban population (European Commission, 2014). Cities can benefit from newcomers; for instance, because they bring new skills and knowledge. However, a large influx of people can also pose major challenges with respect to housing and public services. Not every city is affected in the same way. Even within cities, challenges may differ between neighbourhoods. Especially so-called 'arrival city' neighbourhoods (Saunders, 2011) can suffer from an accumulation of social, economic, cultural and individual problems that impede the establishment of a local sense of community, of belonging. This can limit the opportunities for people to develop new talents and skills.

6 CONCLUSIONS

Cities are economic powerhouses, places of social interaction and fora that enable us to exchange ideas. Cities, however, are also the places where some of our biggest challenges manifest themselves. In this 'urban age' cities are becoming increasingly aware of their responsibilities as well as their capacities to play their part in addressing issues like poverty, segregation, and climate change adaptation. Some cities aim to take the lead by setting ambitious targets and by experimenting with innovative approaches that can be shared across borders. Additionally, the European Union and its Member States increasingly look to cities to put their policies into practice.

Given the complexities of the challenges facing us, we need to explore the opportunities for cross-border collaboration and multi-level coordination. Exploration of new strategies, plans and practices requires, among other things, high-quality data, thorough analysis and clear communication. Visualising information, e.g. by using infographics or interactive websites, can play a vital part in creating and sharing knowledge. In this era of networked knowledge production, bringing statistics to life is indispensable for effective policy-making and informing and involving stakeholders and the public at large, in cities, countries and Europe as a whole.

7 ACKNOWLEDGEMENTS

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Smart-City-Leitfaden für die Seestadt Aspern Wien

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1 ABSTRACT

In einer Vorstudie wurden die Grundlagen für die systematische Ableitung eines Smart-City-Leitfadens aus der Smart-City-Wien-Rahmenstrategie (SCWR) für ein konkretes Stadtquartier geschaffen. Dieser Ansatz wurde am Beispiel der Seestadt aspern angewendet und getestet.

Die in der SCWR definierten Ziele sind die Rahmenbedingungen der Smart-City-Zielsetzungen für das jeweilige Vorhaben der Stadtentwicklung in Wien. Im Sinne einer effektiven Umsetzung ist es nötig, diese langfristig beschlossenen Ziele Wiens in konkrete Ziele für das jeweilige Stadtentwicklungsprojekt zu übersetzen. Wenn möglich, sollten diese quantifiziert, ansonsten in benötigten Qualitäten und geplanten Maßnahmen beschrieben werden.

Für die Zielerreichung auf Quartiersebene sind daher konkrete Leitlinien, Kriterien und Handlungsanweisungen nötig. In diesem Sinne soll ein Leitfaden für Smart-City-Quartiere erstellt werden, der allen relevanten Stakeholdern, z. B. Stadt- und Energieplanerinnen und Energieplaner, Gebietsentwicklerinnen und Gebietsentwickler, Energieversorger etc. und für Wettbewerbe und Ausschreibungen als Orientierung dienen kann.

Als Grundlage dazu werden aktuelle Stadtentwicklungsprojekte untersucht und ausgewertet. Für die ausgearbeitete Studie wurde eines der größten Stadtentwicklungsgebiete Europas „aspern Die Seestadt Wiens" herangezogen, das ein Modellstadtteil für die Smart City Wien (SCW) ist. Anhand der bisherigen Erfahrungen, die in der Seestadt gewonnen werden konnten, wurden einzelne Handlungsempfehlungen formuliert. Diese wiederum können die Basis für die weitere Erstellung eines generellen Leitfadens für Smart-City-Quartiere und somit für Smart-City-Vorgaben (z. B. in Ausschreibungen) sein.

Die in dieser Vorstudie gezogenen Schlüsse bzw. vorgeschlagenen Maßnahmen stellen keine als dogmatisch zu verstehenden Handlungsanleitungen dar. Sie sind Empfehlungen, die noch keiner tieferen Überprüfung unterzogen wurden. In einem weiteren Schritt geht es darum, weitere Fallbeispiele zu identifizieren und den lLeitfaden anzuwenden und weiterzuentwickeln.

Die vorliegende Voruntersuchung bietet jedenfalls eine gute Grundlage, das Thema im Dialog mit allen Beteiligten weiter zu vertiefen und einen großen Schritt in der Umsetzung der Smart-City-Wien-Rahmenstrategie zu machen.

Keywords: Denkstatt, Seestadt Aspern , Smart-City-Leitfaden, Umsetzung Smart-City-Strategie, Wien

2 AUFGABENSTELLUNG

Die folgenden Abbildung fasst die Aufgabenstellung zusammen:

Schaffung der Grundlagen für einen Smart City Leitfaden für die Seestadt aspern

- Ableitung strategischer Smart City Ziele für die Seestadt aus der SCWR
- Entwicklung erster Ansätze für Detailziele, Kriterien und Indikatoren
- Ausrollen für andere Stadtentwicklungs- und Stadterneuerungsgebiete

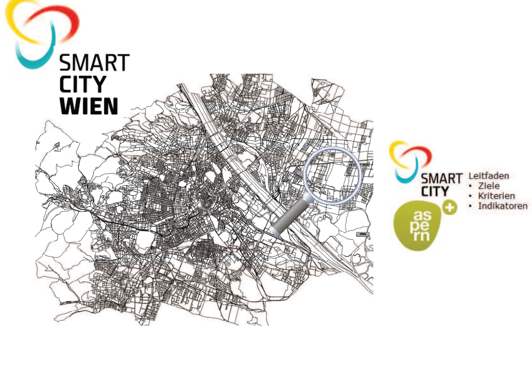

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Abbildung 1: Aufgabenstellung (Quelle: denkstatt GmbH)

3 VORGEHENSWEISE

Die folgende Grafik gibt einen Überblick über die grundsätzliche Herangehensweise zur Ableitung bzw. Entwicklung des „Seestadt-Smart-City-Konzeptes“ und der Erstellung von ersten Smart-City-Guidelines mit Kriterien und Indikatoren.

Abbildung 2: Prinzipbild zur Verdeutlichung der Vorgehensweise (Quelle: denkstatt GmbH)

3.1 Analyse der IST-Situation

In dieser Phase wurde für die wesentlichen Ziele der Smart-City-Wien-Rahmenstrategie die Situation in der Seestadt aspern analysiert. Anhand der Ergebnisse der Studie „Evaluierung der Qualitätskriterien der nachhaltigen Stadtteilentwicklung für aspern Seestadt“[1] und Informationen von der Projektleitung Seestadt Aspern der Stadt Wien und der Wien 3420 Aspern Development AG zu den aktuellen Entwicklungen wurden die bestehenden Smart-City-Qualitäten herausgearbeitet und den Smart-City-Wien-Zielen zugeordnet. Dabei wurden auch mögliche Schwachstellen in der Seestadt aspern hinsichtlich der Smart-City-Wien-Rahmenstrategie adressiert.

3.2 Analyse der Zielsetzungen für aspern Nord

In dieser Phase wurde der bestehende Zielrahmen für die die Entwicklung von aspern Nord analysiert und die Hauptaussagen zu den SCWR-Themen identifiziert. Ebenso wie in Punkt 2.1 wurden die Stärken und Schwachstellen des bestehen den Zielrahmens hinsichtlich SCWR-Zielen herausgearbeitet.

3.3 Erstellung des „Seestadt Smart City Konzeptes“

Hier wurden die in den vorigen Punkten identifizierten Smart-City-Qualitäten bzw. Schwachstellen der Seestadt aspern zu den Kategorien der Smart City Wien zugeordnet und wesentliche strategische Aussagen und Zielsetzungen formuliert. Es wurde dabei sowohl bereits Umgesetztes als auch Geplantes berücksichtigt. Das Ergebnis ist ein erstes „Seestadt-SC-Konzept“ mit Vorschlägen zu den wesentlichen strategischen Aussagen und Zielsetzungen. Dieses erste „Seestadt-SC-Konzept“ wurde mit der Magistratsabteilung 18 Stadtentwicklung und Stadtplanung und der Projektleitung Seestadt Aspern der Stadt Wien abgestimmt.

3.4 Schaffung erster Ansätze für Smart-City-Guidelines

Neben den strategischen Smart-City-Aussagen und den Smart-City-Zielsetzungen wurden für das „Seestadt SC Konzept“ auch SC-Guidelines mit konkreten Kriterien und Indikatoren erstellt. Im Rahmen der Vorstudie wurden für wesentliche SC-Ziele einzelne Guidelines entwickelt, die als Grundlage für Smart-City-Vorgaben in Ausschreibungen dienen sollen.

4 ERGEBNISSE

4.1 Bewertungskatalog für die Ist-Analyse

Es wurde ein umfassender Bewertungskatalog entwickelt, mit dem die Stärken und Schwächen der Seestadt aspern bezüglich der SCWR im Detail identifiziert und bewertet werden können. Dazu wurden für jedes

[1] Clemens Rainer (Verfasser), Wien 3420 Aspern Development AG (Auftrageber); Wien Juli 2014

einzelne SCWR-Ziel[2] die wesentlichen Smart-City-Themenfelder und zugehörige Smart-City-Qualitäten definiert, die zur Unterstützung des SCWR-Ziels in der Seestadt Aspern umgesetzt werden sollte.

Beispiel:

Als Beispiel wird hier das SCWR-Ziel „Steigerung der Energieeffizienz um 40% (im Vergleich zu 2005)“ herangezogen. Der zugehörige Zielindikator lautet: Endenergieverbrauch/Einwohnerzahl der Stadt Wien in [kWh / Kopf].

Die folgenden Tabelle zeigt die Smart-City-Themenfelder mit den zugehörigen Smart-City-Qualitäten, die für dieses Ziel definiert wurden:

Nr.	SC-Themenfeld	SC-Qualität
RE1.1	Grundlagen für energieeffizienten Betrieb	Integrales Energiekonzept
		Energiemonitoring - Gesamtsystem
		Energiemonitoring - Gebäude
		Flexibilität der Energieversorgungssystem für spätere Änderungen
RE1.2	Energieeffiziente Bebauungsstruktur	Kompaktheit der Gebäude
		Optimierung passive solare Gewinne <-> Vorsorge gegen sommerliche Überhitzung:
		Lokaler Luftaustausch
RE1.3	Energieeffizienz technische Infrastruktur	--> siehe Handlungsfeld "Infrastruktur" / Ziel "Aufrechterhaltung des hohen Niveaus der Wiener Infrastrukturen."
		Energieeffiziente Straßenbeleuchtung
		EnergieeffizienteVerkehrsleittechnik
		Energieeffiziente Trafo-/Verteileranlagen
		Energieeffiziente FW-Verteilung (Pumpen, etc.)
		Energieeffiziente Wasserverteilung / Abwasserentsorgung (Pumpen, Regenwasserversickerung, etc.)
		Energieeffiziente Wasserverteilung / Abwasserentsorgung (Pumpen, etc.)
		Energieeffizientes Breitbandnetz, WLAN

Nr.	SC-Themenfeld	SC-Qualität
RE1.4	Energieeffizienz in Gebäuden	Energieeffiziente Gebäudehülle --> siehe Handlungsfeld "Gebäude"
		Energieeffiziente Heizung (Netz, Übergabe, Pumpen, Verteilung und Abgabe, Radiatoren, etc.)
		Energieeffiziente Lüftung (Netz, Pumpen, Ventilatoren, Verteilung und Abgabe, etc.)
		Energieeffiziente Klimatisierung (Netz, Pumpen, Ventilatoren, Verteilung und Abgabe, etc.)
		Energieeffiziente Beleuchtung
		Energieeffiziente sonstige Stromverbraucher
RE1.5	Energieeffizienz Mobilität	--> siehe Handlungsfeld "Mobilität"
		Energieeffizienz im ÖPNV
RE1.6	Prozesse zur Forcierung der Energieeffizienz	Prozesse zur Forcierung der Energieeffizienz

4.2 Bewertungssystematik zur Bewertung des IST-Situation und des Handlungsbedarfs

Um eine aggregierte Beurteilung der Berücksichtigung der SCWR-Ziele in der Seestadt aspern hinsichtlich und des notwendigen Handlungsbedarfs vornehmen zu können, wurde auf Ebene der SC-Qualitäten die folgende qualitative Bewertung vorgenommen:

Wie wird die SC-Qualität in der Seestadt berücksichtigt?

3	wird als Schwerpunkt im Gebiet berücksichtigt
2	wird im Gebiet berücksichtigt
1	wird über Wienweiten Standard im Gebiet berücksichtigt
0	wird im Gebiet nicht spezifisch berücksichtigt

Welcher Handlungsbedarf besteht für den weiteren Ausbau der Seestadt aspern?

3	sollte verstärkt berücksichtigt werden
2	Ausbau von Stärken bietet sich an
1	Berücksichtigung bietet sich nicht an, könnte aber behandelt werden
0	kein Potenzial vorhanden, Berücksichtigung nicht sinnvoll

Diese Bewertung wurde für alle Smart City Qualitäten aller SCWR-Ziele vorgenommen und für jedes Ziel ein Durchschnittswert aus den Einzelbewertungen der SC-Qualitäten ermittelt.

[2] Die SCWR enthält insgesamt 52 Ziele und Teilziele in den Zieldimensionen Ressourcen, Lebensqualität und Innovation.

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4.3 Ergebnisse der IST-Analyse

Ergebnis der Ist-Analyse sind Ergebnisportfolios aus Grad der Berücksichtigung und Handlungsbedarf je Zielbereich. Weiters wurden je Ziel die Stärken und Potenziale herausgearbeitet und qualitativ beschrieben.

Beispiel: Analyseergebnis für den Zielbereich „Ressourcen – Energie“:

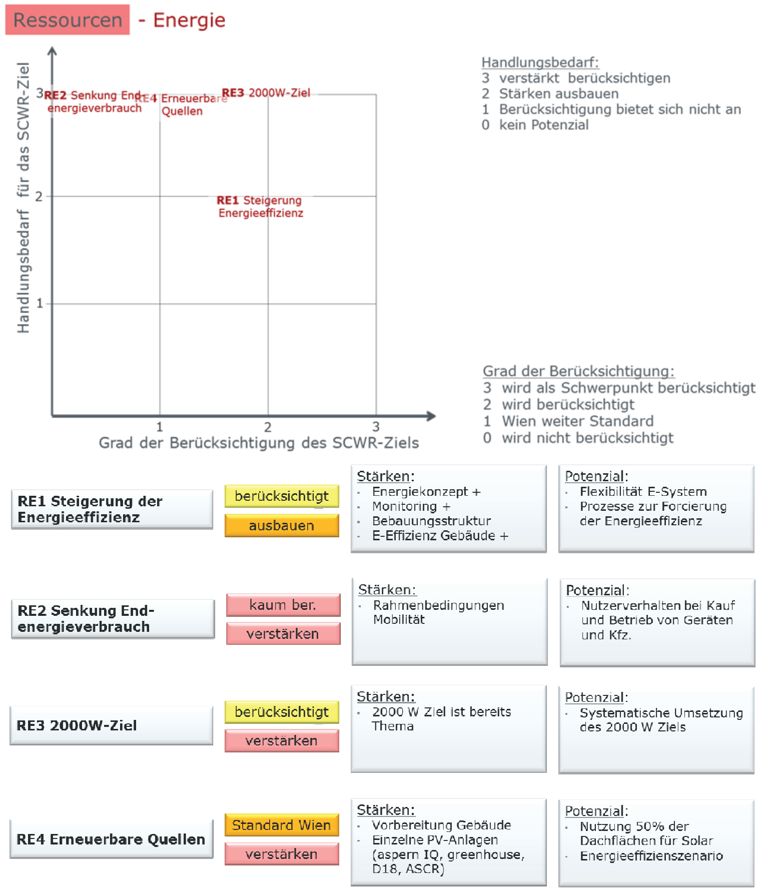

Abbildung 3: IST-Analyseergebnis für die Umsetzung der Ziele der SCWR in der Seestadt Aspern am Beispiel des Zielbereichs Energie (Quelle: denkstatt GmbH)

4.4 Smart-City-Strategie für die Seestadt Aspern

Anhand der Analyseergebnisse wurden im nächsten Schritt strategische Smart-City-Zielaussagen für die Seestadt Aspern entwickelt. Damit ist die Basis für die systematische Weiterentwicklung der Seestadt in Richtung Smart City geschaffen.

Beispiel strategischer Smart-City-Ziele im Zielbereich Energie

- RE1,2 In der Seestadt wird eine hohe Energieeffizienz und ein geringer Endenergiebedarf angestrebt ; dazu dienen die folgenden Teilziele:
  - Energiemonitoring aufbauen
  - Stadt der kurzen Wege umsetzen
  - Mobilität mit Schwerpunkt Umweltverbund umsetzen
  - Nachhaltige Gebäude entsprechend TQB-System planen und errichten
  - Energieeffizientes Nutzerverhalten fördern
  - Prozesse zur Forcierung von Energieeffizienz und eff. Nutzerverhalten einführen
- RE3 In der Seestadt wird die Anwendung der Kriterien des 2000-Watt-Areals zur Senkung des Energiebedarfs angestrebt.
- RE4 In der Seestadt wird auf einen hohen Anteil an erneuerbaren Energieträgern abgezielt, durch:
  - Wärmeversorgung mit hohem regenerativen Anteil umsetzen
  - PV-Anlagen planen und umsetzten
  - Abwärme nutzen

Bewertung:
- umgesetzt – weiter ausbauen
- teilweise umgesetzt – ausbauen
- in Ansätzen umgesetzt – verstärkt umsetzen
- nicht umgesetzt – verstärkt umsetzen

4.5 Indikatoren und Kriterien für die Umsetzung der strategischen Ziele

Für die strategischen Ziel wurden in einem weiteren Schritt Indikatoren und Kriterien vorgeschlagen, die zusammen mit den strategischen Zielen den Smart-City-Leitfaden für die Seestadt Aspern darstellen.

Dieser Leitfaden sollte die Grundlage für alle weiteren Planungen, Ausschreibungen, Vergaben und Abnahmen darstellen.

Beispiel für Indikatoren im Zielbereich Energie

Detailziel 1.1: Stadt der kurzen Wege

- Flächeneffizienz (Baudichte); z.B. Baudichtekoeffizient nach DGNB (BdK)
- Soziale Infrastruktur und Versorgung; max. Entfernung / max. Gehzeit / max. ÖPNV-Zeit von Bildung und Betreuung, Medizinische Versorgung, Nahversorgung, Dienstleister, Gastronomie, Kultur, Freizeit, Sportstätten, Einrichtungen für spezifische Nutzergruppen (z.B. Spielplätze, etc.)
- Freiraumangebot; Erreichbare öffentliche Freifläche [m²/m²BGF] ; Private Freifläche [m²/m²BGF]
- System der öffentlichen Räume; Schlüssiges Konzept öffentlich Räume, das nachvollziehbar die angestrebte urbane Leben im öffentlichen Raum fördert (Konzept)

Detailziel 2.1: Energieeffizienzvorgaben für Gebäude

- Energieeffizienzklasse laut Energieausweis
- Endenergiebedarf laut Energieausweis
- HWB* laut Energieausweis
- KB* laut Energieausweis

Detailziel 2.2: TQB-Punkte –Vorgaben für Gebäude:

- TQB-Punkte gesamt
- TQB-Punkte in einzelnen Kategorien

5 SCHLUSSFOLGERUNG

Die Ergebnisse dieser Vorstudie zeigen Möglichkeiten und Instrumente auf, wie Smart-City-Ziele auf konkrete Stadtteilentwicklungen, Entwicklungsprojekte und Sanierungsprojekte heruntergebrochen werden können. Aufbauend auf den Erkenntnissen dieser Studie soll ein allgemeiner Katalog von Smart-City-Qualitäten (Checkliste) entwickelt werden, der für die Planung und Sanierung von Stadtgebieten und Stadtentwicklungsprojekte entsprechend SCWR herangezogen werden kann. Weiters sollte eine Standard für Smart-City-Leitfäden festeglegt werden, die für alle größeren Stadtentwicklungsprojekte verpflichtend zu erstellen sind

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Three Cities – Lyon, Munich, Vienna – will be SMARTER TOGETHER

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1 ABSTRACT

In September 2015, the cities of Lyon, Munich and Vienna and 28 partners from research and industry were awarded funding for a joint project proposal within the European „Smart City and Communities“ intiative. Under the headline „SMARTER TOGETHER“, the consortium applied for a volume of 25 Mio. EUR for the implementation of „smart“ and innovative actions in the three partner cities and for cooperation with three so called follower cities – Santiago de Compostela, Sofia und Venice. The requested funding is available as part of the EU-framework programme for research and innovation „Horizon 2020“.

The funding is provided to support the implementation and testing of innovative Smart City solutions for low energy districts on a large scale and in an integrated way: Extensive energetic renewal of existing housing stock with (in Lyon and Munich) multi-faceted ownership structures, user-centered sustainable mobility solutions, innovative business models, generation of renewable energy and multiple use of infrastructure through the use of information- and communication technology (ICT). The overall aim is to improve the quality of life in neighbourhoods and to create more sustainable and user-friendly living environments. A particular focus will be on „smart“ and active forms of participation of citizens.

The timeframe for the project roll-out is three years (2016-2018) followed by two years of monitoring and evaluation (2019-2020). Thereafter, successful solutions and findings are to be replicated in other districts and cities for further added value. Here, the follower cities Santiago de Compostela, Sofia and Venice as well as the European city network Energy Cities will play an important role. The projects will be implemented in close cooperation between industry, small and medium-sized enterprises, municipal companies, citizens and other interested stakeholders. The EU commission lauded the right balance between innovative technologies and the social dimension of the project: smart and integrated solutions shall improve the quality of life of citizens.

The main challenge of Smarter Together is related to the so-called co-creation approach. All involved cities, research institutes and industrial partners as well as external stakeholders seek to jointly create solutions and methodologies for innovative and replicable city development, based on lessons learned and strong knowledge exchange. Therefore the project defrined a complex iterative peer-to-peer process, allowing for a constant knowledge exchange among all affected stakeholders.

Keywords: Demonstrationsprojekt, Lyon, München, Smart City Light House Project, Wien

2 SMART CITIES - THE EU PERSPECTIVE

The battle against climate change will be either won or lost in cities, as 70% of all energy-related greenhouse gas emissions arise from cities.[1] Only lately mayors of leading European cities met in Paris to underline the urgent need for worldwide action and the willingness of the cities to contribute by making cities resource-efficient and carbon-free, innovative and open – in short more liveable and smarter for all.

Numerous European activities on reducing urban greenhouse gas emissions have been carried out in recent years. One of the most prominent ones is related to Smart Cities and Communities. It started as a European Industrial Initiative in 2011, which one year later became the so-called "European Innovation Partnership on Smart Cities and Communities (EIP SCC).[2] This partnership brings together cities, industry partners and civil society organizations to reach the European climate and energy goals and to improve urban life through more sustainable integrated solutions. This includes applied innovation, better planning, a more participatory approach to urban planning and management, better transport solutions, and the intelligent use of

[1] EIP SCC 2013, 5
[2] http://ec.europa.eu/eip/smartcities/timeline/index_en.htm

Information and Communication Technologies (ICT) with the final aim of building a European market for Smart City solutions.[3]

In 2012 and 2013, the EIP SCC published two key documents on the EC approach to Smart Cities and Communities: The Strategic Implementation Plan (EIP SCC)[4] and the Operational Implementation Plan (OIP SCC). These documents define the European Smart City activities as resting on three vertical pillars (Sustainable urban mobility, sustainable districts & built environment, integrated infrastructures & processes) combined by eight horizontal priority areas that work as enablers: Citizen focus, policy and regulation, integrated planning, knowledge sharing, metrics & indicators, open data, standards, business models, procurement & financing.

Figure 1: Priority areas of European Innovation Partnership on Smart Cities and Communities[5]

The Strategic Implementation Plan (SIP) highlights the challenges in the priority areas, while the Operational Implementation Plan[6] provides more specific recommendations for the implementation. The SIP and the OIP are implemented by two different means: By investment projects supported by structural funds, and by research initiatives within HORIZON 2020

Since H2020 started in 2014, several calls have been launched in this work programme, covering diverse areas such as demonstrating smart city solutions in the urban context, performance measurement of and data standards for smart city solutions. The most prominent call in the focus area, and also the biggest in terms of volume is the SCC1 Call for "Smart City Light House Projects". The Smart City Light House Projects primarily target large scale demonstration of replicable solutions in the context of cities. The focus should be on the innovative integration of already existing technologies or technologies close to entering the market, rather than on the development of new technologies. Existing urban neighborhoods should be refurbished to near to zero or at least low energy standards. Energy in these neighborhoods is to be supplied predominantly using locally available sources, such as renewable sources and waste heat. Integrated infrastructures, such as smart grids and poly networks should be rolled out, connecting not only the different sources of energy supply and buildings, but also integrating storage technology and electric vehicles. This system ingreation should be enabled by state-of-the art ICT systems, like Neighourhood Energy Systems of Urban Data Platforms.[7]

3 THE SMARTER TOGETHER LIGHT HOUSE CITIES

In September 2015, the cities of Lyon, Munich and Vienna and 28 partners from research and industry were awarded funding for a joint project proposal wihtin the SCC1 call. Under the headline „SMARTER TOGETHER", the consortium applied for a volume of 25 Mio. EUR for the implementation of „smart" and innovative actions in the three partner cities and for cooperation with three so called follower cities – Santiago de Compostela, Sofia und Venice.

[3] http://ec.europa.eu/eip/smartcities/index_en.htm
[4] EIP SCC 2013: Strategic Implementation Plan. Brussels
[5] Ibid.
[6] EIP SCC 2014: Operational Implementation Plan. Brussels
[7] HORIZON 2020 2013: Work program 2014-15 „Secure, clean and efficient energy", 82-86

Figure 2: Light House Cities and Follower Cities of the SMARTER TOGETHER project

3.1 Lighthouse City projects - Lyon

Lyon Metropolis (1.3 M inhabitants) is the second largest urban area in France. It has adopted a smart city roll out strategy which shall allow reaching simultaneously several goals. This includes climate plan targets (3x20 by 2020 and Factor 4 by 2050) by setting up ambitious goals and rules like the development of local energy guidelines for new buildings with better energy performance compared to the regulation (updated in 2012 and 2013), and by developing an Energy Master Plan as framework to reach the sustainability goals. Also, it is intended to trigger a new wave of innovation and economic wealth by making Lyon Metropolis one of the leading metropolis in the smart city economy. The smart city strategy led by Lyon Metropolis paves the way for a “new deal” between the quadruple helix actors: local government, research and training bodies, companies and citizens (more than 40 ongoing projects highlight the smart city model generation which is currently taking place).

