"Sidewalks" as a Realm of Users' Interactions:
simulating pedestrians' movement at a commercial street in Cairo City

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2. Aim.

3. Assumption and method.

4. Case of study.

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1- INTRODUCTION:

- Cairo City is ranked among the biggest 10 metropolitan areas in the world.

- Its population exceeds 18.0 millions plus more than 2.5 million as daily visitors.
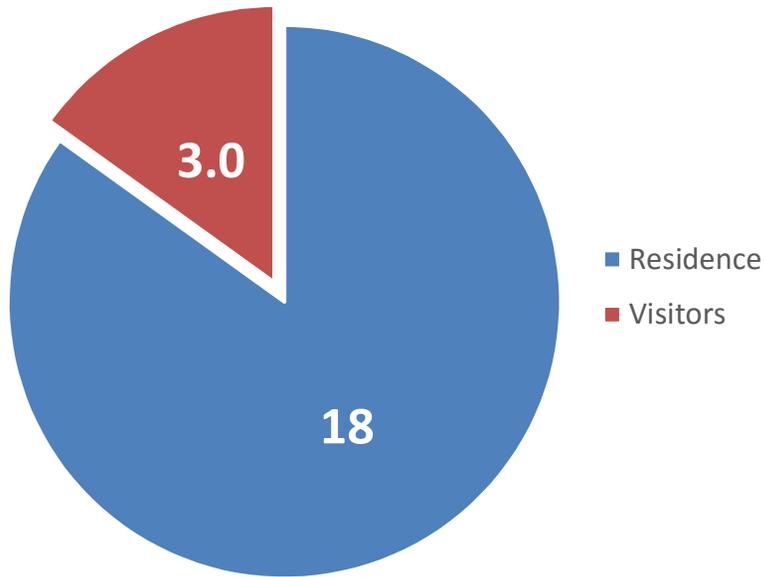
1- INTRODUCTION:

- Transportation and road networks' problems are the worst which Egyptians face daily.

- Governments have constructed "Cairo Metro" to transport more than 5 million passengers daily. But, densities at Cairo City, are still rated among the highest.

1- IMPORTANCE OF STUDY:

- Absence of urban control allows violations which usually cause dramatic changes in densities distribution.

- This study is essential because:

  1) Pedestrians' realms are not defined in the context of Cairo City.

  2) A lack of services at sidewalks, such as: furniture, lighting, and public transits.

  3) Violations caused by pedestrians, merchants and vehicle drivers.

2- AIM OF STUDY:

- This work aims to simulate pedestrians movement in a commercial street at Cairo.

