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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).

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

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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

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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;
- identification of the needs/expectation of owners (private and public) of brownfields;

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- 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]

Owner	Investor	Neighbourhood	Authorities (municipal, state)	Companies (construction)	Financial Institutions (bank)
1) input data about property into db **2)** communication with other stakeholders	**1)** search brownfields by various attributes (location, size, ownership etc.) **2)** advanced options to search brownfields involving analytics (i.e. distance from highway, whether landlot lies in flooding area etc.) **3)** wide access to the relevant geospatial information (borders of natural reserves, companies surrounding brownfields, infrastructure in neighborhood etc.) **4)** wide access to all relevant legal documentation (building code, strategic spatial plan etc.) **5)** information about possible dotations from EU structural funds **6)** consulting services **7)** communication with other stakeholders **8)** ask financial institution for loan **9)** search for 'third' companies that can help for instance with construction	**1)** see brownfields in the neighborhood together with all relevant information about them **2)** explore thematic map related to the neighborhood **3)** report area that seems to be abandoned and hasn't been yet added to db **4)** involve into discussion with investor about the future use of the area	**1)** input brownfields and their attributes into db **2)** add relevant information such as building code, spatial strategic plan etc. into db **3)** propose type of enterprice that can be newly found on brownfield **4)** add information about available dotation for brownfields' regeneration	**1)** Add the profile of the company into companies' directory **2)** Make proposal to investor on contract on some task (i.e. demolition) **3)** Add banner	**1)** Add the profile of the bank into banks' directory **2)** Contact investor with loan proposal **3)** Add banner

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]

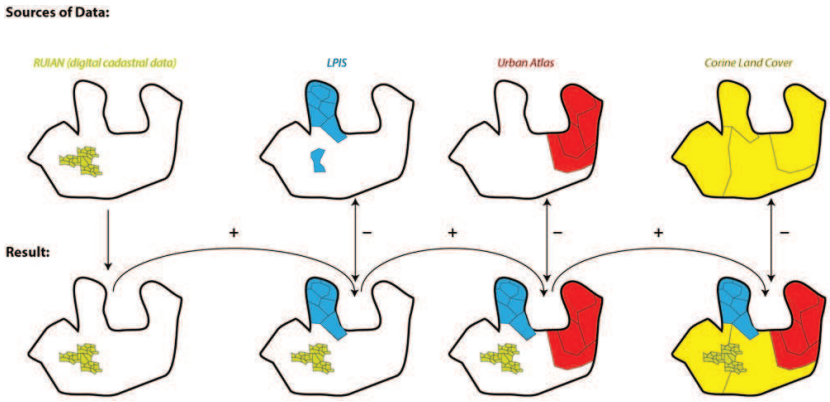

Fig. 2 The steps undertaken for combining the data[15] [17] [19] [21]

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]

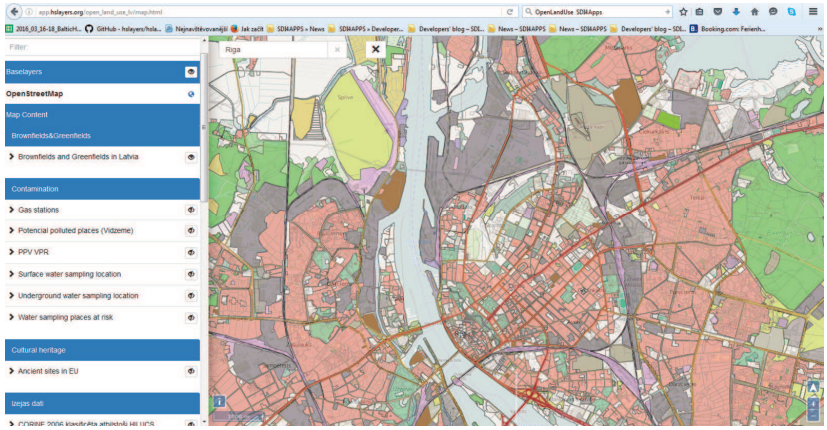

Fig. 3 Open Land use map for Riga city, Latvia [22]

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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]

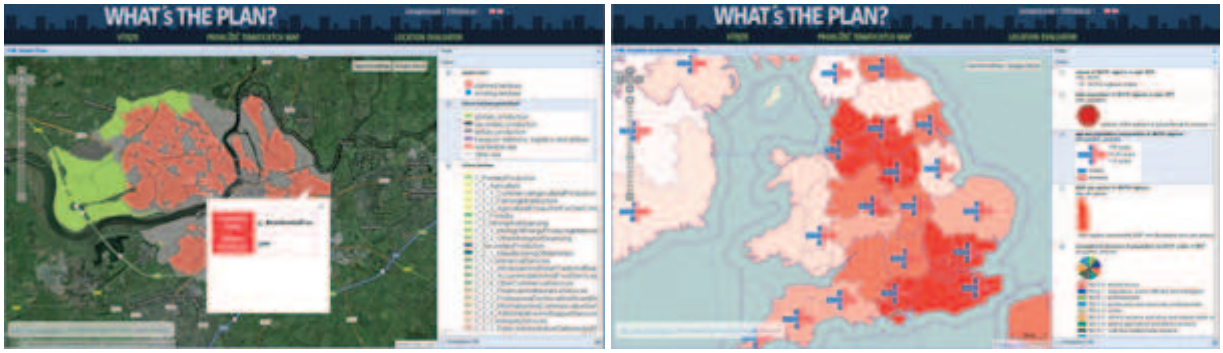

Fig. 5 Thematic Map Viewer [15] [17]

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]

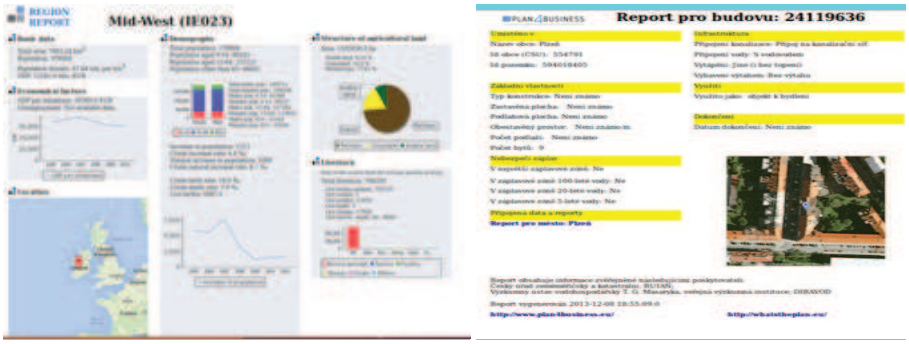

Fig. 6 Location Evaluator [15] [17] [19]

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.

Therehore, 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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