The area Lyon has selected to become its Smarter Together Light House Area is Lyon Confluence, one of the largest urban redevelopment projects in France (150 ha – 600 000 m²existing floor area – 1.000.000 m² of new buildings) and is a place of many urban innovations: For example, guidelines for the selection of a real estate developers with ambitious energy requirements are given in addition to the typical building use requirements and architectural requirements. This has been implemented for the first time in France in 2004 within the FP6 – CONCERTO project and is now the basis of the actual French building regulation. SPL Lyon Confluence now even requires real estate developers to build positive energy buildings which are really innovative compared to the French state of the art. The first one was done within a FP7 Very Low Energy Buildings project, the following ones without any support from the EU. Also, Lyon Confluence has established an international partnership with the Japanese organisation NEDO in order to demonstrate some smart city solutions also clearly positioned the Lyon-Confluence project as one of the leading urban redevelopment in Europe. Finally. Lyon-Confluence is the first WWF approved urban development in France. The sustainable action plan signed in 2010 with WWF addresses many different topics of the sustainable development such as zero carbon development, sustainable mobility, local and sustainable materials, sustainable water management, natural habitat and biodiversity, equity and economic development, quality of life and well-being.

The deployment of the SMARTER TOGETHER project in Lyon aims at four main objectives

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- Increasing the quality of life of inhabitants with many different strategies: construction of comfortable and affordable dwellings and office places, convenient public spaces, easy access to the district, new services and others.
- Involving citizens in the redevelopment of the Lyon Confluence area, and assist inhabitants of the district to improve the comfort of their dwellings and to reduce the amount of energy consumed for the heat demand.
- Refurbishment of existing buildings of the Perrache/Sainte-Blandine area with a target of 550 dwellings – 35,000 m2. In addition, SPL Lyon Confluence will build a 2MWe/4MWth wood-gas fired cogeneration power plant connected to the district heating and 4 PV systems for a total power of approx. 1 MWp.
- Providing support to inhabitants about alternative means of transport with smart charging stands and electric-vehicle car-sharing system.

Figure 3: Light House Area in Lyon

In addition to this, another objective is provide to the Grand-Lyon data platform new sets a dynamic data from the energy sector and the sustainable mobility sector collected by many various sources: smart power and heat meters, building energy management system, energy production systems in the area such as photovoltaic systems and the district heating power plant). These new sets of data will be used to develop new applications or will be used by existing applications such as the Community Management System (CMS) developed by Toshiba that will be used to have a global understanding of the energy flows of the district in order to improve the urban planning process and the planning, design and operation of public infrastructure.

3.2 Lighthouse City projects - Munich

The process of “smartification” - or the steps that ultimately led to the successful funding application within H2020 - started some years ago after a series of unsuccessful applications for EU funding by the City of Munich. The department of urban development planning and the department of labour and economic development cooperated and reached out to other cities, to industrial and research partners, to learn and improve their performance.

The strategic framework for future urban development in Munich is “Perspektive München” with its leitmotiv of “city in balance” which also set the frame for the Munich Smart City strategy. “Smart City Munich” is building upon and expanding on the 4 guiding principles of this framework: 1) far-sighted action and cooperative management; 2) solidary and committed urban society; 3) significant and high quality urban places; and 4) open and attractive appearance. Quality of life, individual development and participation in shaping the own living environment are important principles. Perspektive München also links the development of a "Smart City Munich" directly to specific urban areas with their particular challenges, which are to be addressed through "smart" actions.

"Smart City Munich" puts additional emphasis on the integration of intelligent technologies (energy efficient buildings, sustainable urban mobility, intelligent energy management systems etc.) which support the transition to a post-fossil city. For this transition, Munich set itself ambitious climate goals within the "Integrated Action Programme for Climate Protection", to which the Smarter Together projects are set to contribute: The aim is to reduce CO2 emissions by 10% every five years and to halve per capita emissions by 2030 (from a 1990 baseline); to cover the complete electricity demand of Munich from renewable energies in 2025; to complete the conversion to renewable energy district heating by 2040.

Figure 4: Light House Area in Munich

Specifically, the project will concentrate on Neuaubing-Westkreuz, a district in need of redevelopment, and Freiham, a new neighbouring district that is still under construction. The targets expressed for the area are to implement CO2-neutral energy supply by 2050; to reduce primary energy demand by 80% up to 2050; to increase the annual refurbishment rate from currently 0,8 to 2%; and to increase the annual refurbishment rate of heating systems to 3%;

The smart city project sets out additional objectives in the area of mobility and integrated infrastructures: To provide integrated multi-modal mobility solutions leading to a significant reduction of private cars in the area and adding to the electrification of related transport means, and to reach a reduction of GHG emission by 40%.

- An open data platform merging data from different sources to allow for holistic city planning and the creation of innovative Smart City services.
- To address policy and regulation issues for solutions to be deployed on both public and private ground and addressing challenges of data usage.
- To leverage citizens' and stakeholder expertise to deliver user-centred solutions and to ensure wide take-up of sustainability goals.
- To support business model innovation for solutions in the district

The main emphasis of the projects developed in the context of "Smarter Together" is on modernizing housing estates with varied structures of ownership, formulating user-centric mobility concepts and developing innovative business models. Special attention will be paid to smart forms of active public participation.

With regard to mobility and transport, the project includes plans for multimodal mobility stations that facilitate eco-friendly sharing systems for both private and business mobility. Unavoidable traffic should increasingly be shifted to alternative driving systems – primarily e-mobility. A mobility "butler" – an app

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that doubles up as a registration and payment system – should identify the best available modes of transport for the user.

Within the framework of its Renewable Energies Expansion campaign, municipal utility company Stadtwerke München (swm) aims to produce as much green electricity in its power stations as consumed by the whole of the city. Munich would be the first large city in the world to achieve this. In the project area, municipal utilities company Stadtwerke München are realizing a model eco-friendly power supply in the new Freiham district. Deep geothermal energy will be fed into the district heating network that is currently being built. As Freiham gains access to district heating, the already existing infrastructure for the urban district of Neuaubing/Westkreuz shall be extended. A “virtual power station” will interconnect decentralized power generation units to create a single areawide network that optimizes existing structures.

One exceptionally important aspect is the socially responsible modernization of existing energy systems. Around 35,000 m2 of living space is to be refurbished to meet the low-energy standard of 50 kWh / m2 / year. Organizing these works in in a tenant-friendly way will constitute a major challenge. Since the project catchment area also accommodates numerous owners of small homes, a “modernization toolkit” will be developed containing a variety of components to meet each individual modernization need.

Information and communication technologies will be used to converge and control technical solutions. But at the same time, municipal platforms are to be crafted into a smart data platform to help residents get involved in both implementing the project and using the solutions provided, such as delivery and shopping services.

3.3 Lighthouse City projects - Vienna

In 2014, the City of Vienna adopted the so-called Smart City Vienna Framework Strategy (Smart City Wien Rahmenstrategie – SCWR) as a medium to long-term umbrella strategy for integrated urban development. For example, the strategy aims at a reduction of energy consumption by 40% by 2050, an increase of renewables from 10% to 50%, a reduction of motorised transport from 29% to <15% while maintaining green space at 50%

Figure 5: Light House Area in Vienna

In order to reach these and other ambitious goals and keep up the quality of living in spite of city growth and climate change, joint efforts of actors throughout the city are necessary. Therefore, Smarter Together is already a key project in Vienna, actively involving around 70 experts from different sectors and fields in its implementation: Nine different departments of the Viennese administration, housing associations, utility companies, energy suppliers, SMEs, city agencies and a research institution.

With Simmering, a lighthouse area was chosen which is quite representative for Vienna. It´s traditionally a worker`s district with large housing estates from 1940- 1980 but also some industry and some housing from the 1920ies. It is located in the South-East of Vienna and would have received only little attention without “Smarter Together”, since it is between two large development areas.

In order to reduce energy consumption and CO2 emissions in the lighthouse-area, a multitude of actions are necessary on different levels, targeting the areas of housing, mobility, refurbishment, ICT, user-dialogue and innovation. An Urban Living Lab is currently in development to increase acceptance of the intended actions and to represent the project in the district. In Vienna, the Urban Living Lab will be a vehicle to foster communication in public space. It will be branded for the project and used in various locations throughout the project area of Simmering to foster dialogue and exchange.

Moreover, the project will

- focus on refurbishment of social housing and a public secondary school with a gym (8.800m²) at large scale (66.000 m2) reducing energy demand by >60 % by using new methods
- renovate the district heating system with a unique integration of local renewable energy sources and related new business models
- develop Simmering NW into a flagship e-mobility area and reduce mobility-related energy consumption by novel business and implementation concepts as well as citizen engagement
- involve all main actors of the area (housing operators, energy suppliers, educational institutions and businesses) working together towards integrated and sustainable solutions and at the same time foster the engagement of tenants and residents in the transformation and co-design processes
- work out governance structures suitable for complex integrated renewal projects

All activities are designed to serve as a catalyst of knowledge and substantially contribute to further develop the city's governance in relation to smart city issues and feed into international cooperation and provide the basis for a systematic analysis, monitoring and replication of described solutions.

The city of Vienna as the owner of over 220.000 subsidized apartments has a profound interest in high-end solutions for achieving good technical results as well as efficient methodology to get in dialogue with the citizens The best-practise exchange with the partner cities and institutions involved in Smarter Together has already proved to be of great value for the process of improving the urban renewal processes in Simmering.

4 THE SMARTER TOGETHER APPROACH

4.1 Ambition

The SMARTER TOGETHER project is designed as a systematic approach to establish highly deployable solutions for Smart City Districts. The project wants to develop a systems implementation process of solutions for low-emission housing, electric mobility and urban services which are on the one hand highly adapted to local needs, and on the other hand highly replicable self-dependent in their operations. As key feature, five thematic clusters of co-created smart and integrated solutions will address the needs of four targeted end users:

- Citizens: their needs in regards to social and technological innovation on individual as well as on subgroup level are complex, the solutions must hence be multidimensional and provide for instance financial incentives (cost saving, financial mechanisms…), on demand services (customized, easy and friendly interfaces, respecting the privacy and with no sunk costs), rewarding in various forms, while the whole process of societal innovation requires learning, awareness, responsible implication, engagement and participation;
- Cities: their needs are financial (optimizing capital and operational expenditures (Capex and Opex) and in regards to the openness of the solutions (no vendor lock-in) as well as in regards to human resource development and organizational development. Furthermore, the expected outcomes regarding sustainability and fostering local ecosystem are extremely important.
- Housing associations need to optimize their Capex and Opex as well and find news solutions and services, targeting low income household and anticipating the ageing of their tenants. Also buildings in Smart Cities are no longer consumers of energy only. The increasing importance of building integrated RES and storage systems requires new business models and is about to change the self-image housing companies.

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Editors: Manfred SCHRENK, Vasily V. POPOVICH, Peter ZEILE, Pietro ELISEI, Clemens BEYER

- Utility companies: To run a city efficiently, it is necessary to manage its metabolism in a proper way. Utility operators therefore are important partners for smart city projects. Due to a dynamic environment and the increasing importance of renewable energy, many utility companies are currently modifying their business models, which will become more and more based on holistic services rather than on provision of energy.
- SMEs and Startups: The challenge is to provide disruptive innovations without having business models. Solving this issue requires the cooperation of all stakeholders in order to envision the proper value chain and the monetization side. It will be at the core of the project.

4.2 Work breakdown structure

SMARTER TOGETHER has ten work packages (WPs):

- WP1 Innovation Action Framework provides a first action framework for the successful implementation of smart solutions, striving for capacity building, common perceptions and consistentworkflows in the later Work Packages.
- WP2 Co-Creation for Smart City Solutions - a peer to peer process establishes reference processesand tools for co-creation, building on the inputs of WP1 to define thematic guidelines for successfulimplementation of co-created city solutions in cities.
- WP3 Lighthouse Demonstration Lyon implements the demonstration activities in the lighthousetarget area of Lyon, ensures their monitoring during the implementation and prepares the replicationphase.
- WP4 Lighthouse Demonstration Munich implements the demonstration activities in the lighthousetarget area of Munich, ensures their monitoring during the implementation and prepares the replicationphase.
- WP5 Lighthouse Demonstration Vienna implements the demonstration activities in the lighthousetarget area of Vienna, ensures their monitoring during the implementation and prepares the replicationphase.
- WP6 Monitoring & Evaluation ensures the 3-years post-implementation monitoring phase, running the monitoring infrastructures, collecting data and evaluating processes and impacts.
- WP7 Integrated strategies in Follower Cities supports the replication of successful demonstration solutions and services in the Follower Cities target areas.
- WP8 Replication of smart city solutions ensures the replication of results and outcomes of the demonstration phase as well as replication of monitoring actions both at the city level in the Lighthouse cities and in other cities and at commercial and industrial levels, allowing the scaling-up and deployment of the developed smart city solutions in Europe.
- WP9 Dissemination and Communication ensures effective communication actions and dissemination of project results, which will support transferability towards scientific, policy and industrial communities.
- WP10 Project Management ensures the steering and planning of all activities, time schedule, quality and cost management to meet the project’s objectives from both technical and administrative perspective.

4.3 Addressing the main challenges

The SMARTER TOGETHER project aims at developing co-created smart and integrated solutions for low energy districts, sustainable mobility, integrated ICT infrastructures and citizen engagement within three lighthouse cities, further providing recommendations for follower cities and for all cities which are willing to support sustainable and resilient development. The project is conceptualized as a city LED project that benefits from the institutional advantages of structured governance in dialogue with industrial, SME, third institutional as well as citizens partners.

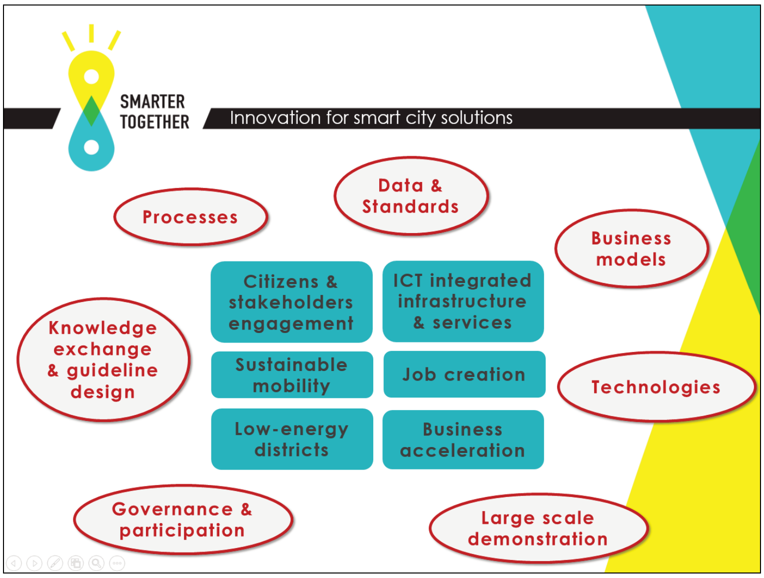

Figure 6: Innovation for Smart City Solutions

For the three cities, the challenge translates into the question of how to manage technological innovation for the benefit of the citizen and with the citizens. Most innovations fail in the diffusion or adoption phase because the end users (the citizen or the cities representatives) have not been properly associated.

A large part of the bottleneck in adopting smart city solutions lies within the cities day-to-day operating of cities: Information currently collected in silos is to be re-connected in sensible ways to create useful insight into more complex dependencies. Long timeframes for authorisation procedures (e.g. site approval, etc.) are getting in the way of tight schedules for implementation. Often, legal frameworks for innovative solutions are missing and it is important to cooperate with legal authorities and politicians to find alternative models. Key questions to address are related to structural improvements in the field of integrated management, organisational learning and change management in cities and regulations.

The three pilot areas are large scale urban areas addressing the refurbishment issue at district scale. The objective of successfully addressing the eco-renovation of existing public and private residential housing present specific legal and societal challenges and appeal to different requirements in communication, management and regulation. Success in implementing projects at this scale is dependent on broad user acceptance and a relevant critical mass to support smart city business models – which are both financially viable for companies and socially acceptable for the end user.

Increased efforts need to be undertaken to activate citizen and residents to engage with the topic of smart cities in their immediate environment and to raise user acceptance. Solutions need to be attractive and tangible at an early stage. All three cities are therefore heavily building and expanding upon existing outreach activities in the pilot areas. The planned “smart” projects provide safety, respects privacy and protects citizens from abuse of their data. Cities as trustworthy partners for data collection and use, play a key role.

Since the three lighthouse cities will implement a great number of highly different but in parts also very comparable projects within the Demonstration WPs 3 to5, the project will face several challenges in order to be able to design co-created and integrated solutions and produce replicable results, In particular the following four main challenges need to be addressed when designing a general concept for the project:

- Cross-Silo-Thinking: Overcome thematic silos in order to allow knowledge exchange between experts of projects with a highly diverse thematic orientation (e.g. IT-experts of e-mobility and smart district projects), helping to overcome specific emerging problems and generating a basic knowledge set of recommendations for cocreated solutions.
- Cross-City-Thinking: Allow a knowledge exchange within a thematic silo but in between all respective experts of that silo (e.g. all refurbishment experts of all cities) in order to address and solve specific thematic problems.

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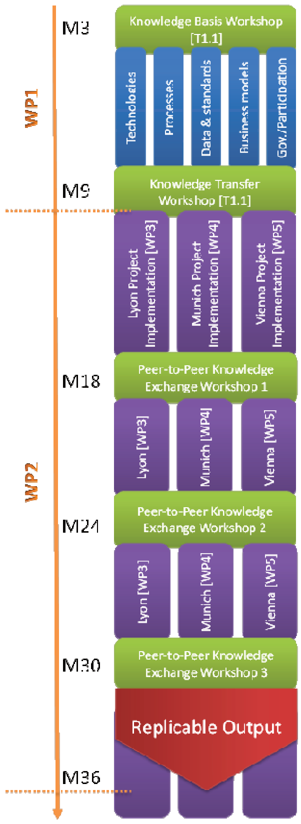
- Stakeholder-Involvement: Involve relevant external stakeholders in order to include all available knowledge into the co-creation process. This step should include both local experts as well as external domain experts.
- Knowledge-Transfer: Disseminate generated knowledge in between the project and over its borders in order to actively perform a co-creation process and to provide a set of recommendations for co-created and integrated smart city solution for cities.

4.4 A concept for co-created smart city development



In order to encounter the outlined main challenges and to foster co-creation within the Smarter Together project, the overall concept of the project consists of two general groups of work packages. While the work packages 3 to 5 are dedicated to the already outlined demonstration projects to be implemented within the three cities, all other work packages are foreseen to enable the development of co-created and integrated solutions, addressing the organizational and peer-to-peer knowledge exchange, allowing for impact monitoring and striving for high replicability. Therefore, a strong interaction between the so-called Enabler and Demonstration work packages will be established.

The main concept can be structured in the following four main steps:

(1) Design of a first innovation action framework (WP1) for the successful implementation of innovative smart solutions, addressing the whole SMARTER TOGETHER project and particularly the smart solutions to be implemented in demonstration activities. This first set of recommendations of key-components, frame conditions and barriers for successful solutions will be the basis for the Demonstration WPs 3 to 5 as well as for the organizational and peer-to-peer knowledge exchange process of WP2.

(2) The peer-to-peer knowledge exchange process of WP2 will then not only try to bring together the experts and affected stakeholders of the demonstration projects at different stages of the implementation process (months 18, 24 and 30) in order to overcome common challenges and to benefit from lessons learned. Rather, by constantly monitoring the feasibility of the WO1 recommendation, WP2 will develop the recommendations further, finally aiming for a set of proven recommendations ready to be used by other interested cities, specifically by the follower cities in WP7.

(3) The already outlined demonstration activities (chapter 3.2, 3.3 and 3.4) will be based in the three cities on a common methodology of urban design thinking, with differences due to the local context. Cities and their

partners will strive to address in a large scale project the five clusters of co-created and integrated solutions, defined in WP1.

(4) Based on the outputs from the demonstration activities, evaluation and transversal activities like replication (WP8), monitoring (WP6) and dissemination (WP9) will be deployed. The replication plan will address the target areas in the follower cities and in the lighthouse cities.. In order to ensure the inclusion of the follower cities in all outlined Enabler activities a dedicated work package has been foreseen (WP7), further allowing knowledge exchange in between the follower cities.

The organizational and peer-to-peer knowledge exchange to be established within the Enabler WP2 is of utmost importance to develop co-created and integrated solutions within the project itself and to develop recommendations based on the lessons learned during the implementation process.

The main concept to follow a co-created approach and to define recommendations for successful solutions for innovative smart cities will start with a knowledge basis workshop, addressing the needs and demands of the lighthouse as well as the follower cities. This workshop to be organized in month 3 of the project will build the basis for the state of the art analysis, which aims to define external conditions, key-components and barriers for 5 thematic focus fields. The final output of this research will be presented and adapted with the city partners in the final workshop of WP1 in month 9.

This workshop will also be the starting point for the actual implementation process of the WPs 3 to 5, providing them with a first set of recommendations for successful solutions. Then, it will be continuously monitored how the recommendations can be applied during the implementation processes of the WPs 3 to 5, recording their usefulness as well as potential needs for adaptation. This activity will be organized within the five thematic clusters, grouping the related projects and allowing for a cross-project evaluation. As defined in chapter 1.4.1 the five clusters are: Citizen Engagement – Innovation Labs, Holistic refurbishment in Smart Districts, District Heating and Renewables, Data Management platform & Smart services, E-mobility solutions.

After approximately one year of implementation and then in 6 month intervals peer-to-peer knowledge exchange workshops will be performed, bringing the knowledge of all involved stakeholders together and respecting the challenges defined in chapter 1.4: Cross- Silo-Thinking, Cross-City-Thinking, Stakeholder Involvement and Knowledge-Transfer. The workshops will include all lessons learned from the implementation processes, improving the first set of recommendations of WP1 in order to provide an output as applicable as possible. By repeating this process three times at different stages of the project SMARTER TOGETHER will be able to continuously improve the recommendations, aiming for a replicable and highly application oriented set of recommendations for co-created solutions.

5 OUTLOOK AND CONCLUSION

The timeframe for the project roll-out is three years (2016-2018) followed by two years of monitoring and evaluation (2019-2020). Thereafter, successful solutions and findings are to be replicated in other districts and cities for further added value. Here, the follower cities Santiago de Compostela, Sofia and Venice as well as the European city network Energy Cities will play an important role. The projects are implemented in close cooperation between industry, small and medium-sized enterprises, municipal companies, citizens and other interested stakeholders. The EU commission lauded the right balance between innovative technologies and the social dimension of the project: smart and integrated solutions shall improve the quality of life of citizens. All project activities are supported and reinforced by local and European communication dissemination work serving the common vision: Being SMARTER TOGETHER in order to provide to provide Smart and Inclusive Solutions for a Better Life in Urban Districts.

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Three Decades of Transport Infrastructure Development and Travel Behaviour Change in the Netherlands

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1 ABSTRACT

It is argued that improvements in the supply of transport infrastructure networks affect accessibility, which in turn influences the distribution of land uses, activities linked to them and eventually the travel behaviour of individuals. Identifying the extent and rate of change in travel behaviour as a response to change in spatial and socio-demographic characteristics, requires long-term empirical investigation of their interrelation. The assessment of long-term trends can provide guidelines for the type, extent and location of future investments in transport and land use development. This paper explores trends in access to transport infrastructure (proximity to the railway stations), land use (location of inhabitants), socio-demographic characteristics of the travellers and travel behaviour (distance travelled by car, train and active modes and total number of trips per day) over three decades. It uses data from Dutch National Travel Surveys at seven time points of five-year intervals from 1980 to 2010 in the Randstad, the Netherlands. The results indicate that while the total number of trips per day has remained stable over time, total kilometres travelled has risen until the mid-1990s after which it has witnessed a decrease. Further more, the findings suggest that train is increasingly used for travelling longer distances and the location of home municipality and proximity to train stations (within a distance of 500 to 1250 m) are closely related to the total train kilometres travelled.

Keywords: Transformation, Infrastructure planning, Long-term impacts, The Randstad, Travel behaviour

2 BACKGROUND

Empirical evidence on the long-term relationship between access to transport infrastructure, land use, socio-demographic characteristics and travel behaviour is needed to assess the impact of previous investments in transport infrastructure and applied land use policies. Such evidence can also provide guidelines for the type, extent and location of future investments. However, studies which quantify the development of such relationships over time are very scarce (Ellder, 2014). This paper aims to shed light on the trends in land use and socio-demographic characteristics linked to travel behaviour over time and across various regions of the Randstad (the population and economic core of the Netherlands situated in the west of the country). The main research question is: How have access to transport infrastructure, land use, individual socio-demographic characteristics and travel behaviour evolved in relation to each other in the Dutch Randstad from 1980 to 2010?

3 METHODOLOGY

A long-term geo-referenced database was constructed, bringing together various sources. Spatial, socio-demographic and travel behaviour data were made consistent for seven time points of five-year intervals: 1980, 1985, 1990, 1995, 2000, 2005 and 2010. The spatial unit of analysis is the municipal borders of year 2004 and previous and consequent spatial and travel behaviour data were converted to these boundaries. The development of spatial, sociodemographic and travel behaviour data was analysed by descriptive statistics separately and in relation to each other.

3.1 Travel behaviour variables

Travel behaviour variables were extracted from the Dutch National Travel Survey (NTS) which provides reliable travel diary data since 1979 on an annual basis. The sample was limited to the Randstad (See Figure 1). In some cases previous and proceeding respondents were added to the respondents of a given year (e.g. 1984 and 1986 were added to 1985) in order to increase the sample size at that time point and make it comparable with the sample size at other time points. The respondents were further filtered by their age (those younger than 20 years of age were excluded regarding their constrained mobility) and whether they

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had reported at least one trip during the survey day. The final eligible number of respondents were: 13.521 for 1980, 15.328 for 1985, 16.777 for 1990, 35.738 for 1995, 32.747 for 2000, 36.749 for 2005 and 14.368 for year 2010.

The investigated travel behaviour indicators were total kilometres travelled per survey day by i) train, ii) car (passenger/driver), iii) active modes (walking and cycling), and by all the above combined. In addition, the total number of trips by the above modes per survey day was investigated. For multi-modal trips, the transport mode which was used for the longest leg of the trip was determined as the main mode. Trips and kilometres travelled by modes other than the above (e.g. motorcycles, tram, bus, metro) are excluded from this analysis.

3.2 Socio-demographic variables

The chosen socio-demographic variables were the respondents‘ age, gender, level of education, income and household car ownership.

3.3 Land use and access to transport infrastructure variables

The living municipality of respondents was categorised according to the Randstad's "daily urban systems", a concept first introduced by Van der Laan (1998) (Figure 1). Though the Randstad and its borders have evolved, its daily urban systems have been relatively stable over time. The three categories of daily urban systems are "urban centres" (Amsterdam, Haarlem, the Hague, Rotterdam, Dordrecht, Utrecht, Amersfoort and Hilversum), "suburbs" (medium sized cities in the vicinity of the urban centres) and "other", including the Green Heart (a preserved and mainly rural area at the center of the Randstad) and municipalities situated in the outer Randstad ring. Furthermore, the distance from rail was measured as Euclidian distance from the municipality's mean centre (regarding the dispersion of built-up area across the municipality) to the closest rail station.