- Accordingly, developing a method to measure pedestrians' densities, by which we can test the relation with the distribution of uses a long the street.
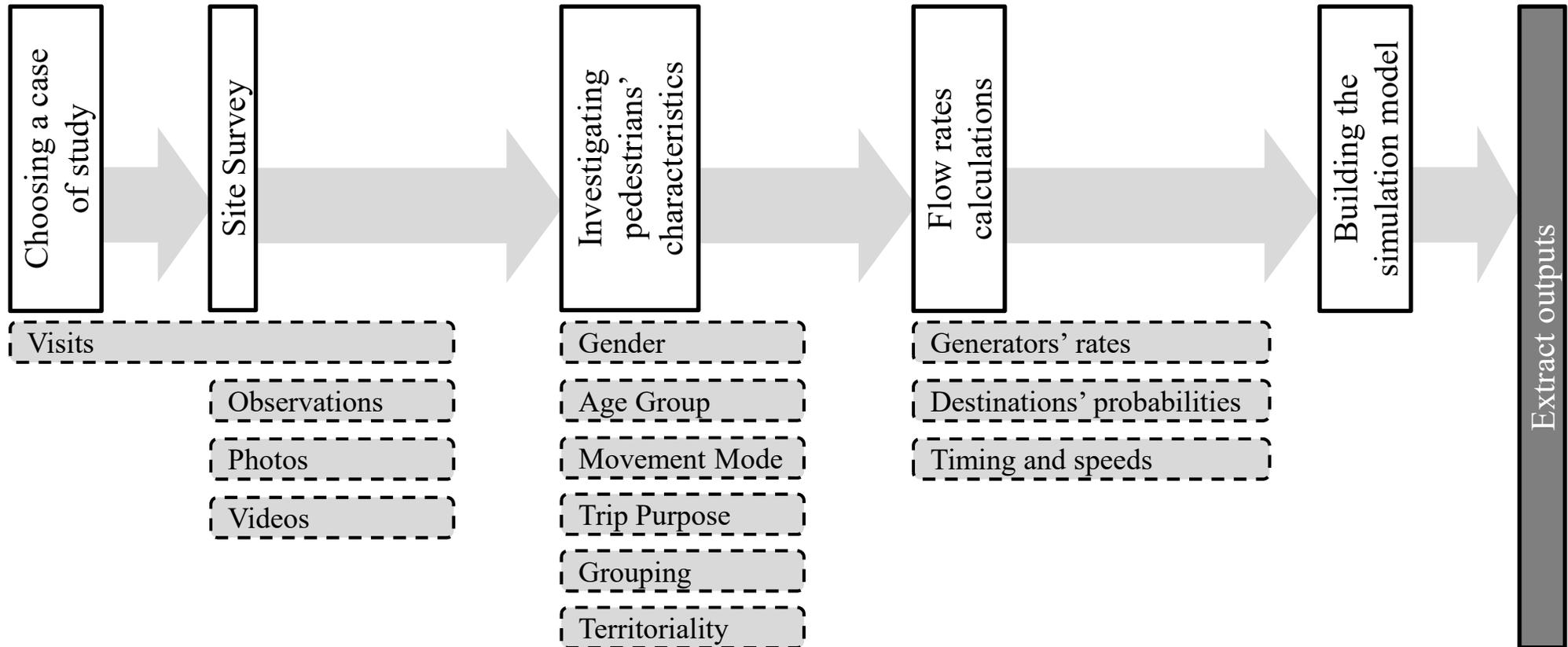
3- ASSUMPTION:

- Arabic and Islamic cities are "Linear open spaces based" cities, that their streets are spaces where both origins and destinations exist at linear spaces.

3- METHOD:

- The method of this work is, basically, based on observations using a photo and video-based survey data.

Choosing a case of study → Site Survey → Investigating pedestrians' characteristics → Flow rates calculations → Building the simulation model → Extract outputs

Visits
Observations
Photos
Videos

Gender
Age Group
Movement Mode
Trip Purpose
Grouping
Territoriality

Generators' rates
Destinations' probabilities
Timing and speeds

4- CASE OF STUDY:

- During the last 18 months, 27 visits have been made to nine planned commercial streets in 5 districts.
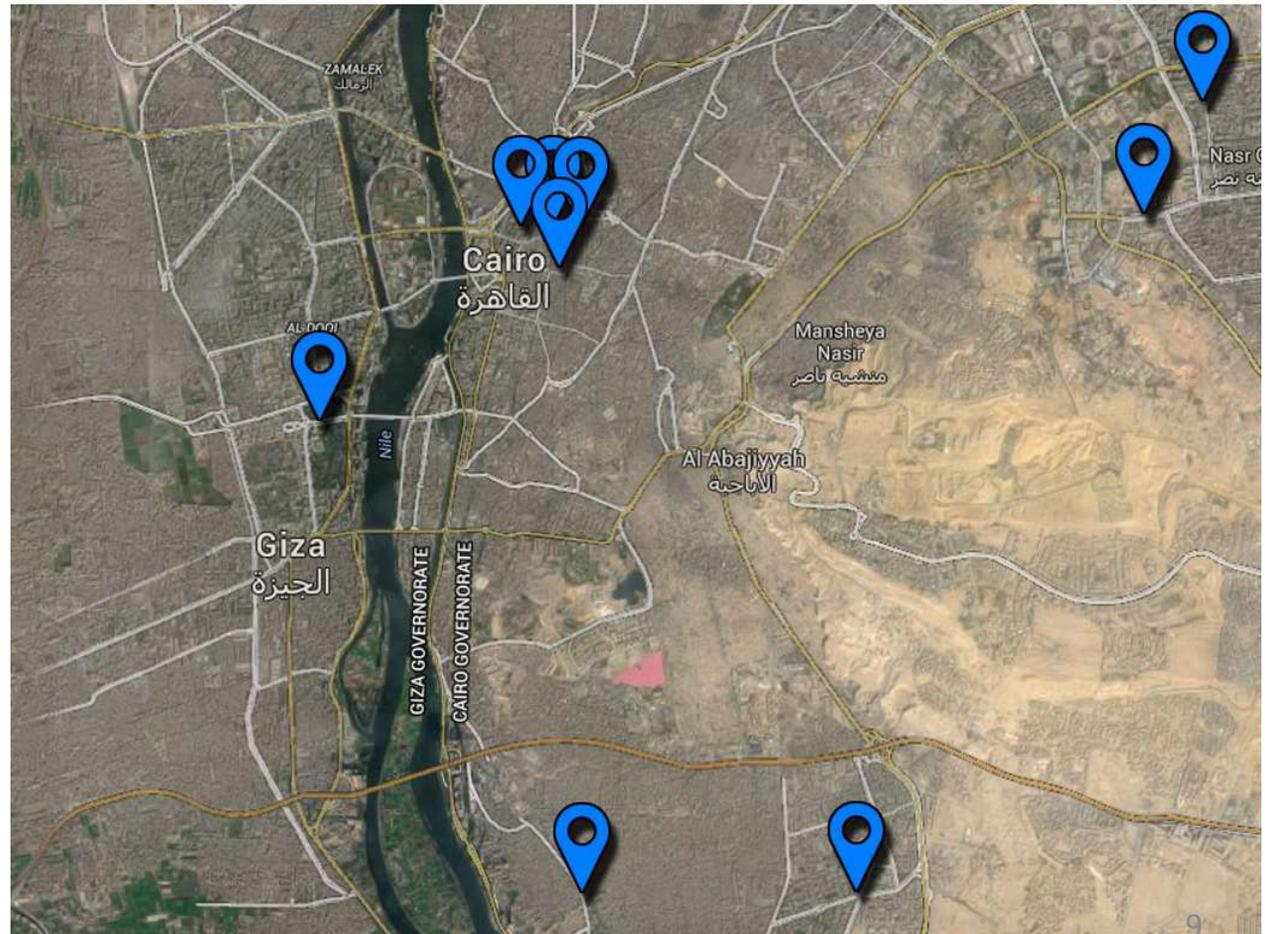
4.1- Choosing a case:

- The case of El-Nasr Street at El-Basateen District south of Cairo has been chosen. It borders, El-Maadi and El-Basateen, these two districts which are populated with more than 540,000 residents (Cairo Governorate, 2016).
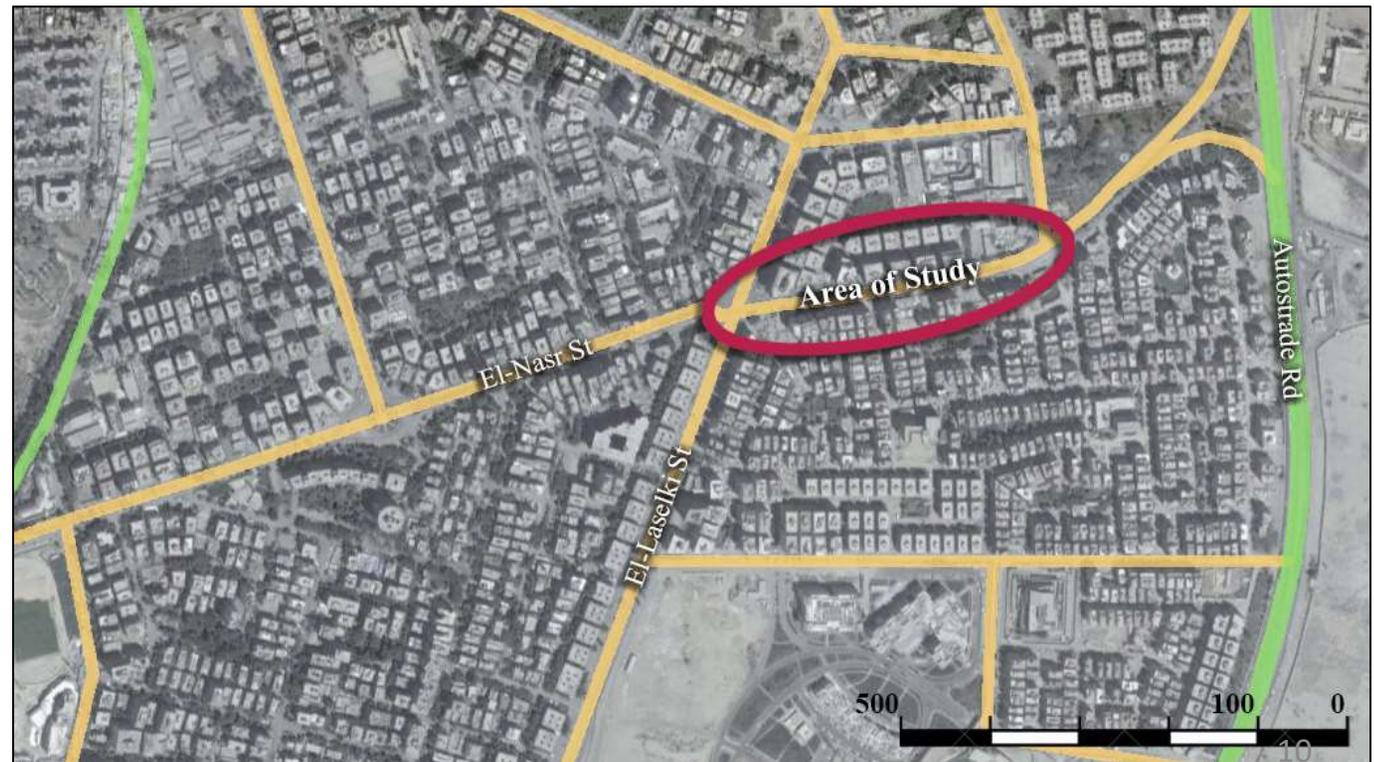
4.1- Choosing a case:

- We specified a 360 m length of the street to be our area of study.
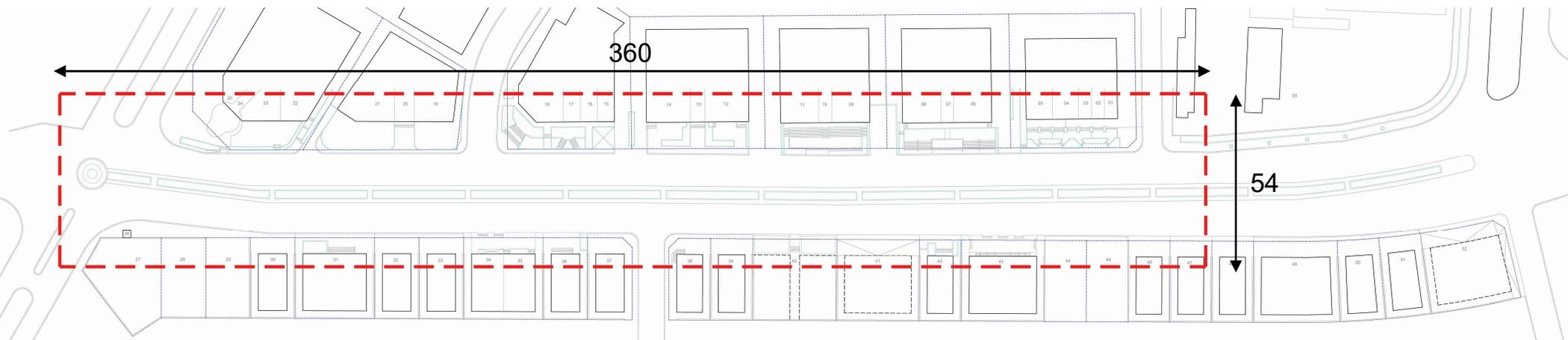
4.2- Site survey:

- Three weeks have been spent, daily visiting site and observing pedestrians' movement.