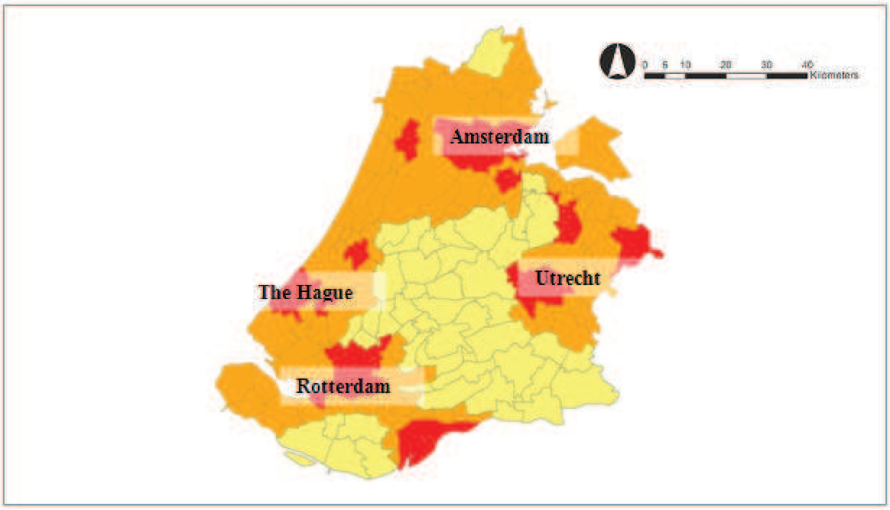

Fig. 1: Classification of "urban centres" (red), "suburbs" (orange) and "other" (yellow) in the Randstad based on daily urban systems (Van der Laan, 1998)

4 TRENDS IN LAND USE, SOCIO-DEMOGRAPHIC AND TRAVEL BEHAVIOUR DEVELOPMENT IN THE RANDSTAD

4.1 Trends in travel behaviour

Figures 2a-d summarise long-term trends in respondents' total kilometres travelled (tkt) by all and separate transport modes (average and median) and total number of trips per survey day from 1980 to 2010.

- Figure 2a shows that the average total kilometers travelled by car is significantly higher than train and active modes. Total kilometres travelled almost mirrors total car kilometres travelled (as car kilometres travelled make up for the most of total kilometres travelled). The tkt has increased from 1980, reaching a peak at 1995, and has been decreasing ever since. However there are two caveats, first, the mean (average) can be greatly influenced by outliers (a limited number of people which travel very long distances by car) and second, car trips are extremely dominant in the sample (at each time point only around 4 % of total trips in the sample were made by train).

- If we look at the trips taken with each transport mode (thus when that mode was chosen), we see that the median of train kilometres travelled is significantly higher than the car kilometres travelled (Figure 2b). Moreover, this median has risen by 10 kilometres over the study period contrary to the median of total car kilometres travelled. This means that train is increasingly being used for travelling longer distances.
- Over the years, the median total number of trips per day has stayed mostly the same, i.e. three trips per day (Figure 2c). However, the share of two trips per day has risen at the expense of four or more trips per day since 1995 (Figure 2d). All in all, we can conclude that while people have changed their total amount of kilometres travelled over time, they have remained stable in their frequency of trips per day.

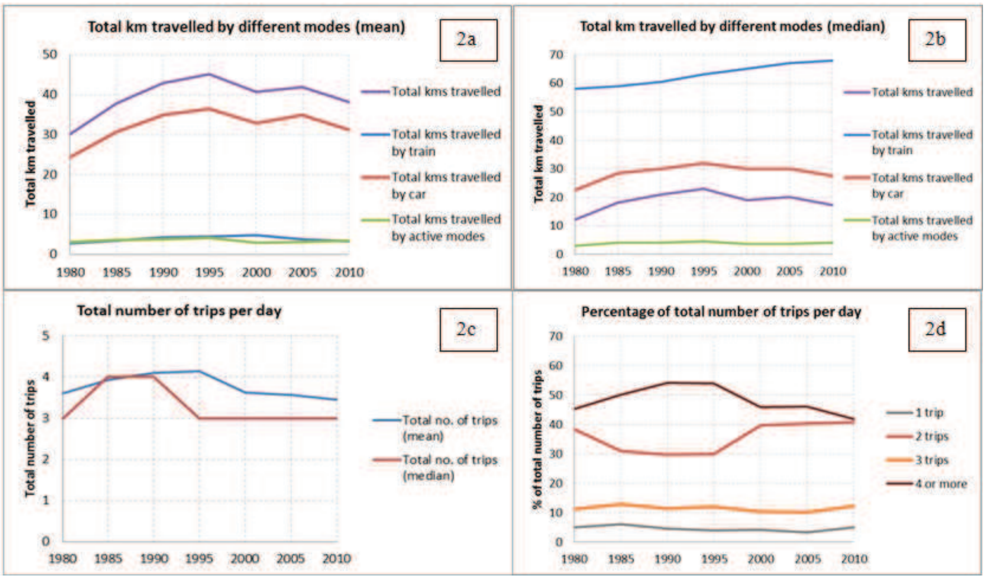

Fig. 2a-d: Trends in mean/median total kilometres travelled by all and separate modes and mean/median total number of trips per day in the Randstad 1980-2010

4.2 Trends in travel behaviour in relation to socio-demographic and land use variables

Figures 3a-h compare the relationship between a number of socio-demographic and land use variables and total kilometres travelled by car versus train.

- As expected, total kilometres travelled (by all and separate modes) generally decrease as age increases. However, people in their 30s followed by those in their 40s have the highest car kilometres travelled while people in their 20s (followed by pensioners till 1995) have the highest train kilometres travelled.
- Men travel longer distances by car compared to women (Figure 3c). Interestingly, this difference reduces significantly when it comes to total train kilometres travelled (Figure 3d).
- As figures 3e-f demonstrate, location is linked to the amount of kilometres travelled. As respondents' home municipality moves from the central urban cores to suburban and other (outer ring and the Greet Heart) municipalities, the total amount of travelled kilometres by car rises, while the total kilometres travelled by train decreases. The difference between central and other municipalities is more significant especially in the case of total kilometres travelled by train. This is likely because municipalities belonging to urban cores benefit from a better access to railway infrastructure supplies and services.
- Figures 3g-h demonstrate the relationship between the distance to the closest railway station and total car and train kilometres travelled. The thresholds of 500, 1250, 2500 and 3750 m radii were chosen based on the distance travelled at five-minutes intervals with the speeds of 3 and 15 km/hr for walking and cycling respectively. Total train kilometres travelled is highest within the "500 – 1250 m" distance buffer from the train station, After 1250 m a distance decay trend is observable.

Contrary to expectation, living in the "0 – 500 m" radius is not related with the highest train kilometres travelled. The proximity to rail stations and total car kilometres travelled seem unrelated.

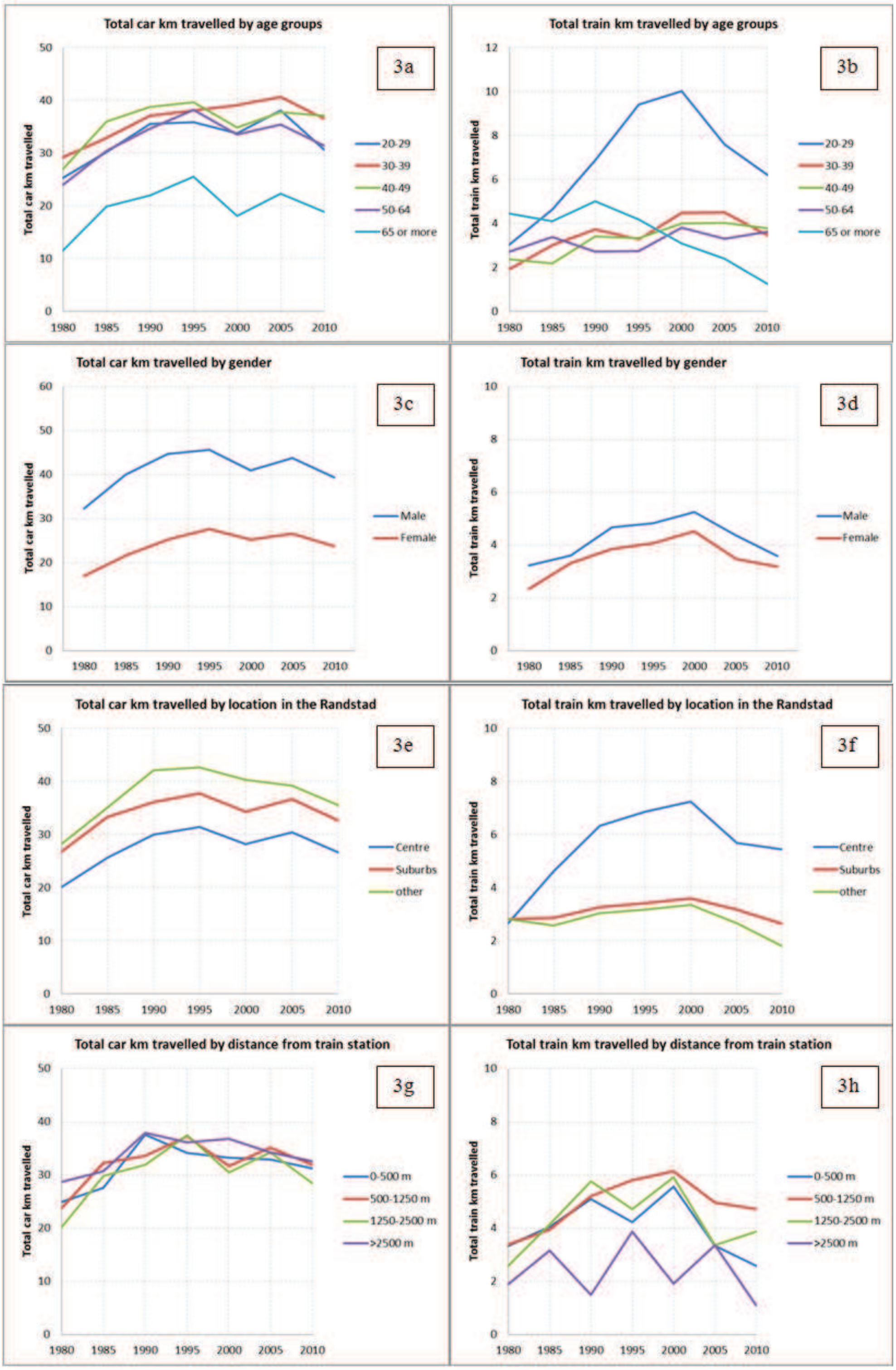

Fig. 3a-h: Trends in total car and train kilometres travelled by age, gender, location in the Randstad and distance from train station in the Randstad 1980-2010

5 CONCLUSION

A summary of relationships between a selection of socio-demographic factors, land use and different indicators of travel behaviour are presented in Table 1. While the majority of these relationships have remained stable over the study period, there are a number of exceptions, some of which were discussed in the previous section.

	Total km	Total km	Total km	Total km	Total no. of

	travelled by all modes	travelled by train	travelled by car	travelled by active modes	trips per day
Age	─	─*	─*	*	─*
Gender (from male to female)	─	─	─	+	+
Education	+	+	+	*	+
Income	+	+	+	─	*
Household car ownership	+	─	+	─	*
Location (from centres to outer rings)	+	─	+	─	─*

Notes: ─ = negatively related; + = positively related; +/─*= overall positively/negatively related, however there are exceptions regarding some sub-categories; *= varying relationship.

Table 1: Summary of relationships between socio-demographic factors, location and travel behaviour indicators

The findings of this explorative study corroborate prior research in the field: where people live –which is related with the 5 D’s of Density, Diversity, Design, Destination accessibility, Distance to transit– is significantly related to their mode choice and kilometres travelled (Ewing and Cervero 2010).

This study also provides some evidence for the hypothesis that a paradigm shift could be emerging where total passenger kilometres in motorised modes has slowed its acceleration in industrialised countries (Millard-ball and Schipper 2011).

Moreover, the results indicate that train is increasingly being used for travelling longer distances. Thus further investment in transport policies to facilitate long-haul commuter trains, especially the high speed railway, could benefit from and reinforce this trend. Interestingly, median total kilometres travelled per day in the Randstad has remained under 30 kilometres, even at its highest point in 1995. In other words, half of the inhabitants of the Randstad have been travelling no more than 30 kilometres a day over the past thirty years. This makes alternative transport modes with relatively limited range such as electric cars and bikes suitable for the Dutch context and especially the Randstad.

Living within 500-1250 m distance of a train station is shown to be related with highest amount of train kilometres travelled. Further detailed investigation into the thresholds within which train station proximity could affect the travel behaviour of inhabitants is required. The findings can have implications for designating the stations’ impact area in Transit Oriented Development plans.

Finally, future research should incorporate multivariate analysis to measure the specific share of various factors in explaining travel behaviour, and their rate of changes in the long-run (e.g. Susilo and Maat, 2007). Various land use and transport accessibility indicators need to be tested to see which is more suitable to capture the change in transport network and land use development over time. A promising approach to measure the long-term share of spatial and socio-demographic factors in travel behaviour is the use of pseudo panel analysis (Tsai et al. 2014). This emerging method applies panel analysis to repeated cross section data (such as NTS) and manages to benefit from disaggregated data while dealing with the limits of repeated cross section data.

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Towards Jeddah Smart City: Assessing People Perception Of Spacious Quality Indicators In Open Spaces

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1 ABSTRACT

Strengthening sustainability within a smart community often begins with a clear vision but it is really a process of creative, local, balanced decision-making that continues to adjust to changing realities of community and urban living. Jeddah, a city with Waterfront communities that attract people all year round, has a strong character and economic backgrounds. It includes dramatically improving access to the waterfront, that is subject to continuous renovations while maintaining attractive, environmentally sound parks, open spaces and recreational opportunities, stimulating mixed use development. The research demonstrates people responsiveness against promenade experience applying wearable sensors that reflects stress levels along studied areas. The results of data will highlight potential of further design recommendations and modifications in order to maintain a sustainable community that supports and encourages diversity taking in consideration long-term and external impacts into account during municipalities decision-making.

Keywords: Jeddah, Smart City, Spacious Enhancement, Urban Design, WearableSensors

2 INTRODUCTION

Strengthening sustainability within a smart community often begins with a clear vision but it is really a process of creative, local, balanced decision-making that continues to adjust to changing realities of community and urban living. Studies have been extendend on many cities waterfront related to their historical impact as well as potential of futuristic developments.

The fundamental principle is to elaborate and enhance the public realm, through transformation of the Gardiner corridor, the creation of networks of public space and parks, of developing park streets to the water that arrive at extraordinary waterfront plazas, of creating a public water edge, and enlivening the whole waterfront with new mixed-use residence and work environments (Nicholas, 2011).

Through Smart Growth, natural resources should be protected through open space design and conservation. Therefor Jeddah Waterfront communities are designed to attract people all year round with its strong character and economic backgrounds.

The aim of the project research presented in this paper is to investigate the quality of openspaces provided along the seafront. Inaddition to analysis of measured emotional stress along the site studied amethodology adopted to answer similar research potentials (Taha et al., 2012,2013) which can define to what extent different cultural environments can influence the perception of the surrounding situations.

2.1 Jeddah City Developments

Jeddah City is the most cosmopolitan city due to its location on the seafront and the main gateway to the two holycities. Its population is almost 3.2million but expectes more than 15 million visitors yearly.

Jeddah municipality strategic plan 2009, “what makes a city successful”, figure 1.

The municipality is proceeding and enhancing their strategic plan related to jeddah waterfront since 2014 till now with upgrading the refurbishing. The main points of development are:

- Introduce integrated waterfront management
- Protect and enhance Jeddah’s waterfront area
- Provide high quality facilities on the waterfront
- and Increase public accessibility

The waterfront Coastal Development extends on 12 km out of Jeddah Corniche is the 30 km coastal resort area of the city of Jeddah. Located along the Red Sea, the corniche features a coastal road, recreation areas, pavilions and large-scale civic sculptures as well as King Fahd's Fountain, the highest fountain in the world.

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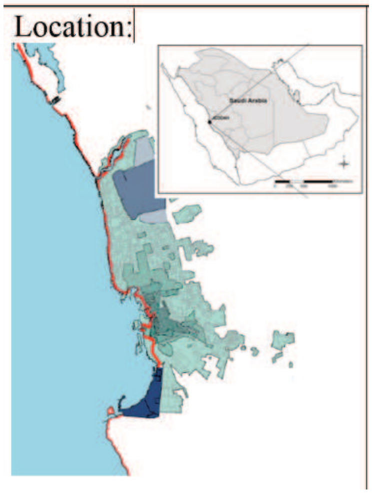

Fig. 1: Jeddah Corniche developments according to municipalities plan, 2009.

2.2 Waterfront Developments impact on Jeddah Community:

Jeddah, the second largest city of Saudi Arabia, a city with Waterfront communities that attract people all year round, has a strong character and economic backgrounds. It experienced a rapid urban growth, spatial expansion and transportation infrastructure expansion over the last 40 years with rates of change ranging from 0% to over 100 throughout the city indicating a wide variability across space and complex urban dynamics. Jeddah's population grew rapidly from 147,900 in 1964 to 3,247,134 in 2007 (Aljoufie et al., 2012).

Currently undergoing renovation, the Corniche will be renewed, expanded, and upgraded with restaurants, play areas, and entertainment (A.Nayer, 2015). The entire renovation phase should be completed around early 2014. Strengthening sustainability within a smart community often begins with a clear vision but it is really a process of creative, local, balanced decision-making that continues to adjust to changing realities of community and urban living by adopting strategies focusing on the elements of successful waterfront development in figure2.

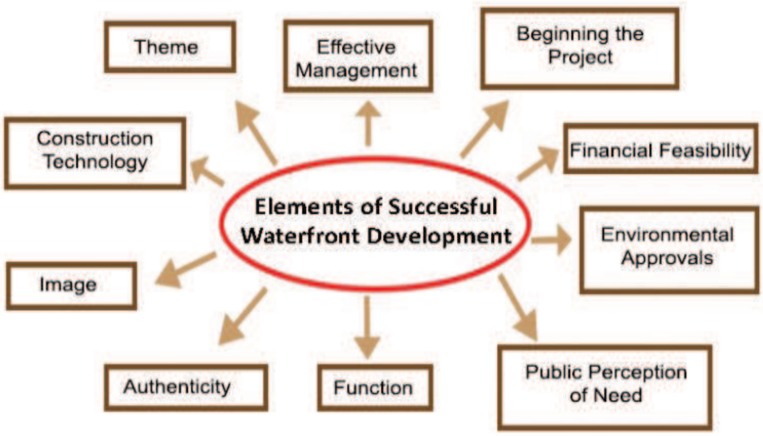

Fig. 2: Elements of successful waterfront development.

3 STATEMENT OF RESEARCH

The research paper represents the results for investigation done with groups of participants along specified walkways along the most populated Research Case study suggested will investigate the degree of responsiveness of various features on Jeddah coastal road, recreation areas, pavilions and large-scale civic sculptures through various undertaken experimental effects during different daytimes.

Data Collected through wearable devices interfaces consider the development of these emerging technologies and their social implications and applications. Tools admitted for the study The Physiological Stress Reaction (Bergner et al. 2011).

3.1 Methodological approach

Investigation for Urban Development regarding community response relative to urban spaces potentials by assessing physiologiccal response, which involves the future collaboration with research team engaged with urban spaces by using wearable computing devices (Taha et al., 2012); briefly set out some contexts of public responses in entertainment open spaces along the developed cornice where artifacts are emerging.

The main demonstarted responses against stress points indicate the change of normal responses, causes are documented via cam recording and trackng specific site location via GPS location. Main steps of the research includes:

- Data analysis from collected data
- Benchmarking against actual surveyed case
- Explicit listing for prospect solution

3.2 Participants and trip selection

Project participants were selected based on average age of 30 to 40 years old. Female majority contributed, since the approach is encouraging the families for outdoor activities in most confortable way possible.

After observation the research team took decision to maximise the stress level by considering the trips on weekends (Friday evening, Saturday morning and evening).

The time selected for the trips was based on family gathering routines as well as peak hours for mostly populated part of the cornice as presented in figure 3, based on the methodological approach presented earlier in (A. Nayer, 2015).

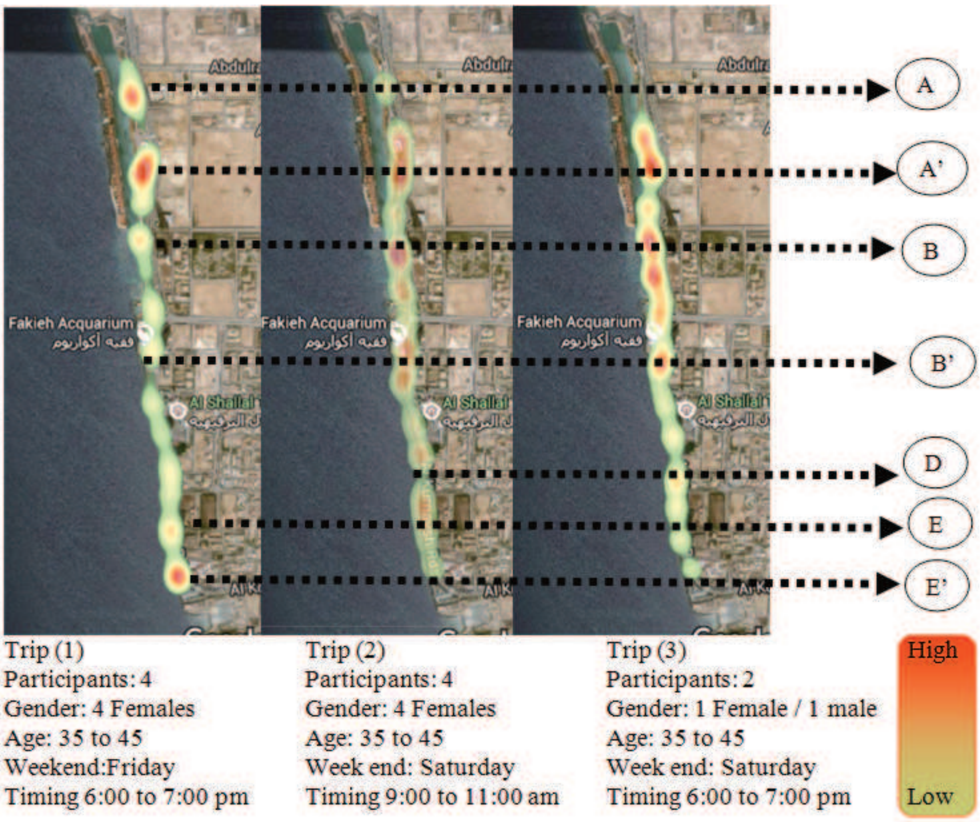

Fig. 3: Stress analysis on trips 1, 2 and 3 on weekend days.

4 ACTUAL INVESTIGATED SITE SPACIAL FEATURES :

Waterfronts are dynamic places by nature. As an edge environment, the overlap of different communities of users and dramatically different conditions make for enormous amounts of complexity and energy as descried in Jeddah experience as follows:

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4.1 Spatial features:

The walkway along the experienced path is paved with a green boundary towards the edge of the main street, slightly slopped towards sea view. Along the waterfront, where no fishing or swimming is allowed, there is a handrail benches and artifacts as well as open slots for families' settings.

In Figure 3 high stress points are indicated at point A, A', B , E and E' are related to parking area with proximity to walkways. Point B as per figure 4, has a crossing point for cars drop off for entertainement facility.

Fig. 4: Entertainement facility at zone B crossing point, extended to a narrow walkway.

4.2 Typical Refurbishement:

along the cornice for the prototype area investigated with total length of 3.5 km walkway with an interuption point B with entertainement facility that requires potenial of car access. Areas are allocated for kids playground with green areas as well as seats and shaded areas.special safety measures along the coastal edge, paving and lighting features as demonstrated in figure 5.

Fig. 5: typical furbishment for Jeddah corniche.

4.3 Derived Areas of potential developments required:

Point A , A' and B stress is again increased due to the undfined boundaries between parking areas as well as high concentration due to accessibility points for mosque in Point A, Restaurants in Points A' and B.

Stress is increased on Point B due to the narrow width of the walkway. In addition to Proximity of service roads at points A, B and E' increasing noise, crowed and stress levels, as per figure 6.

Fig. 6: Proximity of service roads at points A, B and E' increasing noise, crowed and stress levels.

Through analysis of responsive stress level per participant on each trip, considering average path traveled under stress points (A to E) results varied according to complexity of the space configuration or crowed level due to time frames selected.

In figure 7 the results shows that more than 50% of the extended walkway requires amendement to release the obstacles on the walkway, or provide for proper segregation from the amended facilities wether parking areas, service lots, food and beverage outlets or wc's and praying areas.

Comparaison between paths traveledunder stress within the three ttrips are verified in table 1, and figure 8. The results shows that the major service roads and parking area needs to be seen through for better solution. As well as segregation between large restaurants and families sitting areas overlapping the paved walkways.

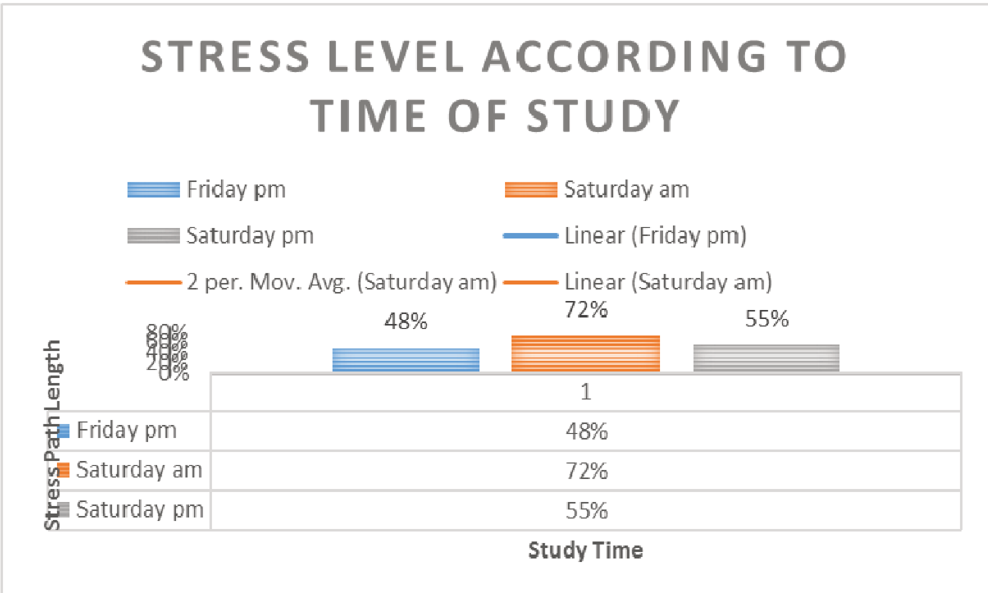

Fig. 7: Title of Figure 1. Please do not use automatic numbering of figures and tables.