- We noted observations which were supported by photos and video records.

4.2- Site survey: Observations

1) Most of pedestrians walk outside the sidewalk where many obstacles locate. They occupy a virtual 2.50 m wide lane from the road.

2) A 2.0 m wide lane of cars permanently park attached to sidewalks. Thus, this lane of parking cars enhances the dis-connectivity of sidewalks.

4.2- Site survey: Filming

- The survey has been executed during November and December 2014.

- Separate video-clips each of which was 5 to 8 minutes have been recorded.

- The weather was moderate as temperature ranged (14°C to 23°C), humidity was 65%, and the visibility ranged from 3 to 9 km.

4.2- Site survey: Filming
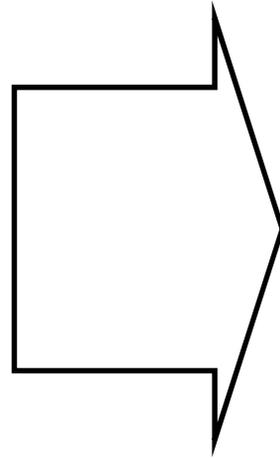

CAM 01

4.2- Site survey: Filming

CAM 03

4.3- Pedestrians' characteristics:

- We classified pedestrians' characteristics into six categories:

    1) Age Group

    2) Movement Mode

    3) Trip Purpose

    4) Gender

    5) Grouping

    6) Location

- We have surveyed a sample of 635 pedestrians whose trips were completed in the video-clip records.

Pedestrian Types

Category	Item	Count	%
Age Group	0~12	33	5%
	13~22	207	33%
	23~50	335	53%
	51+	60	9%
	Total	**635**	**100**
Movement Mode	Walk	620	98%
	Run	0	0%
	Bike	5	1%
	Wheelchair	0	0%
	Assistance	10	2%
	Total	**635**	**100**
Trip Purpose	Transients	209	33%
	Partial user	218	34%
	Full user	102	16%
	Waiter/Sitters	106	17%
	Total	**635**	**100**
Sex	Male	459	72%
	Female	176	28%
	Total	**635**	**100**
Grouping	Individuals	297	70%
	2 per group	94	22%
	3 per group	25	6%
	more than 3	10	2%
	Total	**426**	**100**
Location	Semi -public	174	27%
	Public	192	30%
	Out of Sidewalk	269	42%
	Total	**635**	**100**

Pedestrian Types

Category	Item	Count	%
Age Group	13~22	207	38%
	23~50	335	62%
Movement Mode	Walk	620	100%
Trip Purpose	Transients	209	40%
	Partial user	218	41%
	Full user	102	19%
Sex	Male	459	72%
	Female	176	28%
Grouping	Individuals	297	100%
Location	Semi -public	174	27%
	Public	192	30%
	Out of Sidewalk	269	42%

4.4- Retails' uses:

▪ The case had 49 uses that were currently open and working at the time of survey.

▪ They have been categorized as four major groups, according to type and the average spent time:

    1) Quick needs; pharmacies, ATM……………………...….…..….. (0:2 min)

    2) Daily needs; groceries' & take-away restaurants………………(20 min)

    3) Food Facilities: cafes & sitting restaurants……………….….(30 min)

   4) Usual needs; showrooms……………………………………(30+ min)

4.5- Obstacles:

- Obstacles could be classified into three classifications according to their effects:
    - Dynamic-Physical obstacles.
    - Dynamic-Nonphysical obstacles.
    - Static-Physical obstacles, which is considered in our simulation.

4.6- Calculations: Generators and destinations

- 25 points could be considered as "Generators" of pedestrian.

- Additionally, 74 destinations to which pedestrians intend.

- Using a Origin/Destination Matrix of 635 pedestrians' trips, we specified the probabilities of flow from and to each point.
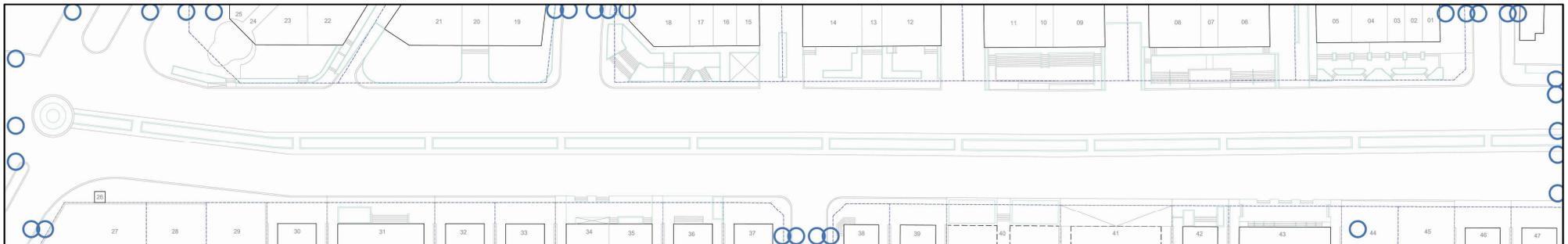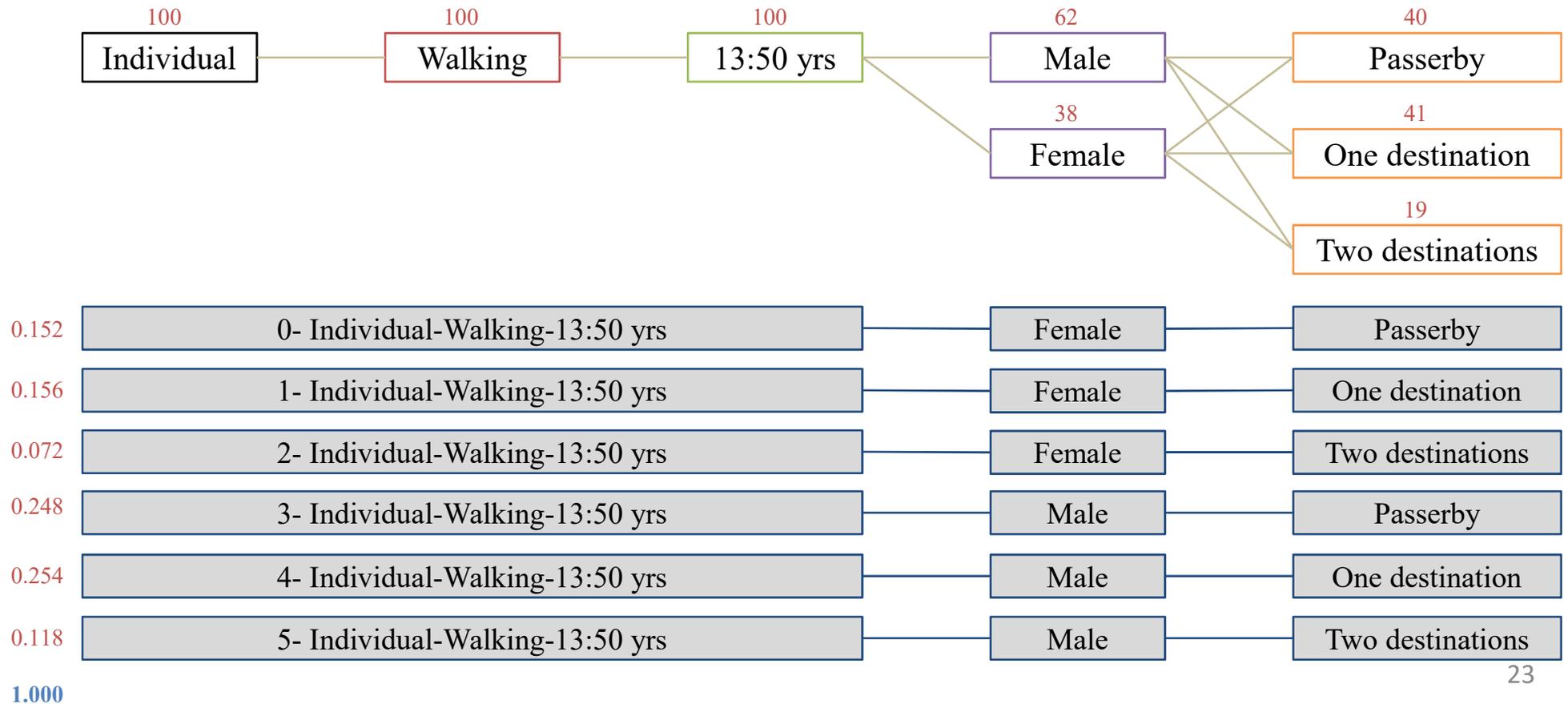
4.7- Calculations: Walking speed