Major stress points	Functions and attractions	Friday pm Week end Total 3.5 KM		Saturday am Week end Total 3.5 km		Saturday pm Week end Total 3.5 KM	
		Density of pedestrians	Average Stressed	Density of pedestrians	Average Length	Density of pedestrians	Average Length
A	Mosque	high	5%	medium	2%	none	0%
A'	Food & Beverage	high	8%	high	12%	high	15%
B	Entertainement	Midum	2%	high	15%	high	25%
D	Food & Beverage	Moderate	8%	high	20%	medium	10%
E	Kids area	Midium	5%	medium	15%	moderate	2%
E'	Parking	High	20%	moderate	8%	moderate	5%
Average		48%		72%		55%	

Table 1: Trip 1 & 3, Stress relevant points against functional digestions on weekend

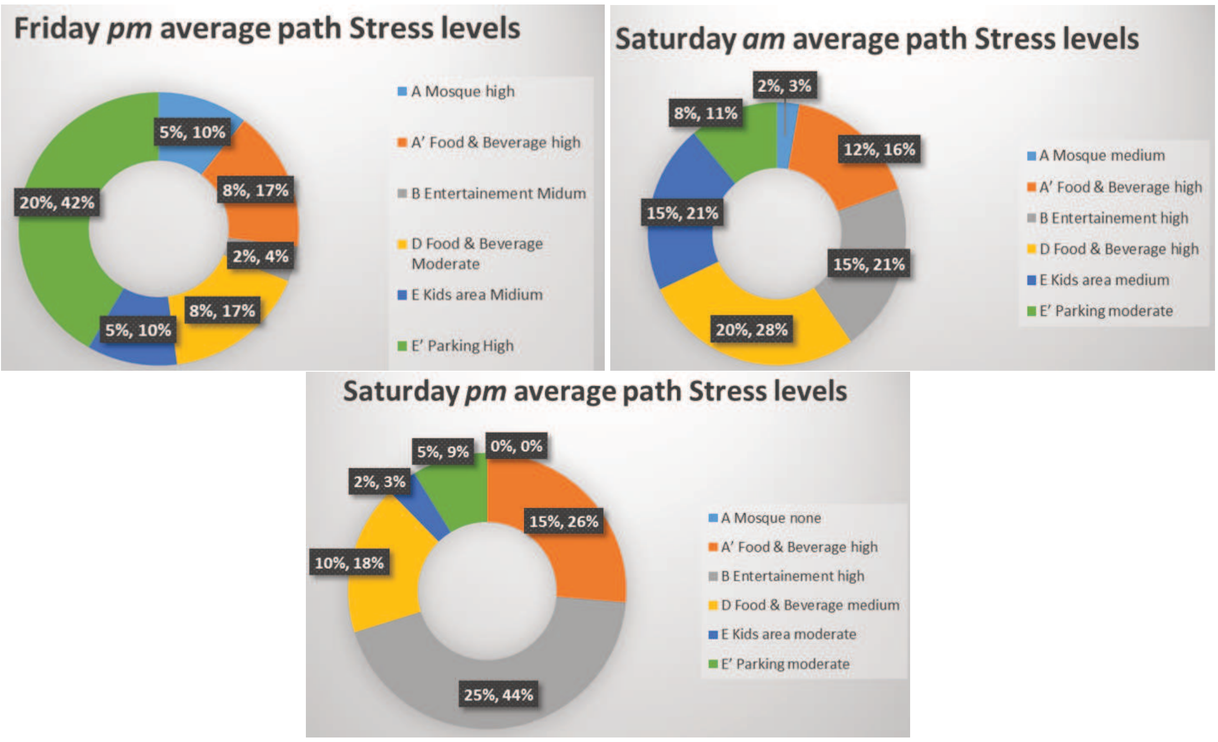

Fig. 8: Trip 1, 2 & 3, Average Stress levels in terms of Path Length .

5 IMPLEMENTATION OF SMART CITY APPROACH:

Coastal and waterfront communities have a distinctive sense of place created by their history and characteristic sights, sounds, and smells (EPA, 2015). Enhancing the services provided for Jeddah Residents and visitors, with potential of increased expatriotes visiting. This issue bring more challenges to be faced to satisfy a vast variety of interests and add creativity to the existing spaces for all ages and genders expected along everyday life not only weekends with high occupancy.

The research suggested to follow the progressive doptation of smart city approach starting with main focal points represented above, and extend the experience towards more paths along the remotly outdoor areas within the city fabric.

5.1 Take Advantage of Compact Design:

Through Smart Growth development, natural resources should be protected through open space design and conservation. Strategic planning of waterfront development will clearly outline the boundaries of development space and conservation space. Because of the limited amount of waterfront, compact design is recommended. This issue is really important regarding to walkways width of clear paths which is considered a necassity for pedestrian accessibility with proper family sitting shaded zoned , and related services.

5.2 Foster Distinct and Attractive Communities

Municipalities should continuously provide for tools and resources for Coastal and Waterfront Smart Growth. This would allow users of the openspaces along the waterfront developped corniche also take benefit of natural resources such as fishing activities and or added activities that will foster attractive communities within specified attraction points along the 12 km of existing development

5.3 Protect the Waterfront

Codes and regulations provided by the municipalities enhances the Watershed Plan to restore and protect waterfront property, nevertheless the degree of awarness of potential users should be raised as part of an organization to plan, coordinate and implement revitalization strategies, like the initiation of campains among young generations as well as regular visitors.

6 CONCLUSION

Under the theme of Smart Developmets, Community interest in public open spaces becomes more challenging especially on waterfronts of cosmopolitan cities such as Jedddah. The results of data presented in the paper highlights potential of further design recommendations and future modifications in order to maintain sustainable entertainement areas as well as enhaning the quality of outdoor activities and sitting areas along the extended coastal development. Smart city approach suggested is implemented in order to explicitly generate solutions for further developments. Such Requirements provides implicit supports and encourages diversity taking in consideration long-term and external impacts into account during municipalities decision-making.

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Understanding Cities and Citizens: Developing Novel Participatory Development Methods and Public Service Concepts

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1 ABSTRACT

The European Commission (EC) aims to facilitate bottom-up initiatives to speed up economic growth. For that it is necessary to empower citizens and businesses. Open data is key to this, as easy access to the right data opens the door for them to contribute as active and efficient actors in European cities. The EC-funded project Smarticipate[1], which is driven by the pilot cities of Hamburg, Rome and London, will foster citizen involvement on four levels: to join forces of committed key stakeholders, to gather local knowledge, to enable exploratory planning exercises and to create new public services. This will be realized by innovative tools, designed within Smarticipate, that provide immediate context-tailored feedback to each contribution made by citizens via online participation services.

This paper outlines a novel methodology that is currently being developed within the project to co-design new public services. Our methodology enables close coordination via an iterative process with diverse urban stakeholders and end users. Citizens and businesses can create and plug their own apps for new public services into the Smarticipate platform we are developing. The overall principle is to interact in co-creation with the cities and citizens of Hamburg, Rome and London and adjust our planning and products directly to their needs. An iterative process is being carried out on three levels: participatory urban planning, user-centered design of applications and user interfaces & software engineering. The first results of this process are presented in this paper, along with an outline of the next steps.

Keywords: Public Service, Smart City, Urban Planning, Citizen involvement, Smarticipate

2 INTRODUCTION

Local governments today are under big pressure to address challenges posed by an evolving society. Citizens and businesses are demanding more effective and efficient public services, but financial constraints, increased administration effort and restrictive disclosure policies make this difficult. At the same time, availability of open data, along with new digital & mobile technologies, offers opportunities to create new collaborative forms of public services. Our Smarticipate platform takes this opportunity head on.

2.1 Role of open data

One of the big advantages of open data is that citizens and entrepreneurs have equal access to shared data. With this, they can take their ideas further and develop interesting proposals that drive our cities forward. Because they can rely on the data, they can make accurate proposals. That not only means a higher likelihood of great proposals, but it also means more efficent reivew of proposals by government. Translated to the European scale, we think the financial savings of this will be at least as large as the economic impact of new investment. Hence, our project partners from the pilot cities of London, Hamburg and Rome recognize the potential of open data to increase the number and quality of citizen initiatives in order to boost economic growth and reduce the burden of bureaucracy.

2.2 A participatory dialog system

Smarticipate will investigate methods of providing immediate feedback to people engaged in participatory planning discussions, including citizens, city administration and entrepeneurs. This feedback can relate, for example, to the costs for a specific building proposal, the regulatory constraints related to placing a local public transport stop, or any other relevant planning parameter. Additionally, Smarticipate will create an interactive model for impact assessment with the ability to modify the modelled objects to understand the impacts of citizen-centric urban planning. To achieve these functionalities, a user interaction tool, including servers for open data, spatial information, planning rules, etc. and mobile applications available for smartphones and tablets, will be developed and tested in the previously-mentioned pilot cities.

[1] http://www.smarticipate.eu

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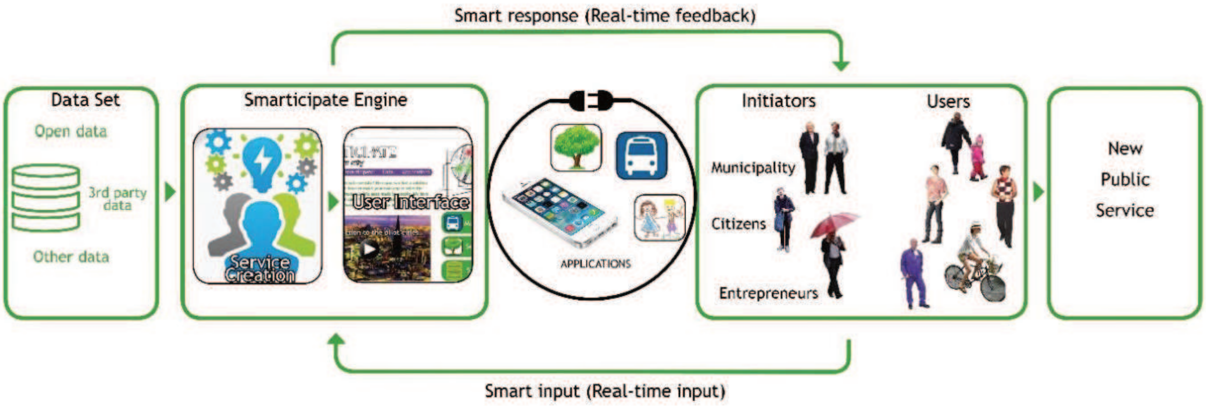

Fig. 1: Smarticipate2 tool

On top of this platform, citizens can create services and innovative user interfaces. They can also add information to the interactive applications to create data about a certain topic for other users. Finally, they receive real-time feedback from other users, city officials and the application itself to fulfil their needs.

2.3 Engaging European citizens in an iterative approach

Smarticipate provides citizens and businesses the information they need to shape their city. By presentating open data in an accessible and understandable way, citizens will be empowered to develop new public services and solutions to urban problems. Smarticipate is collaborating with London, Rome and Hamburg in this three-year project in order to build a web platform and applications that tackle their individual contexts.

Smarticipate follows an iterative design and development approach, by which we actually went to work from the beginning with our stakeholders inside and outside the Smarticipate consortium. In this case, the requirements of the cities and citizens create the basis for the development of Smarticipate with its immediate and context-tailored feedback and shared data. This has three main advantages: (1) An iterative approach that puts new public services central in the process, (2) involving active groups of citizens to define what is relevant regarding citizen empowerment, and (3) defining key elements and urgent issues in the beginning of the development process to ensure that the system created by the Smarticipate team suits the needs of civil society.

3 IT'S ALL ABOUT OUR PARTNER CITIES

The three partner cities are the drivers behind Smarticipate. That means we take their needs and expectations as the starting point for the project. Through this collaborative process we are establishing a viable foundation that will also serve the interests of other European cities.

3.1 London, Hamburg and Rome kick it off

London, Hamburg and Rome were specifically chosen because of their interest and commitment to using smart open data to drive their cities forward. They also represent a wide spectrum of needs and orientations towards participatory governance in Europe. Each of them has different expectations regarding Smarticipate:

- London, more specifically the Royal Borough of Kensington and Chelsea (RBKC), wants to enable residents and businesses to participate in the planning, co-design and decision-making around all the things that impact their urban quality of life.
- Hamburg, i.e. Freie und Hansestadt Hamburg, sees the potential of open data to increase the number & quality of citizen initiatives to boost economic growth and reduce the administrative burden.
- Rome (Roma Capitale) depends on bottom-up initiatives and, since the crisis, the government and the development sector have far less elbow room than before.

Hence, Hamburg and London are examples of 'modern and open local government' that rightly make their government communication very accessible; see for example, the website of City Life Living Local from

RBKC[2] and the Partizipation Portal from Hamburg[3]. These cities have clear needs and expecations about how they want to use the urban platform created by the Smarticipate project to develop their cities. Their varying orientations will reveal a beneficial range of fields of interest: new communication technologies, knowledge and experience regarding urban policy planning in a complex city, the drive to operationalize open data for citizens & business and the knowledge that participation can lead to a much better plan.

3.2 Smarticipate makes the difference

These are the topics that come back in each pilot city and where Smarticipate has to contribute by improving existing processes.

- Space: There is constant pressure on limited urban spaces, leading to conflicts between users and uses. That's most visible in housing, as cities struggle to provide affordable housing for its citizens. This issue has a big impact on urban social and economic life.
- Expectations: Citizens are increasingly well informed, particularly via social media and through newly-available open data. This means they are more critical, demanding more attention and fast responses to proposals and requests.
- Efficiency: Cities are under high pressure to deliver services faster and with a higher quality. At the same time, there are fewer financial resources available. That translates into a bigger burden for city administrations.
- Finance: A realistic plan is always supported by a sound financial framework. That means making a close link between planning process & goals and the financial resources needed to make plans happen.
- Trust: Trust is the foundation of good urban governance and is also the basis for Smarticipate. That means open data must be transparent and accessible to everyone. Only then will citizens collaborate.

4 URBAN STORIES AS A BASIS FOR WHAT WE DO

To gather the detailed requirments and expectations of cities regarding the Smarticipate platform, we're taking the so-called "urban stories" design approach. Representatives of the city government, urban planning specialists and experts regarding open data together developed scenarios that describe typical workflows of citizens interacting with the proposed systems. Hence, the goal is to describe realistic use cases, including individual citizens and real problems. Below we provide the urban stories from the city of London - created in a workshop in April - as they are the first results available. The urban stories from the workshops in Hamburg and Rome will follow shortly.

In order to guide the discussions during the workshops with the cities, we set up five criteria for the urban stories which were presented and explained to all participants at the beginning of the workshop.

- Real-time feedback: Smarticipate users will receive direct, instant digital feedback that is customized to his or her own proposal. Use cases should provide the possibility for this kind of interactive relationship.
- Broadening of participation group: Smarticipate opens spatial planning processes to all citizens. This means taking a special effort to reach out beyond usual suspects and broaden the group of participants.
- Continuous useful activity: Smarticipate will provide continuous support and feedback to citizen initiatives. That means use cases should not be one-off or periodic events, but ongoing activities.
- New public services: The selected use cases should illustrate Smarticipate's potential: supporting citizens in taking over services from government, or in developing entirely new public services.
- Data availability: Smarticipate will be fuelled by open data. It is therefore essential that data regarding the use cases are available for use, and can easily be transformed into useable information.

The following subsections 4.1 and 4.2 describe the urban stories created during the workshops in London.

[2] https://www.rbkc.gov.uk/subsites/citylivinglocallife.aspx
[3] https://gateway.hamburg.de/HamburgGateway/FVP/Application/DienstEinstieg.aspx?fid=59

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4.1 Planning Applications 'Co-creation between a developer and the community'

In general, planning applications are the backbone of civic services in the planning department. But they are also a big burden for the administration in terms of time and money. The following is a synopsis of the urban story that takes on the challenge of planning applications:

An ambitious developer makes a 3D proposal to redevelop an abandoned industrial site in the north part of the Royal Borough of Kensington and Chelsea (RBKC). Smarticipate disseminates the proposal to the local community via RBKC's postal code notification system for planning applications. Neighbourhood residents receive the message and come into action, using the design function of Smarticipate to produce alternative proposals. Smarticipate then provides automatic feedback that the citizens use to improve their proposal, including a check to ensure their proposed building shape is affordable to construct. Their ideas are also published via the postal code notification system. Subscribers can now see the new proposals alongside the developer's original proposal. The borough and the developer - who are also on the mailing list - invite residents to a face-to-face workshop during where the developer's architect presents a compromise. The revised design is republished and continues through the borough's planning application process.

Fig. 2: Scenes from the Urban Story: Planning Applications.

4.2 City Living. Local Life 'Citizen-initiated plan'

Citizen-driven initiatives build stronger connections between residents in local neighbourhoods. Governments often enthusiastically begin such programmes, only to discover later that they require a lot of time from participants - including civil servants. There are two ways to respond to this. The first approach can be called impact-oriented, in which the government measures the positive impact of the programme on society and determines that the time investment of civil servants is less important in light of the positive impact on society. The second approach can be called efficiency-oriented, in which the government prioritizes efficiency of the time investment of civil servants. The consequence is that citizens receive little feedback, often leading to a rejection of their planning proposals. Although professionals always plea for the more 'mature' impact-oriented approach, the efficiency-oriented approach wins in the long term. And because impact-oriented programmes are not legally bound, they're often cancelled after the next elections. The following is a synopsis of the urban story that takes on the challenge of citizen-driven intitiatives:

A group of active citizens have a great idea for their neighbourhood: a football field. Smarticipate provides automatic feedback on their proposal with an outline of the basics: the current owner of the selected site, environmental restrictions, etc. This includes feedback indicating that it's not possible to develop on the selected site, along with two alternative locations where development is possible. Smarticipate then conducts a pre-check of the project proposal, before co-funding begins, via a link with the project verification function of the Spacehive crowdfunding platform. The result includes negative feedback: according to city policy, girls also must be included in the sport proposal. The citizen group therefore attempts to activite more female supporters using RBKC's postal code notification system. The elaborated project is uploaded to the Spacehive crowdfunding platform and fundraising is successful, including co-financing from the Borough. Construction begins. Finally, Smarticipate also identifies key issues from the entire process and links them to the city's Planning Policy.

Fig. 3: Scene 3/12 from the Urban Story: City Living, Local Life

"Luckily, Smarticipate proposes two alternative locations. The group is immediately happy with Tavistock Road because their famous pub, where they always gather to watch Premier League games, is on the opposite side of the street."

5 CONCLUSIONS AND OUTLOOK

The concept described above, including the iterative development processes as well as the two urban stories for London, illustrate Smarticipate's ground-breaking approach towards achieving citizen participation solutions. Although we're currently in the third month of this three-year project, the project is moving very quickly since we began working immediately with the pilot cities and building the project around their needs. The next step in our work programme is to complete the urban stories for Hamburg and Rome. Based on this we will finalise the project requirements, generic used cases and system components while considering technical feasibility and availability of open data.

An exciting activity that we are currently developing is an interactive 'planning exercise'. Through this we will test the Smarticipate concept with a selected group of key stakeholders, citizens and businesses in all three pilot cities. Prototype elements will be shown to participants while they perform a concrete planning exercise. This will take into account different use cases and related open data, such as legal frameworks, policies and financial resources. One of our main objectives is determines if the envisaged real-time feedback feature will provide realistic and effective support for idea development and decision-making. In addition, we will also investigate ways to stimulate and enable citizens to create New Public Services. These planning exercises are therefore an innovative and effective means for contextualizing and narrowing down the system specifications for the subsequent development of Smarticipate technology.

If you want to stay informed or if you think Smarticipate would be interesting in your city, please contact us via the project website: www.smarticipate.eu. We would also be happy to hear your opinion on this exciting project!

The partners in the Smarticipate consortium are: Fraunhofer Institute for Computer Graphics Research; University of the West of England; Austrian Institute of Technology; Geoville Informationssysteme und Datenvereinbarung GmbH; ICLEI - Local Governments for Sustainability; WeLoveTheCity bv; City of Hamburg; City of Rome; and Royal Borough of Kensington and Chelsea.

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URBAN LEARNING – Joint Learning towards Integrative Energy Planning in European Cities

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1 ABSTRACT

This paper gives insight about EU project URBAN LEARNING (H2020 energy call) which began in March 2015 and will be concluded in August 2017. The article carries out the idea and structure, first results and expected outcomes.

The project includes seven capital cities across Europe (Vienna, Berlin, Paris, Stockholm, Amsterdam, Warsaw and Zagreb) and the city of Zaanstad (NL) which all face the challenge of considerable population growth while being committed to significantly reduce fossil energy consumption and CO2 emissions. E.g. Stockholm grew by more than 12.000 people/a (1.5%); in the next 10 years Vienna has to build for 200.000 new people.

Efficient and effective planning processes will be crucial for addressing this challenge. The project cities aim to enhance the capacity of their local authorities on integrative urban energy planning in response to new challenges from EU EPBD (Directive 2002/91/EC and 2010/31/EC), EED (Directive 2012/27/EU) and RES (Directive 2009/28/EC) directives as well as to changes of technologies and market conditions and the pressure to provide sufficient, affordable housing.

The project emphasizes governance processes related to the (re-)development of urban areas. While some cities already started ambitious urban development projects, the institutionalisation of these experiences is missing. The cities are aware and willing, but lack of knowledge, lack of time and sometimes less collaboration across city departments impair this development. External stimulus is needed to overcome these barriers. Project partners address these issues collectively with key stakeholders, such as network operators and energy suppliers and share their findings amongst all cities.

Focus is on multi-disciplinary learning - the project concentrates on innovative technological solutions, instruments and tools and most importantly focuses on innovative governance elements. This will provide potential approaches toward integrative urban energy planning. Developed tools and process improvements will also be implemented in the inner circle of smaller cities under the guidance of each national partner.

In each city a local working group, comprised of experts of various city departments and stakeholders involved in the planning processes, was installed. These groups will help to ensure the implementation of results and outcomes.

Keywords: Joint Learning, Energy Planning, Sustainability, Transformation, European Case Studies

2 STRUCTURE AND CONTENT OF THE PROJECT

This EU-project is divided into four main work packages:

- analysis of innovative governance solutions for integrative urban energy planning and improvement of that process,
- innovative technological solutions,
- analysis of instruments and tools used,
- development of governance models for replication.

The first, and key work package „Innovative governance solutions“, will be explained in the next chapter with first results of the analysis.

„Innovative technological solutions" include technological options on the demand side (low-energy to nearly zero-energy buildings and quarters including on-site use of renewable energy sources) as well as the whole spectrum of innovative supply technologies and systems including innovative district heating and cooling solutions (low exergy or anergy networks, fed from various renewable energy sources and/or waste heat, decentralised combined heat and power, etc.), smart grids and new storage possibilities. Of particular interest for the analysis are aspects of system integration and its implications for the planning process.

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The core of this task is a SWOT analysis of selected innovative solutions and combination of technologies. Input is provided from experiences from ambitious (re-)developments in the city, new findings from national research and demonstration as well as interesting examples of other cities. A crucial step of the analysis will be the identification of implications from innovative technological solutions for the process of designing and planning urban (re-)development projects.

„Instruments and tools" relate to instruments and tools currently in use and those that might be needed in the future to integrate energy aspect in the spatial planning/urban planning process as well as in the planning of urban areas, the latter being the core of the analysis.

All local partners mapped currently used instruments and tools, and analysed them based on a common grid developed by the project partners. The analysis focused on the effectiveness of the current instruments and tools for integrating energy aspects into the planning processes and identified the influencing factors. It considered different tools from the perspective of the different stakeholders involved in the process. The following figure shows an overview of the analysed instruments and tools by type and spatial level in Zagreb.

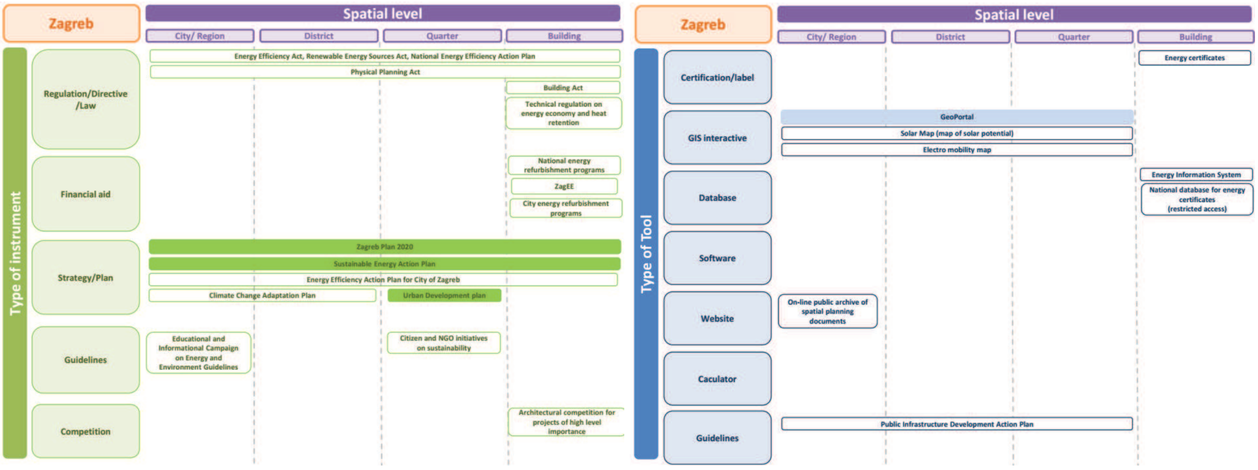

Fig. 1: Simplified mapping grid for used instruments and tools in Zagreb

In the above figure, left grid depicts realtionship between spatial level and type of instrument (legal documents, finacial aid, strategies and plans, guidelines, competition) used in spatial and energy planning. Spatial level spans from the City/Region level to the individual building. The right grid in the above figure shows same level of information, but for different tools which are used in the planning process – such as GIS tools and interactive maps, databases, software, websites, or calculators. The highlighted instruments and tools will be considered more in detail.

Mapping and analysis are shared between the cities to identify common elements as well as shared interests in current practices of other cities. The experience from other cities will be used to include an outside view on the current state of the art process in each city.

Project partners have so far undertaken most of the foreseen analysis and stocktaking work, and are now focusing on research of innovative solutions and ways to improve current governance process.

3 ANALYSIS OF CURRENT GOVERNANCE PROCESSES

3.1 Urban planning and energy planning as governance processes

In the context of the project the „governance process" is an administrative management process related to integrative energy planning as part of the design and planning of urban areas, involving various departments of the city administration as well as their respective negotiating and/or contracting parties. Mostly it includes the adaptation of urban planning instruments such as Land Use Plan.

„Integrative energy planning" in this project is defined as the integration of energy aspects into the urban design and planning process(es). That includes energy planning of supply and demand and involving all relevant parties as early as possible.

The analysis focuses on the way urban planning of (re-)developments takes place in the city administrations today, and in that way provides the baseline and stocktaking of current situation, procedures, pros and cons, and identification of best cases, by addressing the questions:

- which planning instruments are used and how is the procedure of adapting them,
- how, at which moments and by whom energy aspects are addressed,
- how key target groups are being involved,
- how it should take place for effectively integrating energy aspects in the planning processes.

One main outcome is a readable process map of the this/these identified planning process(es) and tables of assessing energy aspects for each process element. The following figure shows one example of such a process map for Vienna. For the implementation phase and the case of subsidized housing additional process maps exist which will be developed and adapted as 'living maps'.

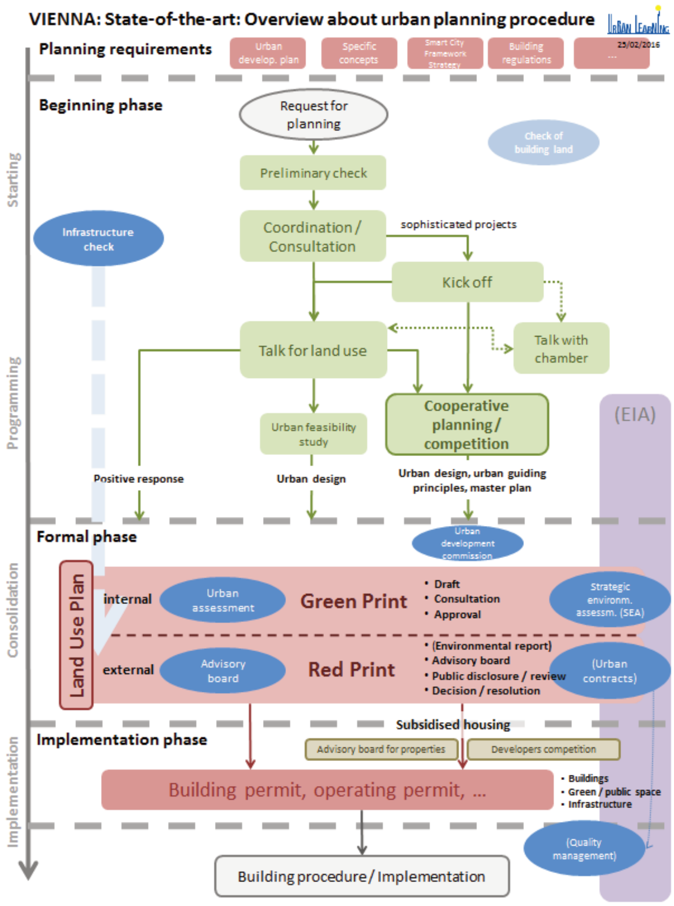

Fig. 2: Simplified process map of the urban planning process in Vienna (draft)

One lesson learned in this project is that using figures of simplified process maps is very helpful for communication, knowledge transfer and identifying information gaps. It also makes the loss of specific requirements defined in the beginning of the process more transparent.

3.2 First main findings

The urban planning process is predominantly similar in the reviewed cities. The development of urban areas needs much consultation and negotiation over years. The latter is the main focus in Amsterdam and Zaanstad. Results of this phase fixed within the Land Use Plan and/or Building Regulation Plan. This/these binding planning instrument(s) exists in each city on a scale of 1:1000, without regarding energy matters. Differences in the planning process were identified as follows: in the duration, adaptation procedure of the planning instruments, use of other planning instruments or tools, involvement of districts due to competencies (especially in Berlin where the districts are responsible for the Building Regulation Plan) and level of public participation.

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Energy is mostly a subtheme of climate protection (mitigation) or sustainability. Hence, the environmental departments are mostly responsible for general energy activities, but have no competency for energy planning. Warsaw, however, does have an energy planning approach headed by the infrastructure department. Energy planning is predominantly done by the energy provider.

Therefore, energy is not a highly relevant issue in the planning process at the moment. Other themes/issues such as green space or mobility have more importance in the planning process than energy. Therefore, up to now no partner city follows an integrative energy planning approach. That means urban planning and energy planning are not regularly connected or energy is not an essential part of urban planning. Energy solutions for new developed areas or buildings are decided by energy providers or commitments are made between developers and utilities. There is no steering of centralised energy systems such as district heating by the city (for instance by defining zones) or defining general energy criteria for districts and quarters. Possible reasons for this situation are missing legal framework that energy should be an integrative part in urban planning or seeing the responsibility for energy planning lies with the energy provider (especially due to privatization). Furthermore, the developer or property owner wants to avoid additional costs when high energy standards going beyond national regulations need to be fulfilled. So there is no support from the private sector.

However, there are voluntary possibilities to integrate energy matters in urban development processes. Some partner cities already have lighthouse projects that include first approaches toward integrative energy planning. A good practice case is the development area Clichy Batignolles in Paris where energy is part of the planning process. The following figure shows an overview of the phases for urban development and the orange points indicates where energy could be regarded. In the beginning phase ("Preliminary studies") an energy assessment of energy needs and scenarios was done. Based on these results, possible energy solutions were identified. Aims for energy like share of renewables for heating were fixed by a development concession contract between the city and the responsible urban developer carried out by tender. Later in the operational phase these scenarios were further developed by using a multi-criteria analysis grid (as part of "Feasibility"). The input of this assessment provide a basis for energy criteria of land sale contracts as well as for tender of developer competitions in the implementation phase (see points "Design" and "Delivery"). Finally, there is an energy check of the building permit. Follow-up monitoring is planned. Such lighthouse projects can serve as drivers and urban living labs. Nevertheless they are difficult to replicate due to funding or special interests for an area.

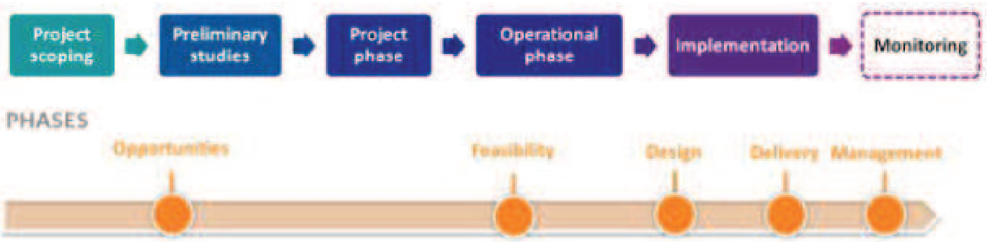

Fig. 3: Urban development process and integrated energy issues in Paris

That leads to the next finding: a city can define and ensure high energy criteria beyond national regulations (e.g. heating demand for buildings) if they are land owner. For instance, Stockholm defined 60% energy efficiency of the national requirements for new buildings (e.g. heating demand) in the Royal Seaport area since 2009. This requirement is already applied by the Environment Programme 2012-2015 throughout all developments in Stockholm. Criteria like this example could be part of land sale contracts. A high share of land owned by the city, as is the case in Stockholm, Paris and Amsterdam, is an advantage for developing integrative energy planning procedures. In the case of private landownership, the city could integrate energy issues in voluntary contracts. This possibility is not used; however private owners have less interest in additional criteria beyond national regulations, which could lead to high investments.

A further finding was there are a lot of energy guidelines and tools available such as potential cadastre for geothermal energy or solar energy, but little knowledge or support to apply them.

Finally, urban planning has already a strong indirect impact on energy efficiency for instance due to regulation of the building density and mixture of uses or the accessibility of public transport.

The results and findings of this analysis will be published in a synthesis report on the project homepage (see references).

4 CONCLUSIONS & OUTLOOK

The projects cities have ambitious goals to reduce greenhouse gas emissions – for instance Berlin want to be climate neutral till 2050 (-85% of GHG till 2050) or Stockholm set the objective of being fossil freen in 2040. In addition, the cities face strong population growth and boosting prices for land as well as rent. With these framework conditions it will be a challenge to reach the energy-relevant objectives.

For achieving the defined ambitious energy-relevant objectives, it is necessary to strengthen the use of renewable energy sources instead of fossil sources. The cities recognize a need for more collaboration or cooperation with the energy provider to find the best solution for urban development areas and to change the energy sources used (e.g. to integrate waste heat into an existing district heating system). It is useful to steer and designate which areas are applicable for centralised or decentralised energy systems in a long-term view. The hardest challenge will be improving the existing energy system within the building stock. The cities have to coordinate refurbishment activities with changes in the energy supply and integration of renewables especially solar energy.

Some project cities – at the moment strongly Amsterdam and Zagreb - face a change in the planning system relating to responsibilities, instruments, planning levels and processes. This might be a window of opportunity to integrate energy matters. The project cities will support each other with experiences and knowledge.

The project cities will integrate experiences of other cities and lighthouse projects in the planning processes. This should lead to an upgrade of the planning process(es) and testing of new governance elements or instruments as well as tools. For instance, a city can use an energy assessment in the beginning phase for an urban area to identify different options for energy solutions depending on waste heat sources, potentials for renewable energy sources and existing energy infrastructure. The best solutions can be achieved through urban contracts or concessions. Further exemplary possibilities for integrating energy issues could be:

- energy studies similar to mobility assessments
- energy as objective and important part of the planning law
- assessing planning instruments for inclusion of energy matters and related procedures
- use synergies (green space, mobility, …)
- using legal instruments especially urban contracts
- help and guidance in applying tools and instruments

However, most important will be the insight on which points in the process which energy criteria are most crucial and with which instruments and tools can help to ensure. It is important to know which building density avoid or enable which kind of energy supply. This has a strong influence for the possible usage of renewable energy sources for heating and cooling. The challenge is to assess and consider long-term impacts of energy solutions about costs and emissions within a fast-paced market. The development of areas has a long duration and needs the coordination of different building phases. Moreover, cities also have to include the security of energy supply in their considerations. Finally, the result of this step in this project will be a blueprint of upgraded governance processes till the end of 2016. Based on these blueprints an implementation plan and models for replication will be developed as a final result in the summer of 2017. The involvement of city administrations, the local working groups and stakeholders should ensure the implementation in each city after this project.

5 REFERENCES

The content of this paper based on the results generated within the project by the involved experts from the cities and their partners. More information on: http://www.urbanlearning.eu/
Following deliverables of the EU project will be soon available on this webpage:
> Deliverable 2.1 Analysis of innovative technological solutions for ambitious urban (re-)development projects, Urban Learning, 2016
> Deliverable 3.1 Instruments and Tools – Common analysis grid, Urban Learning, 2016
> Deliverable 3.2 Map and review of used instruments and tools, Urban Learning, 2016
> Deliverable 4.1 Analysis of the current governance process – Synthesis report, Urban Learning, 2016

Urban Planning through Exhibition and Experimentation in Stockholm

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1 ABSTRACT

In this paper we discuss findings of our case study on the making and implementation of the exhibition 'Experiment Stockholm' in 2015, which, based on artistic exhibits as well as a number of forums, aimed at generating creative narratives for the sustainable urban future in the Swedish capital city-region. Our analytical framework is informed by the emerging notion of 'urban living labs' across Europe as well as 'communicative' and 'actor-relational' planning theory', which is discussed in another paper within the poceedings of this conference (cf. Schmitt et al. 2016). We argue that the exhibition 'Experiment Stockholm' and the activities around it can be characterised as a soft mode of urban governance that can help to unlock creativity and to open up avenues for experimentation and alternative solutions in urban planning. However, caution must be taken to not overvalue such approaches, as our example implies a rather exclusive expert forum instead of a a mode of governance that might be associated with openness and wider engagement. In addition, our example illustrates the significance of suitable and unconventional methods, which otherwise considerably limits the innovative capacity of the participating stakeholders and their search for alternative solutions.

Keywords: exhibition, Stockholm, urban governance, urban living lab, urban planning

2 EXPLORING 'EXPERIMENT STOCKHOLM' AS AN URBAN LIVING LAB

2.1 Introduction

In the following, we will present and reflect upon findings from the exploration, making, and implementation of the exhibition 'Experiment Stockholm' in 2015. Based on artistic exhibits as well as a number of forums, our exhibition aimed to generate creative narratives for a sustainable urban future in the Swedish capital city-region. Our analytical framework is informed by the emerging notion of 'urban living labs' across Europe (cf. Bergvall-Kåreborn and Ståhlbröst 2009; Franz 2014; Juujärvi and Pesso 2013) as well as 'communicative' (cf. Healey 2003a, 2003b) and 'actor-relational' planning theory' (cf. Boelens 2010; Boonstra and Boelens 2011). This sort of literature is discussed in another paper within the poceedings of this conference (cf. Schmitt et al. 2016) with a view of providing an analytical framework. The distilled three cateories (see below) shall help identifying innovative forms of urban governance rather than assessing a vague concept, whose label seems to be increasingly assigned to any sort of 'investigative' urban development setting that can be described as 'not business-as-usual' (ibid). In our analysis, we follow these three categories by adding a number of research questions that have guided our empirical investigations. Before turning to these categories and discussing the empirical findings, we briefly describe the context of the exhibition 'Experiment Stockholm' as well as some methodological notes.

2.2 The study object: the exhibition 'Experiment Stockholm'

The exhibition 'Experiment Stockholm' has been facilitated by the Stockholm-based foundation for art, architecture and urbanism 'Färgfabriken' (the paint firm – named after the former use of the premises where the foundation is located and operating). Among the various exhibitions and related projects and activities in which Färgfabriken has been involved since 1995, this exhibition is the third of its kind that illustrates urban planning issues and potential futures related to the city-region of Stockholm.

An early forerunner was the exhibition 'Stockholm at Large' (2001 – 2002), which, through a number of multi-actor workshops, discussed and developed possible urban futures for Stockholm. The results have been exhibited to the general public (in total about 25,000 visitors). Among other things, the project has led to a new course at the School of Architecture in Stockholm ('The new urban planning office') and a 'Handbook about the future of Stockholm' which illustrates pathways for the future urban discourse in Stockholm (Åman, 2004). Several years later, the concept of 'Stockholm at Large' was further developed into an even larger exhibition: 'Stockholm on the Move'. The preparatory work started in 2010, and the exhibition as such ran between November 2011 and March 2012. “The field of play for the project [here the exhibition ‘Stockholm at Large’] is the big exhibition in Färgfabriken’s main gallery. The exhibition strives to create a coherent overall picture [here about the challenges in the Stockholm city-region], gather the different parts of the project and present an entirety, consisting of a historical background, different visions, utopias and dystopias and some of the infrastructure projects that are on-going and proposed for the region.” (Färgfabriken, 2015a) The exhibition was flanked by a number of workshops and seminars in order to interact directly with a number of stakeholders. “Stockholm on the Move is a profoundly inclusive forum for constructive dialogue among politicians and other stakeholders, a venue for debates about infrastructure and urban development. It is also a forum in which the citizens of Stockholm are given concrete opportunities to develop their ideas, their fears, and their desires about the development of the city and the region.” (Färgfabriken, 2015a). In addition, a catalogue has been published (Färgfabriken 2012) which presents further thoughts and ideas about the development of the region and about global tendencies in infrastructure.

Since ‘Stockholm on the Move’ has been even more successful than its forerunner (200 to 300 visitors per day, 60 workshops and seminars, 37 guiding tours for school classes, 80 for companies and other organisations), the idea has been to make a follow-up exhibition in the fall 2015. During 2013 and 2014, the preparatory work was tackled, which specifically included the re-activation of former and the inclusion of new collaborators and funding partners in the Stockholm city-region, along with the identification and formulation of a number of questions and themes. Two so-called partner-meetings, together with a number of other workshops, seminars and related activities have been arranged during spring 2015. These were supposed to form an ‘inspirational ground’ on which parts of the exhibition should be based on. Over the summer of 2015, together with Färgfabriken (i.e. the creative director, the curator and specific ‘project’ related experts and managers), a number of carefully selected artists have developed concrete exhibits. At the same time, ‘material inputs from other partners involved’ have been integrated too, although a further adaptation (here primarily in form of posters) has been done in order to make the inputs suitable for this kind of exhibition (Interview Färgfabriken 2015).

1	City, suburb, countryside
2	Interaction and integration
3	Nodes and hubs
4	The ‘bigfoot’
5	Dialogue is not monologue
6	Informal methods
7	Varied building, varied functions
8	Beyond the car age
9	Planning for the unplanned

Table 1: The thematic scope of ’Experiment Stockholm’.

In total nine themes (see above, table 1) have been distilled within a number of bilateral meetings and discussions, primarily between Färgfabriken and the involved in-total 35 partners, which represent (among others): five municipalities within the Stockholm county (Hanninge, Knivsta, Sollentuna, Nacka and Stockholm); the Mälardalsrådet, a non-profit special interest organisation for municipalities and the five county councils around the lake Mälaren; the Swedish Environmental Protection Agency; The Nordic Building Exhibition; the Swedish Architects Union; The Nordic Building Exhibition; three research institutions; and five private companies in the fields of environmental consulting, architecture, construction and real estate. These 35 partners have financially supported the exhibition project, albeit with different price tags, and have thus guaranteed themselves ‘a say’ in the preparation and even implementation of the exhibition (Interview Färgfabriken 2015). Although Färgfabriken is a politically independent foundation, one needs to add that it is financed by funds from the National Arts Council, the Culture Administration of Stockholm and the Stockholm County Council, whereas its main sponsor is the Lindéngruppen AB, a family business focusing on the long-term development of industrial companies, as well as by the entrance fees for exhbitions.

2.3 Key research elements/questions

The key research elements/questions have been informed by the three categories addressed in Schmitt et al. (2016), namely 'co-creation' and 'exploration/experimentation' (for both the key question was 'how are the two categories facilitated and practised?) as well as 'evaluation'. Regarding the latter, the key question was 'what sort of tangible or non-tangble outcomes have been co-created and to what extent has the knowledge and learning being generated has (or might have) an impact on any sort of urban policy or governance practices in Stockholm?'. Another set of questions involves the institutional and organisational context of Experiment Stockholm, the emerging actor-networks and power relations, the inclusion and exclusion of stakeholders and ways (and barriers) of promoting them to co-creators of knowledge.

2.4 Methodological notes

The authors of this paper have been directly involved as one of the research partners (see above) in the preparation and in the implementation of the exhibition as so-called participative observers. This enabled the authors to have 'direct access to the empirical field' as participant observers. In addition, three interviews with Färgfabriken and with a number of partners have been conducted.

3 OBSERVATIONS FROM 'EXPERIMENT STOCKHOLM' AS AN URBAN LIVING LAB

3.1 The preperatory phase: Two partner meetings in March and April 2015

The main idea of these partner-meetings has been to further settle the nine proposed themes (see table 1) among the official partners, discuss trends and challenges, visionary pathways, and potential innovations. Färgfabriken has defined and briefly introduced the themes and the methods, but has not narrowly defined them, allowing a high degree of freedom for the participants, particularly at the first meeting. At the second meeting, some clearer guidance has been given to the participants. Moreover, it is striking that pencils and paper have been the only tools to express ideas and outcomes from the group work. This has certainly pre-defined (if not restricted) the scope of experimentation.

In addition, the scope of experimentation has been further constrained by the observed roles that most of the participants have played out. Although Färgfabriken has shaped an informal atmosphere and made clear many times that the discussion should go beyond contemporary topics and debates in urban planning in Stockholm, it was striking to see how little the participants have left their professional and institutional backgrounds. Their inputs to the discussions were, for the most part, anchored in their daily work, their everyday life eperiences, and convictions, particularly in regard to the challenges and problems they are facing. Consequently, only a few were willing (at least to some extent) to think 'outside the box' and thus to experiment with various ideas, scenarios, etc.

As for an outcome of the two preperatory partner-meetings, one can say that the nine themes have not been questioned or re-formulated; rather, they were made concrete with some state-of the art reflections on cities from a 'social cohesive' and green-biased perspective. This can be traced back - not only to the chosen themes as such - but also to the selection of participants, which seem to follow a (although not very outspoken) certain 'normative agenda' that Färgfabirken had also in mind (Interview Färgfabiken 2015).

3.2 The exhibition phase and reflections thereafter

„[…] Experiment Stockholm […] seeks to examine and experiment with strategies and solutions for dealing with the challenges of a rapidly growing Stockholm region. […] Experiment Stockholm is a laboratory made up of the exhibition spaces, of seminars, debates and other events. We hope many people will meet in this experimental environment where we challenge old ways and propose and test new models and ideas together" (Färgfabriken 2015c).

This has been the official opening statement on Färgfabriken's homepage to describe what Experiment Stockholm is about and what the main intention is. In this light, it coincides nicely with the three categories that characterise urban living labs as discussed in Schmitt et al. (2016) and which structure the analysis below. It is also noteworthy that in this paper we focus specifically on six so-called 'experiments' within the exhibition and not on the many other events, seminars or even the artistic exibits that were presented in the exhibition spaces. These experiments have essentially been workshops organised by one of the partners (often municipalities in concert with Färgfabriken) which were adressing one or two of the nine overall themes (see table 1), and which were targeted at developing various futures and planning solutions of concrete neighborhoods.

3.2.1 Co-creation

These experiments have essentially been closed clubs, since only the official partners, as well as some specific guests, have been invited. Nonetheless, due to the variety of partners, these experiments can be qualified as multi-disciplinary collaborations. However, the majority of persons came from the urban planning departments of municiaplities, so we could see a clear dominance of 'physical' planners in most of the experiments. This was further strengthened by the presence of invited building and construction companies. Most of the experiments proceeded within group-work (often between 4 to 8 persons with its usual dynamics) and presentations to all participants (in general 30 to 50 persons) followed by discussions. As in the case of the prepatory meetings, what was striking here was the use of rather conventional methods, as there was a clear focus on 'shaping' and 'designing' specific places related to actual local planning projects and challenges by using overview maps of the existing physical structures, which were then re-modelled with the help of pencils, paper and a number of toy blocks.

3.2.2 Exploration and Experimentation

The scope of the topics of the various experiments have been introduced by guest speakers (regularly consultants), as well as representative from Färgfabriken, followed by a further introduction by the organiser (here usually a representative from a municipality). What was striking was the fact that the tasks conveyed to the group have been neither carefully defined nor particularly questioned by the participants. Eventually, due to the rather conventional (and thus for most of participants, familiar) methods (see above), the various groups entered immediately into the above described re-modelling of the given neighborhood. This, together with the limited time (often 45 to 60 minutes for one task) has certainly limited the scope of exploring the issue at hand, and also the scope of experimentation. Since the 'experiments' have not been underpinned by commonly agreed understandings, having been limited by the rather conventional methods and the fact that concrete and well-known planning problems have been tackled, it has been rather difficult for the various groups to switch to a mode of 'unforeseeable' future-making.

3.2.3 Evaluation

Through our interviews we have learnt that, in two cases, the results from these experiments have informed one informal policy document as well as one draft planning scheme. Others have reportetd that the experiments have helped them to 'think-out-of-the-box', particularly through the multi-disciplinary networking, which otherwise hardly takes place in their lives as planning practitioners. Some of the organising municipalities have articulated that the experiments have particularly supported (in-house) discussions on the topic at hand, as the experiments offered new perspectives. One of the municipalities has even utilised 'Experiment Stockholm' as a staff training opportunity by joining, as much as possible, the various events, seminars, and experiments in order to make best use of the membership fee to become an official partner of Experiment Stockholm.

4 CONCLUSION

Allthough in this paper we have focused on the six experiments, one question is of course the relation of these more practice oriented forums to the more 'artistic-based' exhibition. Our respondents have argued in general that the latter has been a frame rather than a foundation for creativity and experimentation. In some ways, the exhibits have been too abstract, and it has been difficult to make linkages to the more workshop-like experiments. This can be considered a 'tightrope walk' to link prospective and art-inspired themes with current 'real-world problems' of stakeholders.

Another point for reflection is the membership principle, which included those with the willingness to spend their resources (money and time), but excluded others. As a concequence, the established temporary multi-disciplinary networks can be chacaterised by an exclusive, if not elitist, urbanist community within the Stockholm city-region.

On the positive side, one can certainly note that Experiment Stockholm has offered a learning environment with many networking potentials (for members within the experiments, but also for other interested 'persons' in the numerous seminars and events, as well as the artistic exhibition as such). Also, some of our respondents mentioned that the various activities have helped them think in a more comprehensive way about urban planning and thus overcome the prevailing silo mentality in urban planning, opening up avenues for cross-sectoral coordination.

The ‘meetings’ and ‘experiments’ that have been discussed here have also illustrated the important role of more organisational issues in practicing ‘co-creation’ and ‘experimentation’ within multi-disciplinary networks. First to be mentioned is the functioning of the networking-platform, which includes the role and performance of the facilitator as well as the moderator (cf. also Schmitt et al. 2016). Secondly, the significance of suitable and unconventional methods should be mentioned, which are significant in regards to provoking visionary thinking and supporting creative alternative solutions.

Our observations within Experiment Stockholm suggest as well that this soft, temporary, and to some extent experimental mode of governance faces the same deficits regarding transperancy, legitimacy, durability and equality as similar attempts to strenghten participative planning approaches that run in parallel with formalised urban planning procedures. First to be mentioned here is the rather individualistic appraoch, which means that not only the membership principle decides who is in or out, but also, once included, the individual capacities play a crucial role. Here one should mention the observed group work dynamics (and their inherent selective processes), presentational and communicative skills, and the fact that such settings clearly privilege charismatic and knowledgeable personalities. Another point is the durability of the established actor-networks, which need to be carefully maintained by follow-up activities and creating new windows of opportunities for co-creation. As a third point, one should add that the resources and available mechanisms for transfering lessons from such ‘experiments’ within urban governance are unevenly distributed within these actor-networks.

All of these critical points need to be carefully considered when appraising ‘urban living labs-like’ approaches, as the case of Experiment Stockholm illustrates. Following Schmitt et al. (2016), we argue that this example can indeed be characterised as a soft mode of urban governance that can help unlock creativity and open up avenues for experimentation and alternative solutions. However, caution must be taken to not overvalue such approaches, as our example implies a rather exclusive expert forum instead of a mode of governance that might be associated with openness and wider engagement. In addition, our example illustrates the significance of suitable and unconventional methods, which otherwise considerably limits the innovative capacity of the participating stakeholders and their search for alternative solutions. Hence, we argue that: if considered as a complementary approach to public urban planning, the applicability and legitimacy of such soft and experimental modes of governance as discussed above need to be carefully considered.

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Visibility as a Stake for Cities

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1 ABSTRACT

Visibility has been recently discovered by sociologists. It is different from fame. Fame is the mere consequence of meritocracy: some talent is recognized, a name is well known. Visibility involves the use of Medias, and the popularity (of the star) concerns not only his (her) talent but also his (her) person (face, style …). In the first part of the paper, this difference is described. In the second part, the analogy between visible persons and visible cities is explored in these fields: (1) the appearance of a new spatial division of labor (metropolises, which are visible / mid-sized cities) (2) adverse selection (the stake of choosing the specialty of a city) (3) different mindsets (in visible cities and mid-sized cities) (4) security in large cities (the symbols targeted by terrorists are there) (5) the interaction between visible persons and visible cities.

Keywords: planning, urban form, smart city, urban strategies, visibility

2 INTRODUCTION

The American novelist Upton Sinclair wrote a book "Mammonart" on the links between famous artists of the past and the economy. We quote him: "Mr. Ogi must have an audience" (Mr. Ogi is the name of any artist). Of course, audience (and therefore money) matter in an artist's life. But one has recently discovered that there are two kinds of audience. Some artists are famous: their talent is recognized, their name is well known. It is meritocracy. And other artists, the "stars" are in a different situation: their popularity involves the Medias (Internet) and not only their talent is popular, but their person (face, style …) is worshiped. They are "visible".

To the difference fame / visibility corresponds the difference amateur / fan, when audience is concerned. We find pertinent theory on fame and amateurs in the book of the American sociologist HS Becker "Worlds of art", and on visibility in the book of the French sociologist Nathalie Heinich "De la visibilité" ("On visibility").

In the first part of the paper we shall present what is visibility and what is the difference between fame and visibility. In the second part we explore the analogy between visible persons and visible cities in several fields: spatial division of labor, adverse selection, mindsets, security and interaction visible persons / visible cities.

3 AMATEURS AND FANS

There is a continuum going from "grace" to "trance". Amateurs are mostly on the side of "grace" and fans, on the side of "trance".[1]

To understand "grace" we can refer to the philosopher Kierkegaard, quoted by the German sociologist Siegfried Kracauer in his book "The detective novel". The community of believers is communing (during the mass) when everyone resents that his neighbor is a fellow man, since Man is always between God and Immanence. Things are as the words say that they are. Concerning amateurs: they commune when their pleasure is such that they resent that they are between Art (embodied in the Artist himself) and Immanence (the uncultured brute).

"Trance" is described by the French novelist Louis Hémon in "Battling Malone, pugilist". Describing the audience at a boxing match he writes: "The crowd, suddenly infuriated… became a living clamor, an horrendous unleashed wrath. Men got up out of their chairs, apoplectic, the veins of their forehead as prominent as cables, shouted insults and blasphemies, shaking fists and ready to rush forward etc."[2]

According to HS Becker a world of art is characterized by conventions. They are known by amateurs and mastered by the artists. Therefore the pleasure of an audience of amateurs is also a "judgment of taste" (to

[1] But amateurs can be very vulgar, and fans can remain still. Amateurs are vulgar when there is a scandal. For instance, when the piece "Déserts" ("Deserts") from the French composer Varese was premiered in Paris, in 1954, there was a scandal. It was recorded, and the record is available on YouTube.

[2] The translation from French is by the author of the paper.

use the words of Bourdieu): the spectacle was adequate to the chosen conventions. At the opposite, the fans cherish and worship the personal features of their idol: face, style, clothes and even anything familiar to the idol (his home, for instance) or concerning him (her) like tastes, moods … Their behavior is passionate and tribal.

We can sum up the difference between amateurs and fans in this table:

	Amateur	Fan
Interest	Heritage, Style, History…	Personality of the Star, rumors and information on it, objects linked to it …
Motivation	Taste, Culture	Entertainment, Identification to the personality of the Star (imitation, worship …)
Criteria	Judgment of taste	Spontaneous pleasure
Behavior	Discretion	Enthusiasm
Places	Museums, Concert halls, Festivals …	Shows with the worshiped Star
Examples of places	Paris, London, Venice …	Graceland3, Hollywood, Halls of fame …

4 THE HEINICH'S THEORY ON VISIBILITY

At the start there is the appearance of cheap technology allowing the reproduction of artworks, highlighted by Walter Benjamin (Heinich, 2012). More, there is a dissymmetry: the Star is alone, and the fans are many (Heinich, 2012). Indeed the Star is helped by many professionals able to promote the sales. They combine in the best way physical presence and virtual presence of the Star. It results in a worship of the person of the Star. Success explains success: the self-realizing predictions (when the fans prepare themselves to marvelous time) matter. But they are not enough. Talent and … chance matter also (this is a point highlighted by Nassim Taleb in his book "Antifragile: the things which gain from disorder"). An audience of fans is wise when it is enthusiastic about the successful spectacle: it is the outcome of an accord of talent and chance. Paradoxically, a star knows his or her fans less than famous artists know the amateurs supporting them. Painters meet the amateurs buying their paintings, know their tastes and can adapt their style to these tastes (Becker, 2010). The Star does not know his fans (since they are so many) but is able to develop empathy with them. The success of the famous artist relies less on chance. But when the success of the Star exists, it is bigger.

The Heinrich's theory brings more. She is a follower of the French sociologist Bourdieu. She adds a "capital" to the capitals defined by Bourdieu to explain the search for distinction: cultural capital (innate ease with culture is concerned), educational capital (knowledge acquired in schools), economic capital (money) and social capital (social connections). It is the visibility capital, the main features of which are:

- It is measurable. The size of the audience can be measured.
- It is accumulable. The success of a Star allows more success. One can define the production function of a star: G = f (Cv (ev), P (ep)) – DU (ev, ep), where: Cv is the visibility capital, P is the output (the number of professional performances), ev is the effort to acquire visibility, ep is the effort to produce performance, DU is the disutility of the efforts. G is the net gain, f is the gross gain. Suppose: $\partial G / \partial ev > \partial G / \partial ep > 0$. The star is a wise entrepreneur if he (she) develops the visibility capital, not working but attending galas, TV shows, or being busy with humanitarian activities, for instance. In other words, one unity of effort devoted to visibility triggers more gain than one unity devoted to production. Another consequence of the visibility capital is the Lyndi effect. It has been discovered by an American sociologist, Albert Goldman, who studied music and musicians. It has been commented by mathematicians like Mandelbrot and Taleb. Concerning human beings it states: the longer has been the career of some star, the higher is his expectancy to remain in the course of career.[4]
- It is transferable. The heirs of a star are visible persons, who can become celebrated more easily since their personality attracts attention.
- It is worth money. The stars get gifts, make appearance in advertisings, obtain sponsorship etc.
- It is convertible. A star can convert from an activity to another one (an actor becomes a singer etc.).

[3] It is the home of Elvis Priestley in Memphis (USA). It is the most visited home in the USA, after the White House.
[4] However this « law » is not so pertinent when human beings are concerned. First, life expectancy is bounded. Second, it often occurs that a star does not keep its ability to create empathy with his audience.

The consequence of the existence of visibility capital is an upheaval of social hierarchy. Nathalie Heinich distinguishes "added value" and "endogenous value": "added value" concerns talented artists who become visible persons such as cinema actors, singers … or sportsmen or sportswomen etc. and "endogenous value" concerns the raw phenomenon of visibility, which is explained by the curiosity of people, not by the talent of the visible persons. So the monarchic families, the persons appearing in telereality programs, the journalists interviewing and meeting celebrities and even … weathermen and weatherwomen are visible persons.

5 THE ANALOGY BETWEEN THE VISIBLE CITIES AND THE VISIBLE PERSONS

This analogy exists in several fields.

5.1 A new spatial division of labor

The large metropolises are visible, while the mid-sized cities imitate them and are not so much visible. Indeed, in some large cities (London, Paris …) the needs are fashioned, and the Stars live there. Only there, they can work. They need professionals of many kinds: consultants, impresarios, journalists, script writers, sound engineers etc. (Los Angeles, with Hollywood, is an example). The needed atmosphere is there. The large metropolises are in competition to attract this professional milieu. The visibility capital of a large city is useful. The décor of the city is nice, and always reshaped. Here one can observe this top of the artificiality of the city: artification. According to the French philosopher Lipovetsky, artification is when all in the everyday life has to be beautiful. Possibly subsidies incite to shoot movies in these cities. To support nice museums, Opera houses, theaters etc. is costly, but the inhabitants of the large cities are rich, and these cities have big budgets.

More, the historical center in large metropolises is the place for entertainment, leisure, culture … at the disposal of the inhabitants of the whole metropolis. Here are the nice places, the museums, the concert halls, the nightclubs, and the restaurants … The experts in transport have recently discovered that the flows of transport inside the metropolises are not as they have believed before: just from the periphery to the centre to the workplace, and return from the centre to the periphery, to the home. There are flows from a borough to another to work, to shop, to buy services etc. And there are flows from periphery to the centre to have entertainment there.[5] Here are the popular places, the nice décor, which are shown on the TV screen, in movies etc.

The synergies in visible cities are a consequence of the visibility capital. For instance, if one attends a congress in Paris, one can meet famous persons during the congress, then visit the city, go to the show and eat in celebrated restaurants etc.

Of course there are many places in these cities formatted to welcome visitors, trigger their whims and incite them to spend money during their stay. But this does not mean that the quality of life is very good for the inhabitants. Indeed, it is at a standard level. There are many reasons: (1) As all the places in the visible cities have to be nice (the city is artified) there are always building sites anywhere (2) Noise is a problem in all the attractive places (where are the bars, the nightclubs, the cinemas …). One can give the example of the famous passageways of Paris which inspired Walter Benjamin when he wrote his book "Paris, capital city of the 19 th century". They are closed Saturday and Sunday as it is asked by the inhabitants (who know the code to enter the passageway). Some protest that these places could be open to visitors, formatted to welcome them etc. which would trigger proceeds, and jobs. There is a conflict: if the quality of life is preserved, economic opportunities are lost. (3) In some quarters of visible cities many movies are shot. It raises problems. Among the tens of professional specialties in cinema, there is one which consists in preparing the ground for the shooting outdoors. An authorization of the police station is needed. The shooting is announced on panels. Parked cars are removed. It is called in French "ventousage" ("suckering") meaning to put suckers on the ground to prevent drivers from parking their cars. During several days, three, four or five big trucks full of electronic equimpent will be parked in the street. Circulation of cars and pedestrians can become impossible (for instance when special effects, like "effect of snow", are produced). The filmmakers are fond of shooting in these places because it is nice décor. It is also fashionable, authentic and popular. (4) In Europe, the standard of life is raising continuously. As the inhabitants of large cities are

[5] After a presentation by the Russian geographer Olga Verdina, at the International Geographic Union congress, in 2015, in Moscow.

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richer, they are frequently out of their home to shop, to go to the show, to eat in restaurants, to visit exhibitions etc. The networks are saturated. Car attrition allows an improvement. But often streets and plazas are replete with people. (5) Also there is the stake of security that we deal with in a particular paragraph.

At the opposite life in some mid-sized cities is more pleasant. These cities are silent, sure, walkable, the networks are not saturated and the pace of life is not frantic.

5. 2 Differences in mindsets.

The inhabitants of the large cities are used to observe and understand visibility. The inhabitants of the mid-sized cities are familiar with fame, the consequence of talent and competency. The two are very different. It is shown by the Heinrich's notion of "endogenous value" In this case celebrity does not correspond to a particular talent but is the consequence of curiosity of people and exposure to the Medias. Visibility involves empathy with the audience, use of Medias and links with "entrepreneurs of visibility" (journalists …). Fame is when somebody is recognized as talented. The words are celebrity (visibility), or fame, or reputation, or renown. A coarse scheme explains the difference: in the large metropolises, the needs are fashioned, while in the mid-sized cities, one produces the products which allow the satisfaction of the consumers.

5.2 Adverse selection

The cities have to choose specialties and to build their own image. The large metropolises can attract all sorts of cultural activities, all kinds of shows etc. They are not "specialized cities". At the opposite mid-sized cities are (possibly) renowned in a single field (festivals, fairs…). They cannot blur their reputation by mingling different kinds of events. Take the example of cities which are well known in the field of classical music: Bayreuth (Germany), Salzburg (Austria) and Prades (France)… These cities cannot organize festivals of jazz, or world music. It is not a problem for large cities.

It is a sensitive issue. The size of the city matters very much. It seems that the threshold for an Opera House is 300000-500000 inhabitants. For a concert hall and an orchestra, it is perhaps 200000 inhabitants (sometimes two cities have an orchestra in common, or an orchestra performs music intermittently).For a simple auditorium, the threshold is less (perhaps 100000 inhabitants).

In Paris, Bercy Arena allows sports competitions and concerts. There are more than 20000 seats. It can be used for all kinds of shows. There is no problem because of a particular vocation. From an economic point of view, it is profitable since it can be used very often.

5.3 The stake of security in visible cities

The main symbols are in visible cities. Are concerned some quarters, plazas, monuments etc. They are targeted by terrorists. Also the means of transportation are targeted. They are used by many people at certain times. There are also attacks against political or religious symbols. When an attack (in a large city) occurs, the videos on it show a décor which is familiar because it is often visible on TV screens, in movies etc. Therefore it triggers a stronger emotion. Of course, the inhabitants of the large cities are worried of the possibility of attacks in their cities. But the inhabitants of the mid-sized cities are also afraid. In general, there is no symbol in mid-sized cities that terrorists could choose to hit. The mid-sized cities are more secure.

5.4 The interaction between visible persons and visible cities

The visible persons and the visible cities are in mutual dependency. Each benefits from the other. When they live in large metropolises, the Stars find the professionals they need, and the industry of events and the "entrepreneurs of visibility" (journalists) are there and of course the "atmosphere" (fashion, new "trends" …) is there. The studios (films, TV, radio) are there.

Not only the visible cities are benefitting from the purchase power of the Stars living there, but the décor is made more prestigious by the presence of the Stars. Thanks to sponsoring and events, they are shown in the prestigious places of the cities, in TV programs, videos …There are particular tour operators which offer trips allowing seeing Stars in the quarters where they live (when they move in the streets, when they shop…). Internet sites warn that some Star is presently in a shop or a restaurant etc.

6 CONCLUSION

If visibility has been discovered by sociologists recently, the topic was dealt with decades ago. For instance, famous books were written on the scandals and even crimes having occurred in Hollywood. The topic has been dealt with by journalists and novelists. We shall describe the ideas on visibility between the two World Wars (crust, anomy, Nemesis …) to highlight the opposition between these ideas and the current theory. We conclude by summing up the consequences of visibility for cities.

6.1 The ideas on visibility between the two World Wars.

We shall quote a half-forgotten French novelist, Edouard Estaunié, who wrote “La vie secrete” (“The secret life”). According to him we do not know one another. Of course, we meet and are in touch, but without understanding the main features of our personality. It is called the “crust”. Only when the breaking of the crust occurs, we have the opportunity to know who the other persons are really. This occurs when there is a drama. That is why the novels fascinate the readers: the narrator takes the reader in a drama, which is the opportunity to display the deep personality of the characters. The “secret life” is shown. Today it is the role of movies. According to Lipovetsky the success of cinema is explained: “it fulfills and old dream of humanity, living vicariously”.

Another theme of this time was anomy. As early as the 18 th century, the French philosopher Diderot in his book “Le paradoxe du comédien” (“The paradox of acting”) described the actors: “ in society I find them polished, caustic and cold; proud, light of behavior, spendthrifts, self-interested; struck rather by our absurdities than touched by our misfortunes; masters of themselves at the spectacle of an untoward incident or a recital of a pathetic story; isolated, vagabonds, at the command of the great; little conduct, no friends, scarce any of those holy and tender ties which associate us in the pains and pleasures of another, who in turn shares our own”. The actor is not like other people, since he simulates passion perfectly, without resenting it. Later the word “anomy” has been used to describe the particular life of Stars: solitude, hidden passions, precarious equilibrium of the personality etc. A theme linked to anomy was Nemesis. Celebrity implies curiosity and often when some weakness of a star is known, it triggers disastrous consequences. Finally, the star could be destroyed (Nemesis).

Today visibility of the stars is explained in another way: consumers’ society, capital of visibility (Heinich), artist capitalism (Lipovetsky) and social imaginary. The idea that the stars are anomic is somewhat blurred. Of course, some stars have behaviors they prefer to hide (and fear the curiosity of Internet users). But many stars are wise entrepreneurs and rich people. They seem to manage their image. And Nemesis should not be exaggerated: in many jobs chance matters and a star can be victim of bad luck, becoming unable to use the means warranting success.

6.2 The consequences of visibility for cities.

Since the phenomenon of visibility changes the society, it changes the hierarchy of cities. Today, there are visible cities (the large metropolises like New York, London, and Paris …) and mid-sized cities which are less visible. But these mid-sized cities are not only cities imitating the visible cities. They are the places of competency and fame (which are very much different from visibility).[6] Fame is the consequence of performance, while visibility concerns personal features and is generated by Medias. The stars are of different kinds: worshiped stars in the visible cities, and renowned persons in the mid-sized cities.

The visibility in large cities has consequences on quality of life. There it is not at its top. In the mid-sized cities, possibly quality of life is better.

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[6] A typical example in one of these cities is the owner of an enterprise, who succeeded. He becomes popular in this city.

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A Shift from 2D Design Paradigm of the 19th Century to 3D/CityGML, BIM, 3D Printing and Some of Smarter Cities in Poland

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1 ABSTRACT

A road from paper-based- administration of the 80-ties to Smart Cities of today is being showed in this paper. Shift from paper do digital environment started with regaining of Polish independence in 1989, 26 years ago. The first e-mail from Poland was sent in 1990 year, 19 years after the first e-mail on the world of Ray Tomlinson (1971). Transfter of legal responsibilities, legal power, competences and finance from the top to local levels resulted in revolution in IT sector, which was the first commercial sector running in apost comunist country, in the 80-ties and the beginning of 90ties.Pressure for changes was visible exspecially in the biggest cities, and were initially connected with process of "mucicipalization" – i.e. – transfering of ownership of land from the state level to the level of municipalities. Signum Tempori of this time, was a process of transfer of state owned land to the city property of the City of Gdansk, where more than 30 000 real estates of of the market value of 750 million US dollars were transferred and became municipal between 1992 and 1994 years.More and more LIS (Land Information Systems) and GIS (Geographic Information Systems) were implemented, without interoperability rules and standards. Lack of ability to adapt centrain common standards between State Surveying and the biggest cities resulted in appearance of more than 20 graphical applications and more then 20 textual databases applications which required later substantial efforts and costs to overcome information chaos. 10 biggest metropolitan Polish Cities spend more then 3 times than the General Office of Geodesy and Cadasrte of Poland, between 1991 and 1994. Gradual implementaion of INSPIRE Directive and the Law of National Infrastrructure of Spatial Information created unprecedented shitf from paper maps and paper records to almost all digital Poland. Expenditures of c.a. 650 million PLN were assigned to creation of digital representaion of all 34 data layers of INSPIRE Directive for the impelmentaion period of 2010 to 2019. Nevertheless, this amount has been almost doubled in the first 3 years, taking into acccount expenditures of only regional and local GIS/SDI Projects.Polish spatial and economic conditions created spatio-economic background, within which more than 65 % of GDP of Poland is located within 12 metropolitan areas, and at the same time around 67 % of Polish GDP is being generated by more than 4 million of micro or small businesses (often small "family" businesses.).Polish Spatial Planning Law of 2003 has weakened spatial planning regulation, allowing for certain "exception from the rule", which became a new rule in itself. Basically, this "door" in the law to obtain building permint outside the borders of local development plan – resulted in issuing of more than 700 000 building permits – all located ouside territories of local spatial development plans between 2003 and 2015.Therefore we observe freely flowing process of urban sprawl on one hand and increased land consumption, expecially in the peri-urban zones of all metropolitan cities, and on the other hand, from the economic point of view – Poland has experienced unprecedented GDP growth in recent 10 or 12 years.Nevertheless several really interesting projects have been kicked-off by metropolitan cities, regions and General Survey of Poland (GUGIK). One of the most interesting projects – ISOK (Informatic System of State Protection against Extraordinary Threads) was impelmented between 2011 and 2015, at the cost of c.a. 300 million PLN, resulting in creation of laser scanning data for 92 % of territory of Poland. Continuation of this project was secured in the autumn of 2015 year, devoting budget of 189 million PLN for the project called CAPAP (acronyme from " Centre of Spatial Analysis of Public Administration), which aim is to provide 3D model of all buildings in Poland, in compliance with CityGML LOD 2 (second Level of Detail), withing the time frame 2016 – 2018. So, all territory of Poland will become 3D in 3 years time in accordance with CityGLM LoD2 and some studies and pilot projects going in this direction are being described in this paper. Some recent exercises with 3D printing of new urban projects are being reported at the end of article.

Keywords: 3D, CityGML, Database, GIS, Smart City

2 FIRST 3D MODELS OF CITIES IN POLAND

2.1 Metropolitan Area of Warsaw Project, Centertel, Geosystems Polska, 1997

Revolution in 3D visualization with excellent compter graphics of Silicon Graphic Workstations reached Poland in 1993 and 1994. A lot of Indy, INDIGO2 and O2 workstations were used at this time in Poland. GEOSYSTEMS Poland LLC was established in 1995 and equipped with INDIGO2 and Indy Workstations, with Stereographics Crystal Eyes 3D glasses – started a project for one of mobile phones prodiver company – Centertel. In the result of project, aimed for collection of 3D models of buildings for UMTS network planning (1997), a stunning project for area of Metropolitan Area of Warsaw (ca 2500 km²) has been completed in less than a year, resulting with ca 140 000 models of buildings in 3D, stereodigitized from stereoscopic aerial images.[1]

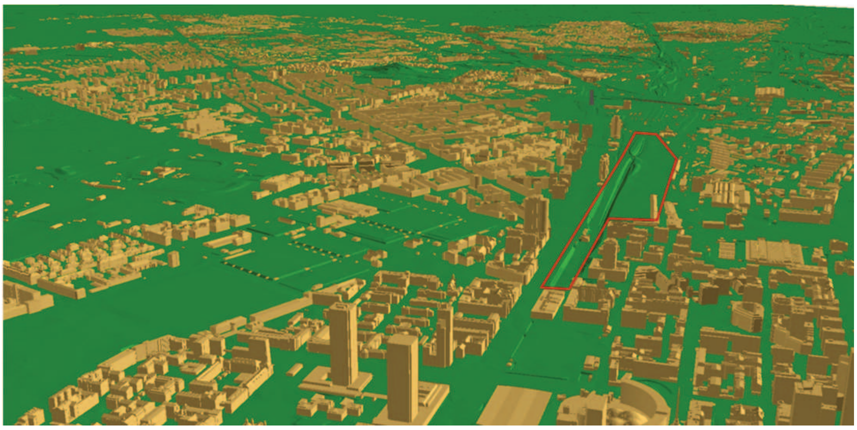

Fig. 1: screenshot from 3D model of Warsaw, build by GEOSYSTEMS Poland in 1997 for Centertel, with red polygon, indicating site for a new development project, to increase compact character of city centre of Warsaw.

2.2 Intelligence meet Geospatial and 3D / Iraq and what this has common with Google KML and Google Earth ?

KML stands for "Keyhole Markup Language" – memorizing Key Hole (KH) reconnaissance US satellites, belonging to KH-series satellites, started to be developed withing the framework of CORONA Project.

It seems that "First Infomration War on Iraq" from 1991 has been also a battle/test field for a lot of new technologies and the end of certain epoque for other older technologies. Declassified report of one of American generals stated clearly, that generation of older US intelligence satellites was no longer adequate for growing information needs. War in Iraq, Yugoslavia and some other conflicts gave birth for other technologies, namely VHR (Very High Resolution satellites), like of IKONOS, Quickbird, Worldview series (in USA) and Pleiades satellites in Europe. Moreover, the ownership of Keyhole company (2001), initially co-funded by CIA/NGA, Sony , was passed to Google(2004) and already Google has launched Google Earth application and led to much wider usage of KML format.

2.3 3D Models of 55 Cities in Poland, fruits of IKONOS Satellite Ground Station in Poland, 2005

While the creation of 3D model of Warsaw Metropolitan Area within the timeframe of one photogrammetric season was perceived as success in 1997, similar projects could not be treated as success in the beginning of next decade. Mobile network operating companies paid enourmous fees for obtaining of UMTS Licenses in Poland, while their needs for 3D models of all cities could not be met quickly due to too small number of companies with proper experience in 3D a, reaoperating at this time olish market.

With the purchase of IKONOS satellite groundstation in 2003, this situation has dramatically changed. It took 14 months to prepare investment blueprint (6 months) and to physically build and test (8 months) 20 million USD investment into Earth Surveillance Satellite ground Station. and the first image with 82 cm resolution from IKONOS satellite was received directly to the antenna dish on September 30th 2004.

[1] W.FEDOROWICZ-JACKOWSKI, Internal company information from the realization of contract between GEOSYSTEMS Polska, sp. z o.o. and PTK Centertel, Warsaw, 1997

Winter season 2004/2005 was used for the detailed preparation of next photogrammetric season, and within 2005 photogrammetric season images of 42 Polish Cities were acquired in stereographic mode, resulting in 3D models of more than 1,3 million buildings in the same year, with average speed of 3D digitization of. Ca 1000 buildings per person per one working day.

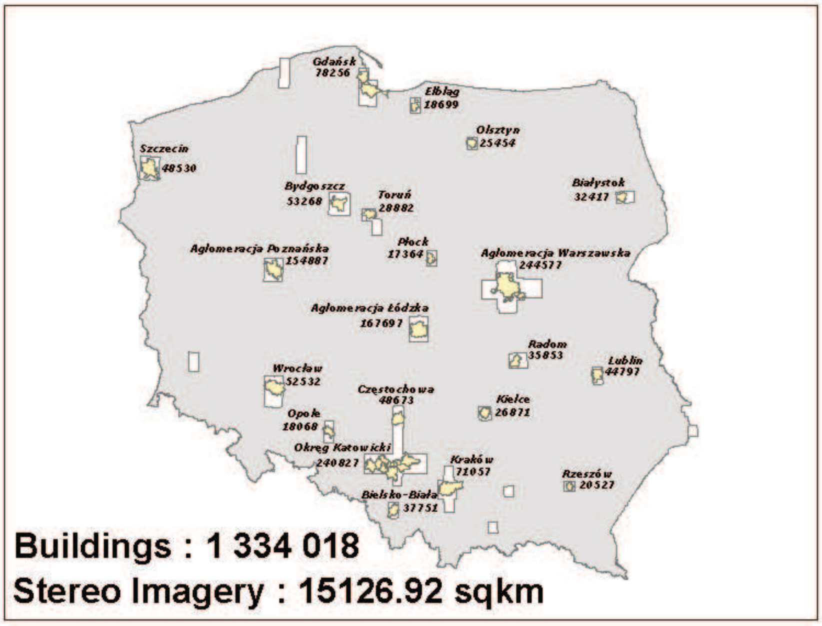

Fig. 2 : Collection of IKONOS satellite srereopairs for 42 cities of Poland by SCOR SA, resulted in acquisition of 15 126,92 km², what allowed for construction of simplified 3D models of 1 334 018 buildings in 2005

Stereodigitizing was realized the same day, mmediately after imagery collection of each IKONOS stereopairs, reducing greatly time (end cancelling the former need do develop regular Kodak 9” x 9” film frames and the time of their scanning). Obviously, accuracy of 3D models, derived from stereodigitizing of satellite imagery was much lower then this of the aerial photogrammetry, but the time-trade-off was very significant.

While in year 2000 there were only 2 companies in Poland, which could deliver 1 or max 2 city models in 2000 year each, executing contracts for mobile operators, the 2005 IKONOS campaign delivered 3D models for 55 cities and lead to creation of more than 1,3 million 3D buildings. The level of detail of therse models of buildings was obviously much lower than the one being achoieved today. Basically, these models were simplified volumes of the buildings, most of them with rectangular 3D shapes. Geometric quality of these models was between submeter accuracy for “x” and “y” axis and around 2 meters for “z” axis. Speed, consistency of this method, rigid process of quality control were important enough to convince owners of all mobile network operating companies – to buy these 3D models from TECHMEX SA – the executing arm of this contract and the owner of the data.[2] The second serious client for 3D models of cities – were the cities alone. Majority of the 3D data models of all collected cities were sold to them in the next years. Cities used this type of data for building of spatial planning applications and took actions to model the noise models, mainly for areas of city centres (according to the noise Directive of the EU)

[2] M.BOROWSKI R.LACH, W.KUZNICKI, A.KOWALCZYK, , Realized project of 3D City Models of 42 Polish Cities, on the basis of extraction of vector data from stereopairs of IKONOS imagery, 26th EARSeL Symposium, New Developments and Challenges in Remote Sensing, 3D Remote Sensing Session, Warsaw, Poland, May 29th – June 2nd, 2006

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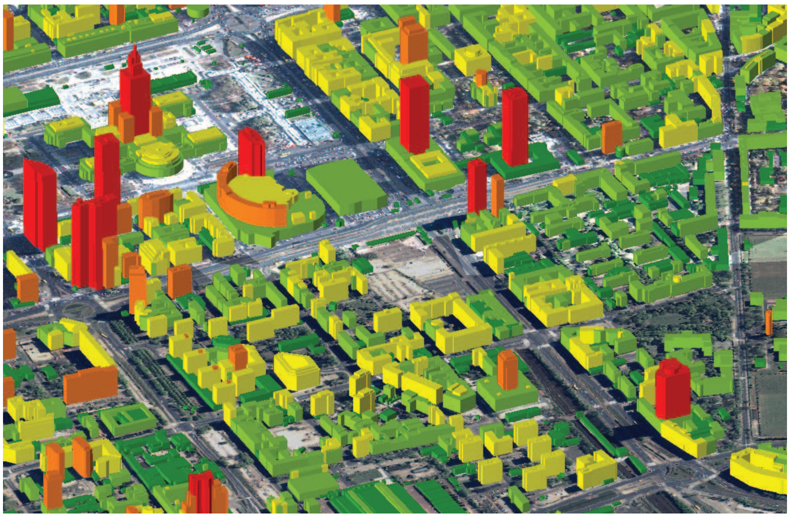

Fig. 3: 3D model of centre of Warsaw, derived from stereopais of IKONOS satellite, 2005

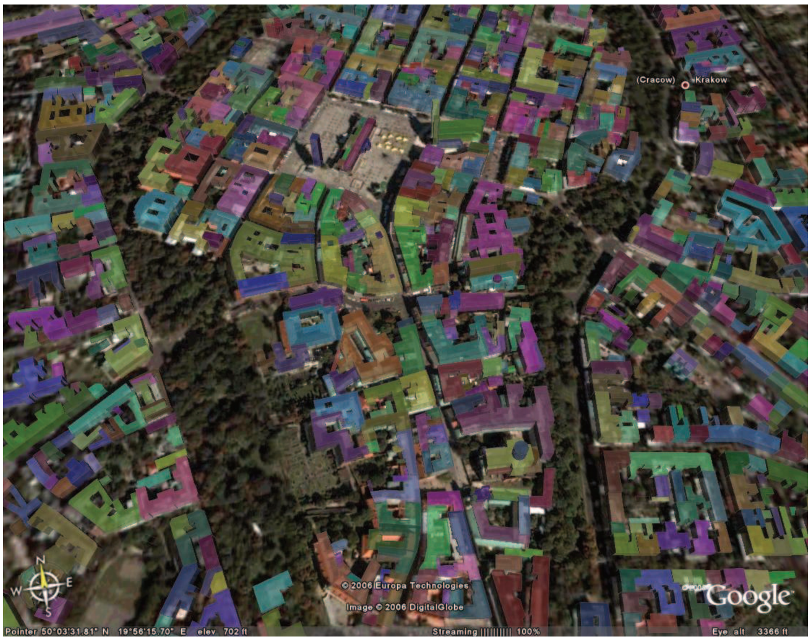

Fig. 4. 3D Model of the City of Krakow from stereodigitization of IKONOS satellite imagery, exported to KML format, shown in Google Earth,2005

2.4 3D Models of Polish Cities, in time frame 2006 to 2014

Invention of first digital photogrammetric cameras (UltraCamD, Vexcel, DMC) provided next boost for development of 3D models and applications. First photogrammetric aerial camera was purchased by MGGP Aero in 2007. MGGP Aero was earlier present at traditional Polish market. Gradually more and more companies were using digital photogrammetric cameras.

Variety of 3D models of Warsaw exists, and it's natural in the market driven economy, that various forces try to position themselves on rich-geospatial content market. Architects and developers used to build 3D models of buildings of new buildings, mainly, high-scrapers in the centre of Warsaw, using most often SketchUp tool (by Trimble) often also used for visualization of ancient monuments and/or historical buildings. Cities alone announced more and more public tenders with aim to produce 3D models of cities, consisting of Digital Elevation and Digital Terrain, Digital SurfaceModels (DEMs, DTMs, DSMs), vegetation models, road/railway/metro and 3D building models.

Obviously, as each city developed ita own TOR/SOW(Terms of Refference/Scope of Works) specifications, resulting city models differ one from the other and obviously you could not pick 2 cities and have the same information backbone of their 3D models. Most of Polish bigger cities built their own 3D models, but all of them have various x,y,z accuracies, various level of details as well as various semantic content.There are some cases and some characreristics of 3D models of some biggest cities of Poland, described below.

Fig. 5: 3D Model of historical centre of Warsaw, built in 2006

2.4.1 Warsaw

First 3D model of Warsaw was built in 1997, however its aim, as described at the beginning – was to satisfy the needs of mobile network operating company for Warsaw metro area. First, more detailed 3D model of the centre of Warsaw was acquired in 2006.

This 3D model was built from strereodigitizing of new aerial photos. Textures were acquired from terrestrial photos, which were processed further and drapped over 3D wireframe model. Cost of this model was at the level of ca 8258,06 PLN /1 km²

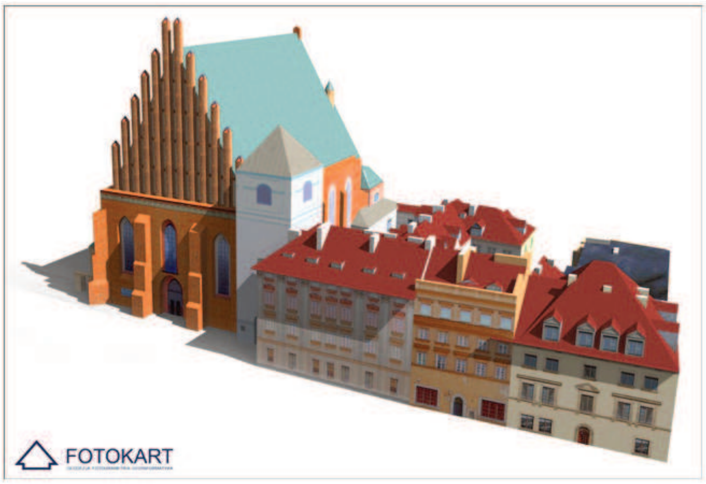

Fig. 6: Example of the level of details of 3D model of historic city centre of Warsaw. One of blocks., 2006

2.4.2 Gliwice

Fig. 7: Screenshot from Aurora application, industrial building, 3D model of Gliwice, 2007

3D Model of Gliwice was built with greater accuracy in the very centre of the City, and the smaller accuracy for the rest of the city, coverig area of 133,88 km².

Cost of this model was 2906,93 PLN/ 1 km²

2.4.3 Toruń

The City of Torun has requested the elaboration of 3D model in 2013. Detailed model of historic centre of Torun was created, allowing for some basic database operations. While you open webpage with 3D model you can adjust your graphical user interface, selecting desired layers of data for display and manipulation, set up some basic viewing properties, etc.

Interesting approach was taken in the City of Toruń, where data from several sources were combined and merged. 3D models of buildings were elaborated, taking the data from aerial photos and existing databases. It may be observer however, that there is a lot discrepancies between true geometry of the newly acquired LIDAR data (aerial laser scanning data with denstity of 12 points/1m²)

Cost of the model 3966,90 PLN/1 km².

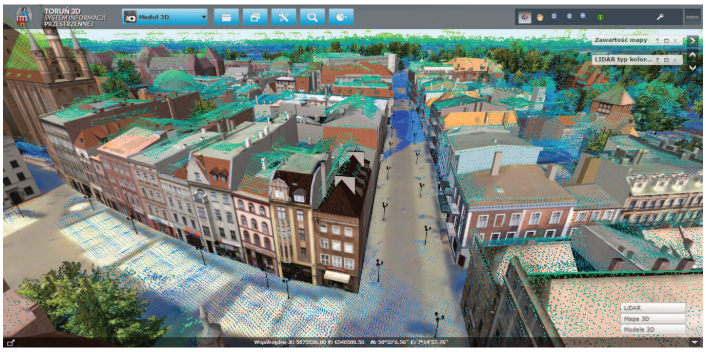

Fig. 8: Combining detalied building models of historical centre of Toruń with LIDAR point clouds, 3D module of Toruń's City geoportal.

2.4.4 Wrocław

City of Wrocław didn't organize any tender for execution of 3D model of the City. 3D model of the City has been worked out instead by the offic staff of the City of Wrocław, with LoD 0 and LoD 1 levels, mostly with the use of ESRI software environment.

Fig. 9 3D model of the City of Wrocław, a 3D module of the city geoportal.

City of Wrocław invested recently (2015) into acquisition of new digital photos and orthophoto of 5 cm resolution which provides a lot of details, previously not able fod precise identification.

Fig.10 Ortophoto of Wrocław with 5 cm resolution, acquired in 2015, displayed in urban geoportal of Wrocław.

2.4.5 Lublin

City of Lublin intends to complete its 3D Model until the end of 2017 year and curently some test works with usage of digital photogrammetry and the use of the LIDAR data were executed in 2015. The City of Lublin has also acquired two coverages of the LIDAR data for the entire City territory, in 2013 and 2014 years. The first LIDAR data coverage was acquired from Main Office of Geodesy and Cartography of Poland with density of 12 points/ 1 m² . Next coverage of LIDAR data was acquired in 2014, with the density of ca 25 points/1m². Both these LIDAR coverages of Lublin have also images collected from digital cameras.

Department of Architecture of the City promoted the use of the LIDAR data among the city officers and more then 50 persons were trained in usage of LIDAR data LiMON Viewer from DEPHOS Software company. Since LIDAR point cloud data of Lublin were installed in Server/Desktops architecture with LiMON Server and 70 LiMON Viewer licenses – a growth of 3D analyses became gradually visible in recent 2 years. Moreove, cooperation of the city administration with Lublin Faculty of Architecture and with Supercomputing Centre of Swierk (NCBJ) created som eadditinal spin-off effects. Usually these are surveyors, who specialize in 3D laser scannning services in Poland, while in Lublin a series of 3D scanning projects arose from architectural society at the Faculty of Architecture of Lublin Polytechnic.

TESTS of EFFICIENCY and of ACCURACY of 3 D model of LUBLIN in 2015.

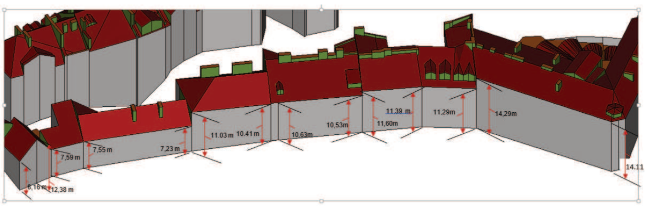

Fig.11 : 3D model of the Test area 1, derived from stereodigitizing of aerial photos, 2014

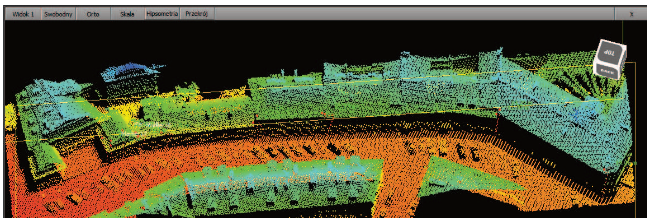

Fig. 12: 3D point cloud from laser aerial scanning (LIDAR data) of ISOK project, Test area 1

3 Test areas were selected in Lublin in order to determine best methods of data collection and processing, aiming to create CityGML standard compliant 3D models, at Level 2 and Level 3 of the detail of CityGML specification.

Fig. 11 shows 3D model derived from stereopairs of aerial photos of Lublin, acquired by MGGP Aero in 2014, Fig. 12 shows the same test area by LIDAR dataset of ISOK project, with density of 12 points/1m². Relative hights of buildings elevation were measured independently in Bentley V8 viewer (for model derived from stereodigitizing) and in LiMON Viewer (for measurements from point cloud data). Result of these measurements were compared in a table below :

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No of point	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Relative height Measured on model	8,61	11,56	13,31	11,34	8,19	8,16	12,38	7,59	7,55	7,23	11,03	10,41	10,63	10,53	11,60	11,39	11,29	14,29	14,11
Relative height Measured on ISOK LIDAR point cloud	8,62	11,31	13,38	11,33	8,15	7,64	12,58	7,,63	7,75	7.50	11,09	10,70	10,74	10,47	11,73	11,45	11,30	14,29	14,06
Δ h = difference in height measurements in[cm]	**1**	**25**	**7**	**3**	**4**	**48**	**20**	**4**	**20**	**27**	**6**	**29**	**10**	**6**	**13**	**6**	**1**	**0**	**5**

Table 1: Comparizon of relative hight of the buildings from stereodigitizing anf from LIDAR measurement

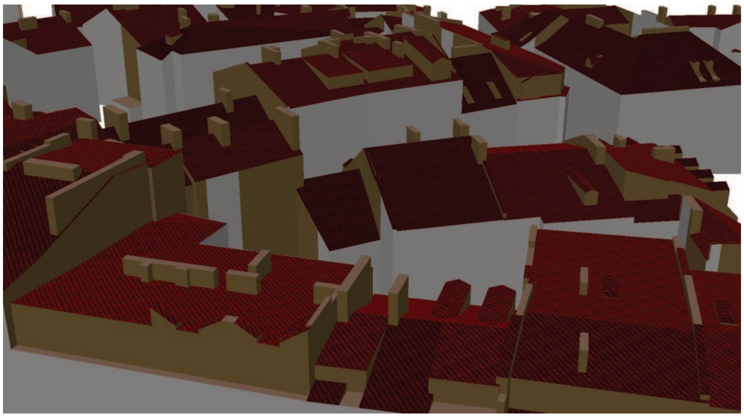

Fig.13: sample model 3D, CityGML LoD 2, with roof details from stereodigitizing

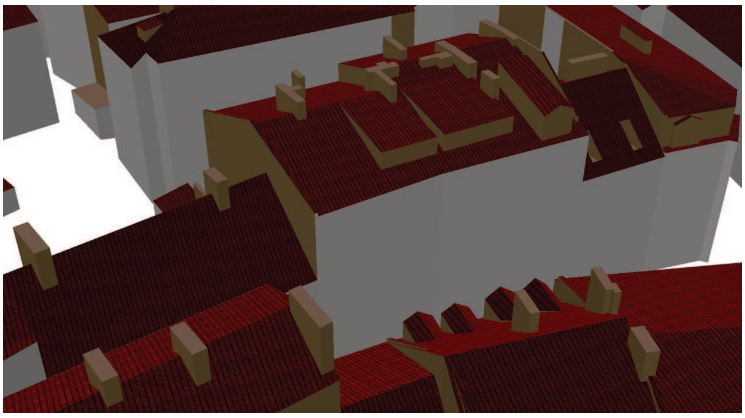

Fig.14: sample model 3D, CityGML LoD 2, with roof details from stereodigitizing

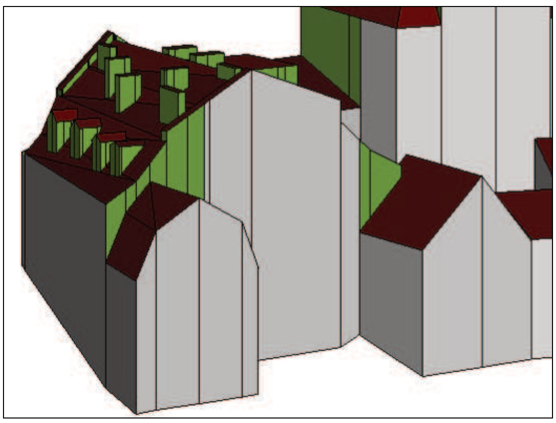

Fig.15: source data(aerial), Fig.16: Model 3D derived from stereodigitizing

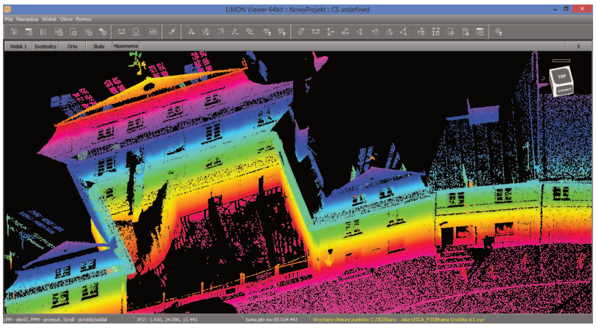

Fig.17: LIDAR from terrestrial scanning are excellend data source for buildings elevation details

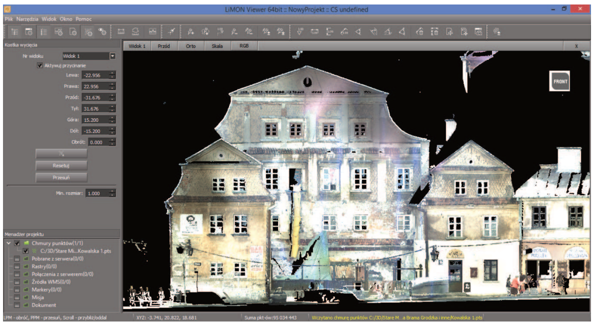

Fig. 18. Result of terrestrial laser scanning, PTS format (z,y,z + color data), scan by LEICA P20

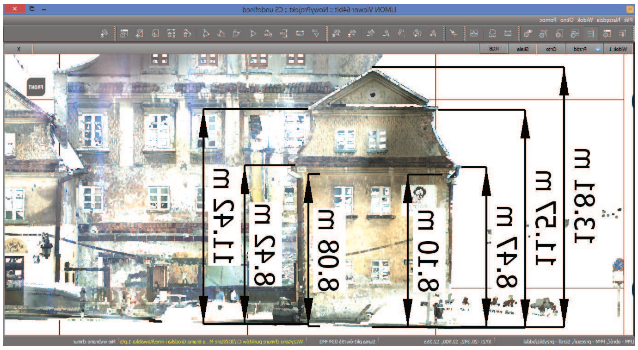

Fig.19: Terrestrial laser scan of the building, Leica P20, PTS format – idea tool for measurement

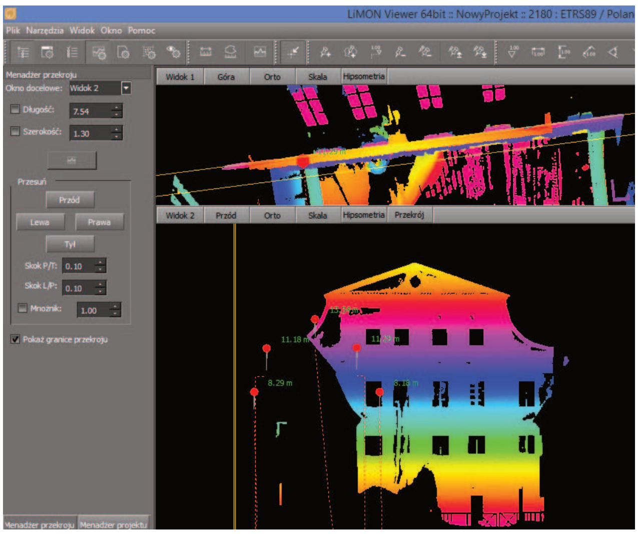

Fig.20: 3D data of terrestrial laser scans are ideal complementary data source for aerial scannning or data derived from stereodigitizing of aerial photos.

As it can be seen on Fig. 15-Fig.20 – terrestrial scanning data are ideally complementary to aerial data. When relying on aerial data while stereodigitizing complex roof shapes of the buildings, especially in the dense environment of historical city centres – operators of stareodigitizing stations often can have problems with exact interpretation of particular details of roof. Fig 15 and Fig.16 ilustrate the case, when operator of

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digitizing station made a mistake, while digitizing the building roof. The building on the right side is digitized with mistake. Adding terrestrial laser scan data, one can achieve complimentary data source, which is ideal for completion of the full CityGML model in 3D, with LoD 3 – the third level of detail of the buildings.

A state-wide projects of 3D buildings are usually picking up the second level of detail, since the third level of detail requires adding the windows, doors of the buildings, and this alone – without adding data from terrestrial laser scans – might be very difficult, if not the impossible.

3 REAL EFFICIENCY AND ECONOMY OF SCALE – ISOK PROJECT (2011-2015)

It took almost 1,5 year for Main Office of Geodesy and Cartography of Poland to prepare Executive Study of the ISOK Project. ISOK is the acronyme for : "Informatic System for Extraordinary Threats of the State". ISOK Project was and answer for anti-flood activities, and taking into account 2007 floods (cost over 4 billion PLN, more than 15 lives lost), the State authorities decided to spend ca 300 million of PLN (around 75 million USD) to implement the system.

The King died, Long live the next King. Since era of Very High Resolution has beed captured by Google (Google Earth) and era of digital cameras was used by Microsoft (BING) a new phonomenon has been born and more widely used in geospatial world – the world of LIDAR.

Almost whole Poland's territory was covered by LIDAR data coverage with density of 4 LIDAR points per 1m² in rural areas and with density of 12 points/1m² in the areas of 203 Polish Cities within timeframe of 2011-2015.[3]

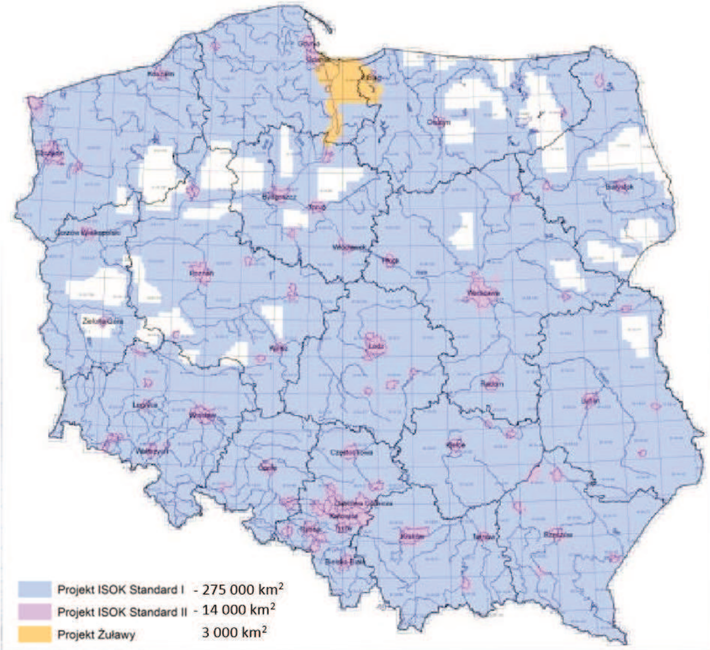

Fig. 21: Areas of ISOK Project. Blue : LIDAR Coverage 4p/1m²(rural) , Pink : 12 p/1m² (203 cities)

4 BENEFITS AND CONSTRAINTS OF CITYGML STANDARD

4.1 Benefits

Its good that CityGML standard was approved by OGS as OGC standard. One could get a headache from monitoring the evolution of 3D data file formats. Starting from the early times of prof. Greenberg experiments at 70-ties and 80-ties at the Cornell University, Silicon Graphics development impulse (early 90-ties), SIGGRAPH heritage, and the "volcanic" eruption of various 3D file formats. This has created

development and adoption by OGC the CityGML standard – we can observe gradual growth of interoperability in the 3D environment, between various user groups.

[3] P.WOŹNIAK, Status of Distribution of LIDAR/DEM/DSM data of ISOK Project, Main Office of Geodesy and Cartography, Warsaw, 2014

As observed by SOM (Skidmore, Owings & Merill) and others, there are no single universal software tools, which could fit the requirements of all participants of the design/planning process. Using even more sophisticated packages, like Revit from Autodesk, it is usually required to use whole range of various applications, applied for construction calculations, AM/FM applications, sun/shading, modelling, visualization, investment planning, project management, so usually it takes from 9 to 15 various project packages, involved into the whole planning/execution cycle. Obviously – this is possible only for bigger planning/development companies, since "one-man show" or "family" businesses – still can not afford the purchase of expensive software toools. The majority of the Polish small design beauros, architectural ateliers, still uses either 2D version of Autocad (LT) or Archicad, - withius sophisticated 3D funcionalities.

	Standard/Criterion	VRML	X3D	KML	COLLA DA	IFC	GML3	CityGML	DXF	SHP	3D PDF
1	Geometry	++	++	+	++	++	+	+	++	+	++
2	Topology	0	0	-	+	+	+	+	-	-	-
3	Texture	++	++	0	++	-	+	+	-	0	+
4	LOD	+	+	-	-	-	-	+	-	-	-
5	Objects	+	+	-	-	+	+	+	0	+	+
6	Semantic	0	0	0	0	++	0	++	+	+	+
7	Attributes	0	0	0	-	+	+	+	-	+	+
8	XML based	-	+	-	-	+	++	+	-	-	-
9	Web	+	++	++	+	-	-	+	-	-	0
10	Georeferencing	-	+	+	-	-	+	+	+	+	+
11	Acceptance	++	0	++	+	0	0	+	++	++	++

- not supported; 0 basic; + supported; ++ extended support

Table 1 Comparison of various features of 3D data formats.

Nevertheless, earlier formats CAD formats (*.DGN, *.DXF, *.DWG) have their own strong limitations. Visible shift towards IFC and B.I.M. takes place in some EU countries. With the visible shift to more opened data policies its getting easier and easier to use Open Data layers, bacground landscape information (DEMs, DSMs) as required surrounding environment of the architectural / urban objects.

Deep implementation of INSPIRE Directive, and earlier proces of implementain of various LIS/GIS solutions came to a point, where the entire Poland will go "digital" up to 2020, including more than 32 million of digital cadastral parcels and more than 25 million of buildings. Last year announcement of the authorities of Operational Programme "Digital Poland" about funding of CAPAP project, gives a hope, that all the buildings in Poland will be converted to CityGML (LoD2) within timeframe of 2016-2018.

So far, 3D models of the biggest cities of Poland were built with various accuracy requirements, in different timeframe, with various scopes of semantic information, and mainly for historical city centres. Recent decision on funding of CAPAP Project (Earlier Acronyme "Polska 3D+") – gives a hope, that all models of buildings will have the same semantics, the same accuracy, the same level of detail, and that it will be posisble to make searches across the Internet, due to the fact, that WebGL and object thinking about buildings must be finally applied.

4.2 Constraints

CityGML overcomes all former problems of various 3D formats, and its most complete, ie provides all aspects of 3D information, like : geometric, semantic and topological. CityGML is however relatively complex[4], with its detailed requirements. Majority of self-governments in Poland do not know yet how to deal with CityGML. Provided that even the whole Poland will be converted to 3D buildings within 3-4 years from today, the biggest problem seems - the willingness of adoption of the new 3D standard in all the units of selv-governments. There are around 100 biggest cities, 379 counties (powiats) and 2479 municipalities. Without the proper implementaion environment, tools to control proper creation of CityhGML- compliant buiildings it will take at least 4-5 years time before existing 2D reality will convert into 3D dream. Although CityGML is the best standard, taking into account its geometrical, semantic, and topological contexts, the mental adoption of CityGML will take at least several years in Poland.

[4] S.ZLATANOVA J.STOTER, U.ISIKDAG, Standards for Exchange and Storage of 3D Information: Challenges and Opportunities for Emergency Response, 2012

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5 RECENT PROJECTS OF AERIAL, TERRESTRIAL AND MOBILE LASER SCANNING

There are some Interesting projects going on in several cities. The City of Lublin trained more than 50 officers in usage of LIDAR – point cloud data, with the use of LiMON Viewer/LiMON Server solution.

Since the City asked the Main Office of Geodesy and Cartography – for delivering point cloud data of ISOK project (2013) and acquired new point cloud data (aerial laser scanning campaign) in 2014, as well as experimented with terrestrial laser scanning of the Old City, its level of preparation to implement CityGML standard grew up significantly in the recent 2 years. The City of Lublin requested the elaboration of 3D Model, acting together with the Main Office of Geodesy and Cadastre in Poland, as well as experimenting with first initial CityGML effort in some test areas of the city.

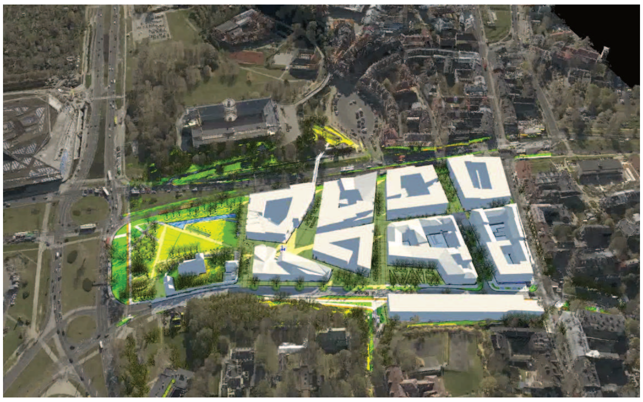

Fig.22. 3D model of “Podzamcze” district in the very centre of Lublin with backgound of LIDAR data

Fig. 22 is one of frames of animation of the new Spatial Development Plan of Podzamcze District, elaborated by PA NOVA SA (a planning & development company from Gliwice), approved at the City Council Meeting of the City of Lublin on May 21st, 2015. It must be explained here that Podzamcze area was very problematic, since this is a huge knot of various problems and various priorities of different groups of interests. However, due to very explanatory nature of 3D data and its animation, with synergy of the up-to-date LIDAR data – the Spatial Development Plan of Podzamcze District was approved, after rejection of 191 ammendments – to the plan – voted at the session of the city Council on May 21st, 2015. Complex knot of various problems was re-solved due to usage of 3D planning data and merged LIDAR point cloud data, (cooperation with DEPHOS Software and the use of their LiMON Viewer/LiMON Server solution. Ability to undertand complex 3D relations, ability to review all the project details by City Council Members, helped a lot. Thanks to this techniques, problem, which could not be solved from several years, has been effectively solved, provide the grounds for new investments, which will shape the new centre of Lublin in coming years. The City of Lublin is recently investing into a lot of development projects. Usage of various 3D data took place in recent 3 years in Lublin, starting with the use of original data from ISOK project, acquired in 2013, to new aerial laser scanning campaign of 2014 (with density of 25 points/1 m.sq.) to terrestrial laser scanning from Leica and Riegl (respectively P20 and VZ400 scanners) and the plans to use light helicopters to scan some more important – investment zones, to acquire newest coverages, later to be integrated from the various data sources and with usageof various data capturing technologies (stereodigitizing of aerial photos, autometic conversion of LIDAR data into 3D models, integration of data from terrestrial laser scanners).

The new era of 3D design and planning is well under way in Poland, and CAPAP Project will give huge additional boost, to make a significant shift from old design in 2D, of XIX-centrury paradigm to 3D/4D methodologies, ending up with 3D printing of the new development projects and delivering both CityGML and printed 3D Models of various development projects.

One os such an examples is given below, showing new urban development project oF PA NOVA SA in the Centre of Gliwice, Poland, modelled with CityGML (with usage of recent aerial and terrestrial laser scanning data) and printed with 3D printer.

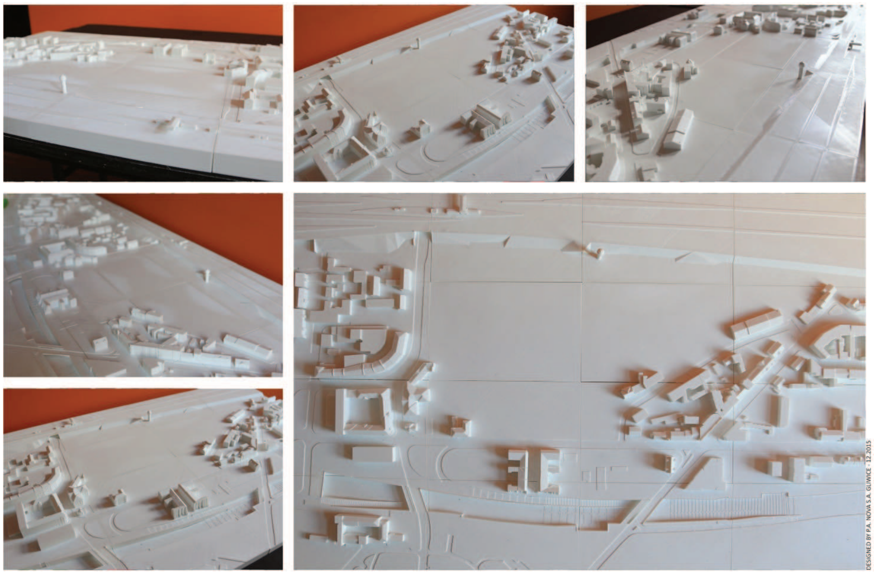

Fig. 23: 3D-print of 3D model of the City of Gliwice, courtesy of PA NOVA SA.

6 CAPAP PROJECT

Following big success of ISOK project -

CAPAP (is the acronyme for Center of Sptial Analysis of Spatial Information). CAPAP ss the follow-up project of ISOK Project due to big success of its predecessor.. The scope of this project includes – finishing the collection of LIDAR data collection for the entire Polsih Territory. Currently the coverage of the LIDAR data for Poland is at the level of 92 % of the whole Poland's teritory. (for comparison LIDAR data for England scored for 72 % of England's territory in September of 2015 year).

Collection of new LIDAR point could sets for 100 biggest cities is also scheduled within the project scope.

Creation of 3D buildings for 25 million buildings in Poland in accordance with CityGML Level 2, is also scheduled within the project scope between 2016 and 2018.

7 CONCLUSION

Completeness, accuracy, cost, funcjonality and new applications areas of 3D modelling of buildings and other complimentary data sets will strenghten Polish cities on their road to Smart Cities- behavioural patterns, in e fee years from now, along the production cycle of 3 dimensional information of the entire country. Poland in 3D will carry out next generation applications, even hard to imagine today. The proces has already started.

7.1 Completeness

Production of 3D datasets of buildings will provide whole country coverage of 25 million 3D buildings. The data on cadastral parcels, topographic database BDOT10k and CityGML LoD2 datasets will be available for the whole area of Poland (ca 312 000 km²)

7.2 Accuracy

Accuracy of 3D models of the Cities will be in the range from 20 cm to 40 cm. Planimetric accuracy might be very accurate for x/y coordinates, since mor ethan 200 cities have been mapped with 10 cm resolution orthophotos. "Z" accuracy – of the exisitng aerial scanning campaing of ISOK project proved to be in the range of 7 to 12 cm in th emajority of cases.

7.3 Cost

As explained above various cities generated their 3D models with various costs withing timeframe from 1997 to 2015. Comparing various independent projects – being carried out by the cities alone, and knowing cost factors of the CAPAP project it seems that the cost of creation of 3D model for particular Polish cities will be at least 5 times less expensive then earlier induvidual projects.

7.4 Functionality

Is seems that recent developments of the CityGML test projects provide the hope that 3D City Models will be available directly on the Internet (like CityGML model of The New York, by T.Kolbe et al.[5]). 3D data of buildings will be accessible to browse and search through regular web browser.

Clicking on each building will open its attribute table, stored at the municipal database.

Semantic-rich data from BDOT10k databases will assist in serach and analyses of the required records.

7.5 New Applications Area

Its hard to invent various application fields, but ad other important projects already have showed (Berlin, Paris, Barcelona, Graz, The New York and dozens of others) each city can apply various features of 3D models for various application areas. Be it “Atlas of Energy”- like in the Berlin case, be it – sustainable development, be it “solar roofs potential”, - or any other area. One could imagine, that the availability of 3D models not only possible on mainframes of the past, but also at regular servers, smartphones and tablets will open quite new applications areas, like augmented reality and others. One could imagine, being called from the boss to stay in particular city and manage few more action items. You could just see the surrounding 3D environment through your smartphone or tablet, /where are the nearest free places in nice hotels/ or maybe even use QR code to pay for the room – bought right from the street.

Imagination is the only limit.

[5] KOLBE, CityGML goes to Broadway, 2015

Mobility Patterns and Lifestyles in Vienna – Case Study Liesing

Jiannis Kaucic, Stephanie Kirchmayr-Novak, Wolfgang Neugebauer, Joanne Tordy, Christof Schremmer

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1 ABSTRACT

The aim of the study is to understand the linkages between housing form, mobility patterns and lifestyle with focus on leisure activities, using the example of Vienna/Liesing. We analyse how mobility behaviour of daily and leisure activities is linked to mobility and leisure orientations as well as the availability of local recreational facilities, private or semi-private green spaces in the neighbourhood. The study shows that the general mobility orientations of residents in the district of Liesing to some degree contradict the reality of their daily transportation. It seems that in the case of trips to work and training the factors location, accessibility and travel time have more influence on mode choice than the factor lifestyle or mobility orientation. For leisure trips the correlation of lifestyle or housing form with mode choice becomes more important and overlays and stratifies the influence of locational factors.

2 LIFESTYLES, LEISURE BEHAVIOUR, MOBILITY TYPES AND TRAVEL

Different definitions and measurements of the concept of lifestyle as well as different views of how travel behaviour is influenced by lifestyles exist in transport studies (Van Acker et al., 2015). Sociologists such as Weber (1972), Bourdieu (1984), Ganzeboom (1988) and Schulz (1992) agree on the communicative character of lifestyles: individuals express their social position through specific patterns of behaviour, consumption and leisure. These behavioural patterns are shaped by underlying opinions and orientations, including beliefs, interests and attitudes. Thus, travel behaviour is not simply determined by price, speed and comfort but is also related to attitudes, status and preferences. Travel behaviour is then one example of a behavioural pattern in which lifestyles are expressed. In the paper at hand, lifestyle is defined as a construct composed of individual activities, attitudes, interests, opinions and values which are amongst others expressed in certain leisure as well as mobility orientations and behaviour.

3 MOBILITY PATTERNS AND PARAMETERS INFLUENCING IT

The causes for individuals developing certain mobility patterns are very complex. Main parameters influencing mobility behaviour are characteristics of the individual person as well as characteristics of the built environment. The urban form and the dispersion of urban functions are relevant, as well as the transport infrastructure and its quality. The density, size and distribution of different urban functions (housing, workplaces, education, shopping, leisure, administration etc.) affect the distances that have to be overcome by urban citizens, commuters, visitors etc. (Schremmer et al., 2009). Furthermore, the transport infrastructure and the transport system are shaped by the urban configuration, as well as the other way round; existing transport infrastructure influences the development of the urban configuration.

At individual level, objectifiable parameters like socio-demographic characteristics show strong influence on mobility patterns (Wittwer, 2010). Subjective parameters of lifestyle, habits or environmental awareness are increasingly discussed within mobility research, even though it is unclear how empirically significant the explanatory potential of lifestyle parameters (goals in life, importance of spheres of life, values) is compared to the objective parameters (Hammer et al., 2006).

4 MOBILITY PATTERNS, MOBILITY ORIENTATIONS AND LIFESTYLES IN LIESING, VIENNA – A QUANTITATIVE AND QUALITATIVE ANALYSIS

4.1 The Data

A two-fold approach was chosen to allow for an in-depth analysis of mobility patterns, orientations and lifestyles in Liesing, Vienna. First, a representative stated preferences survey was conducted in order to determine a) the housing situation, with special regards to housing form and green space availability, b) orientations and opinions with regard to leisure and travel infrastructure c) resident's leisure behaviour

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concerning visit of certain leisure infrastructures and d) their mobility patterns (primarily mode choice) for leisure activities. A total of 424 respondents were interviewed by phone, covering a representative distribution of Liesing's inhabitants in terms of age, gender and housing type. Second, the qualitative method of Communal Probes was used with 20 inhabitants of Liesing. This creative approach to capture citizens' perceptions and opinions was designed to support the interpretation of the quantitative hard facts by providing a phenomenological perspective.

4.2 The construct of 'lifestyle' and measuring mobility behaviour

The construct of 'lifestyle' was built from the elements mobility orientations, leisure orientations and leisure behaviour, representing customary leisure activities. Mobility orientations and leisure orientations were operationalised by preference ratings on item lists of certain infrastructures related to transport and leisure in the neighbourhood. Leisure behaviour was inquired referring to the predominantly frequented leisure facilities. Measuring mobility behaviour to work/training and shopping for daily needs as well as to leisure facilities was operationalized as stated preference on the means of transport predominantly used for trips undertaken for the respective purpose.

4.3 Constructing 'lifestyle types'

In order to test the hypothesis of lifestyle having an influence on mobility patterns for leisure activities, individuals were grouped based on the elements described above. To construct 'lifestyle types', the items on mobility orientation, leisure orientation and leisure behaviour were selected from the questionnaire, followed by factor analysis and cluster analysis. This clustering has led to the identification of 4 'lifestyle types'. They were differentiated by characteristics on the basis of statistically significant deviations from the mean of all cases. In order to clarify their cluster-specific differentiation in terms of their mobility and leisure orientation and leisure behaviour, we labelled the clusters with characteristic names: 'Suburban', 'Urban', 'Neighbourhood' and 'Ecological'.

4.3.1 Cluster 1: 'Suburban'

Cluster 1 (N=102) represents respondents who based on their preference ratings can be labelled as car affine. This cluster stands out due to high stated importance of infrastructure related to children education, daily shopping, and services as well as high importance of green spaces in the neighbourhood. In contrast to this stands the highly negative assessment of provided infrastructure in the neighbourhood. Members of this cluster show a high frequency of visit of private or public green spaces. 80% of the 'Suburbanites' possess at least one car.

4.3.2 Cluster 2: 'Urban'

Cluster 2 (N=69) represents respondents who are public transport affine. This cluster ascribes low importance to leisure/sports facilities for all ages, services for seniors and community facilities as well as infrastructure related to children education, daily shopping, services and green spaces in the neighbourhood. Interviewees of this cluster show a high frequency of visit of arts, culinary or shopping facilities. 81% of the 'Urban' group possess at least one car.

4.3.3 Cluster 3: 'Neighbourhood'

Cluster 3 (N=60) represents interviewees who rate all modes of transport as equally important and therefore can be labelled as multi-modal. This cluster ascribes high importance to leisure/sports facilities for all ages, services for seniors and community facilities. The frequency of visit of private or public green spaces and sports facilities is average, and the frequency of visit of arts, culinary or shopping facilities is highly below average. This type more likely owns a car (85%) and has the lowest share of members without a driving license (7%).

4.3.4 Cluster 4: 'Ecological'

Cluster 4 (N=181) represents respondents who attribute high preference to bicycle and walking infrastructure as well as to public transport. Their orientation towards car is below-average. This cluster is characterized by a very positive assessment of infrastructure related to children education, daily shopping, services and green spaces. The leisure behaviour shows a high frequency of visit of arts, culinary or shopping facilities and above average orientation towards sports facilities. Conversely, the orientation towards private or public green spaces is low. This type to 80% owns a car, but has the highest share of members without a driving license (14%) within the sample.

4.4 Lifestyle types and mode choice

In this section, the previously established lifestyle types are examined for their mode choice for different activities.

4.4.1 Mode choice in leisure time

The modal split to the private garden or community garden as well as to public green and free spaces is due to its close proximity to the apartment or house naturally characterized by a high share of walking. However, small differentiations are visible between the lifestyle clusters. The orientation towards transport infrastructure to a degree contradicts the stated preference of means of transport for this particular leisure purpose. For example, the 'Ecological' group shows the highest modal split of car within the sample. For leisure activities related to sports facilities, the mobility orientation within the clusters shows higher similarities to the mobility behaviour than in the previous leisure destinations. The 'Suburbanites' show the highest modal split car (50%), the 'Neighbourhood' group has the highest modal split public transport (35%) and the 'Ecological' group displays the highest share of walking in the sample (52%). The modal split to arts and culture destinations is in all clusters characterised by high shares of public transport (50%+), but also significant shares of car (30%+, except 'Neighbourhood'). 'Suburbanites' have the highest share of car mobility (almost 50%) and the lowest of public transport in the sample (also almost 50%). For cafes, restaurants and clubs, the modal split in the sample overall is almost evenly split between walking, public transport and car but also shows variations between the lifestyle clusters. The modal split to shopping malls and shopping streets in the sample is characterized by a high modal split of car (46%) and significant shares of public transport (28%) and walking (24%). Here, the phenomenon of contradicting statements regarding mobility orientations and predominantly chosen means of transport again becomes apparent. The 'Urban' group shows the highest share of car use (83%) for these trips, followed by the 'Ecological' group with 50%.

4.4.2 Mode choice for work/training

The modal split to work and training differs significantly between the lifestyle-clusters: The highest shares of car use can be found among the 'Suburban' (51%), the 'Urban' (47%) and 'Ecological' (44%) groups. The highest shares of public transport to work/training are among the 'Neighbourhood' (53%) and 'Urban' (45%) groups. The share of walking is highest within the 'Neighbourhood' group with 12% and below 10% in all other clusters.

4.4.3 Mode choice for daily shopping

For trips to shopping for daily needs, significant shares of car are observable among 'Suburbanites' (51%) and 'Urbanites' (46%), followed by the 'Ecological' (43%) group. Only the 'Neighbourhood' group displays lower shares of car (33%) and higher shares of walking (47%). Public transport is very evenly distributed among the lifestyle clusters with shares ranging from 13%-17%.

5 CONCLUSIONS

In the study at hand an analysis of mobility patterns, orientations and lifestyles in Liesing (Vienna) was conducted on the basis of a quantitative survey with 424 respondents, followed by qualitative, in-depth probes with 20 participants. This chapter highlights the main conclusions of the empirical analysis.

5.1 Mobility orientations and mobility behaviour: Desired mobility versus infrastructural constraints

The district of Liesing is characterized by a very high volume of motorized transit traffic on main routes, the highest motorization compared to the rest of Vienna (about 500 cars per 1000 inhabitants compared to 390 in Vienna), the highest share of car trips on modal split and high loads in the road network and congestion. The results of the study confirm that for certain leisure activities and to an even higher degree for work and training as well as for daily shopping, the share of car trips is high. At the same time, accessibility by public transport is only considered positive along two corridors directed to the city centre, while the connection of local centres within the district from East to West and between the corridors is unsatisfactory. Also the network of cycle paths and footpaths is fragmentary and of low quality, which contributes to the low modal split of walking and cycling. The empirical analysis shows that the general mobility orientations of residents in the district of Liesing to some degree contradict the reality of their daily transportation, depicted in the transport measures above. The connection to public transport is considered most important by the respondents, as well as the existing supply is evaluated positively. The rating of importance of connection to highways and high-level roads is significantly lower. Additionally, satisfaction with the supply of parking and highways is comparably low among residents. This reflects the negative image of individual motorized traffic in the district, emerging from traffic congestion due to high volumes of commuter inflow and transit traffic as well as shortage of parking space in some areas.

5.2 Complex relationships between lifestyle, social factors, location and mobility

In order to test the hypothesis of lifestyle having an influence on mobility patterns for leisure activities, social groups or 'lifestyle types' were identified based on orientations and attitudes towards transport and leisure infrastructure as well as the frequency of visit of different leisure facilities. The analysis of the identified clusters showed that several relationships between personal and household characteristics, housing location, availability of green areas and private open spaces, availability of transport modes and the chosen lifestyle exist. Educational attainment, occupation and income, but also factors related to the stage of life of the individual, such as family formation (children) or retirement (age), influence the decision on the place of residence and the possibility and desire to own certain private goods, such as cars, single-family houses or private gardens. The ownership of these goods again influences mobility patterns. The decision on the place of residence and location within the city on the other hand determines the availability and accessibility of public infrastructure, such as public transport infrastructure, services, supermarkets, offerings of leisure, etc., and therefore influences freedom of choice of transport mode. The three elements – lifestyle, social factors and location – are interconnected and interact.

5.3 Modal choice for daily trips: The influence of lifestyle on mobility patterns subordinates to the factor 'location' if accessibility constraints are high

The study shows that a mixture of lifestyle, social factors and location factors has an influence on the choice of transport modes. Depending on the trip purpose (daily trip or leisure trip) and related destination and accessibility constraints, one of the factors emerges as the deciding one. In terms of mobility orientations, the quantitative survey shows a clear picture of multi-modality of the residents of Liesing. One cluster of 'Suburbanites' (24%) can be described as car oriented, while the three other clusters (76%) deem all means of transport as important, show no preference of car, or even prefer other means of transport.

For trips to work and training as well as for shopping for daily needs, the modal split shows a different picture opposed to the identified lifestyles and mobility orientations: Of all persons with trips to work and training, mobility patterns are characterized by high shares of car (45%) and public transport (39%) and very low shares of bicycle (3%) and walking (8%), with very little differentiation between lifestyle groups. By housing type, single family home residents show a significantly higher share of car use to work and training (52%) as well as for shopping for daily needs (57%) than residents of the other housing types. It seems that in the case of trips to work and training the factors location, accessibility and travel time have more influence on mode choice than the factor lifestyle or mobility orientation. This is due to the fact that trips to work and training are to a very high degree bound to a certain destination, and freedom of choice of destinations taking into consideration travel times and accessibility is restricted. The differentiation of mode choice for daily shopping trips between lifestyle groups is not as distinct as it is between housing types, showing the higher influence of 'location', population density and related density and quantity of offerings compared to lifestyle and mobility orientations.

5.4 Modal choice in leisure time: The type of leisure activity, its location, the distribution of opportunities in space and life style have an influence

The mobility patterns in leisure time show a similar interaction of lifestyle and locational factors influencing the choice of transport modes as those for daily trips. However, the modal split for leisure trips better represents the multi-modal mobility orientations found among the respondents: The share of trips done by car is lower than for daily trips and other modes are well represented.[1] This confirms the hypothesis that people are freer to decide where to go and what transport mode to use when it comes to leisure activities. The modal split significantly correlates with the location[2] of the leisure facilities headed for. Amongst the respondents, the highly frequented public and private green spaces are also related to short travel distances and the ones with the highest share of sustainable transport (mostly walking). The other leisure destinations are less frequented but show higher travel distances and a higher share of car and public transport. The share of public transport is higher for trips to leisure activities which are rather located in other districts of Vienna or in the centre (arts and culture, culinary art and shopping), which are better accessible by public transport and generally have restrictions regarding car traffic (being it parking restrictions or traffic overload). For leisure trips to destinations which predominantly are in greater distance to the residence (sports facilities, arts and culture and culinary art), the correlation of lifestyle or housing form with mode choice becomes more important and overlays and stratifies the influence of locational factors. This becomes evident in the clear patterns in mode choice of lifestyle groups and housing types, with 'Suburbanites' and residents of Single-Family Homes traditionally having the highest shares of car use, the 'Urban', 'Neighbourhood' and residents of Multi-Storey Buildings having the highest shares of public transport use and the 'Ecological' group and residents of Multi-Storey Buildings having the highest shares of walking. Leisure trips for the purpose of shopping constitute an exception with a generally high share of car-use and 'Urbanites' displaying high car shares in particular. In this case, the type of activity and related convenience of means of transport as well as location factors[3] additionally have an influence on the mode choice.

The tendency to combine trips for different purposes to mobility chains also comes apparent in leisure time. The frequency, mode and location of certain leisure trips correlate with the frequency, mode and location of other leisure trips. For example, trips for sports, culture and shopping display strong ties. Here, shopping centres or locations which combine offerings for all these purposes may have an influence on selection and combination of trips and mode choice.

5.5 Leisure orientations and behaviour show high importance of green spaces in Liesing

A clear preference towards green spaces is visible in Liesing. Both the preference rating and the satisfaction with the green spaces provided in the neighbourhood are significantly higher than for the other leisure infrastructures inquired. Also, green spaces are mostly accessible by foot and in close proximity to residential areas. From surveys we know that in many cases a pre-existing orientation towards green spaces led to the decision on the place of residence in Liesing. This high value of high-quality and well accessible green spaces in Liesing is important to keep in mind when developing new residential areas in the district.

Parallel to the high orientation and positive opinion towards green spaces, also the leisure behaviour (i.e. stated frequency of visit) shows a clear trend towards private and public green spaces. 'Private garden, terrace or community garden' is the most frequented group of leisure facilities among the interviewees, followed by 'public green spaces and free spaces', 'sports facilities', 'shopping opportunities', offerings related to 'culinary art' and lastly 'arts and culture'. Generally, the frequency of visit of all kinds of green spaces is very high, with more than 80% visiting any type of green and free spaces at least 2-4 times per week.

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[1] Shopping as a leisure activity is one exception, with 46% share of trips done by car.
[2] This also implies that distance, accessibility and travel times to the target destination have an influence.
[3] E.g. opportunities to combine activities at one location.

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