- A walking speed matrix has been developed to specify pedestrians' speeds according to each characteristic and influence of obstacles.

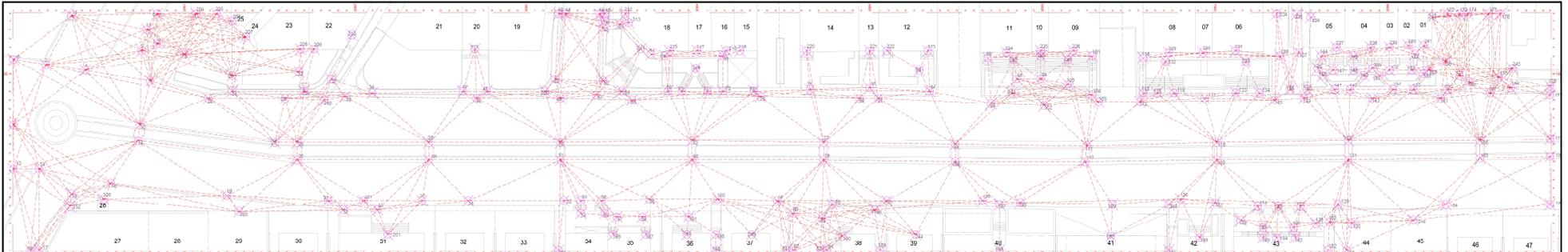|	Age				Movement Mode			Sex		Grouping			Trip Purpose			Obstacles				
	50+	23~50	13~22	0~12	Walk	Run	Bike	Male	Female	3 Pedestrians	2 Pedestrians	Individual	Transient	Partial User	Fully User	Stairs/level	Vehicles	neighbor pedestrian	Narrow width	walls/fences
Pedestrian typical speed is counted as 5.75 km/hour	0.6	1	1		1	2	3	1	0.9	0.7	0.8	1	1	0.85	0.75	0.5				

4.8- The model:

For our model, we used ArtiSoc-V3.5. It is a multi-agent simulator software. According to our pedestrians' classification mentioned, we have developed six agents which behave differently.
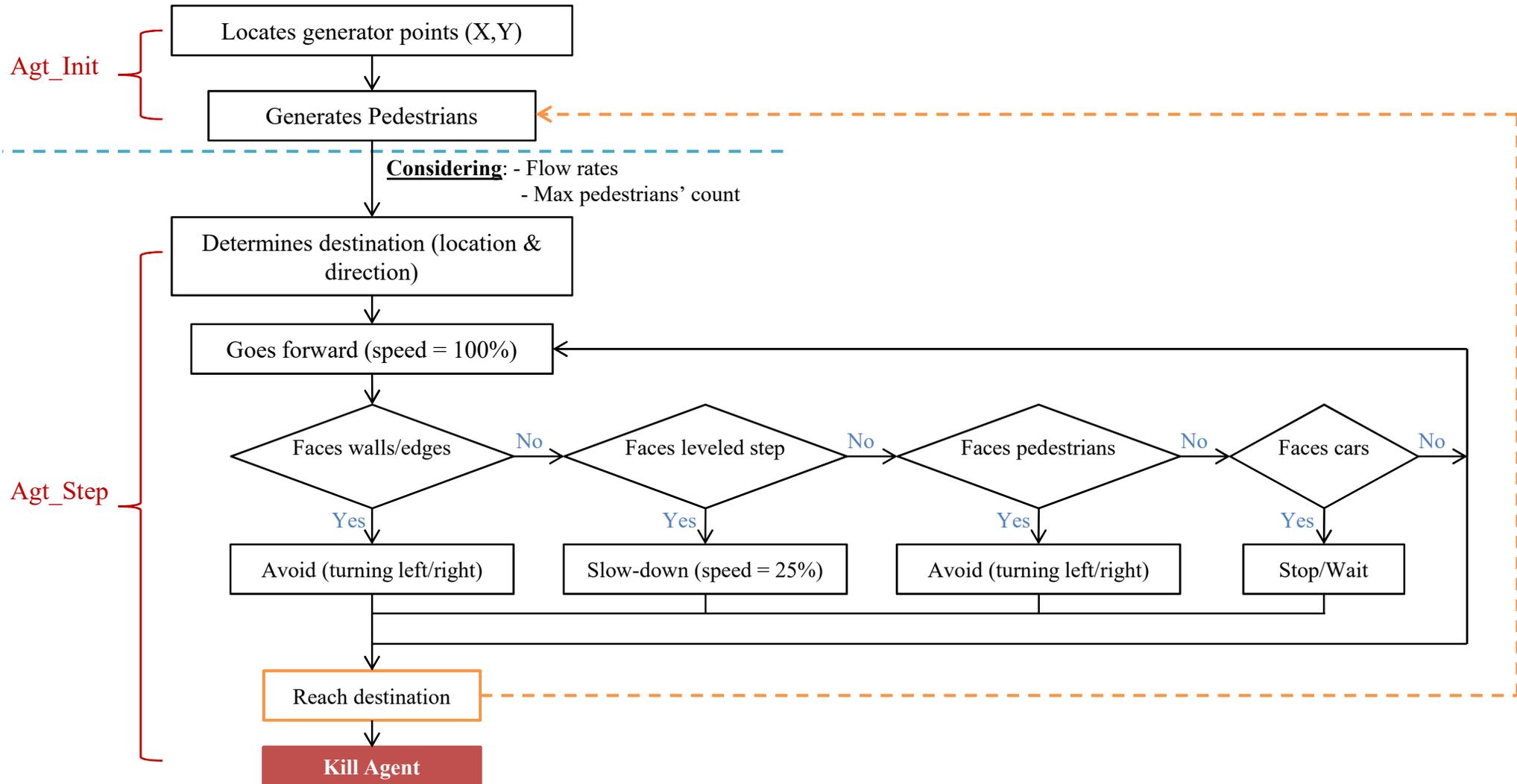
100	100	100	62	40
Individual	Walking	13:50 yrs	Male	Passerby

			38	41
			Female	One destination

				19
				Two destinations

0.152	0- Individual-Walking-13:50 yrs	Female	Passerby
0.156	1- Individual-Walking-13:50 yrs	Female	One destination
0.072	2- Individual-Walking-13:50 yrs	Female	Two destinations
0.248	3- Individual-Walking-13:50 yrs	Male	Passerby
0.254	4- Individual-Walking-13:50 yrs	Male	One destination
0.118	5- Individual-Walking-13:50 yrs	Male	Two destinations

1.000

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4.8- The model:

- For the movement method, we developed a "Waypoint Map" by determining the most frequent nodes and links for walking in real situation.

- Accordingly, we have calculated "Shortest Path" using the Dijekstra's Algorism to reach a destination.
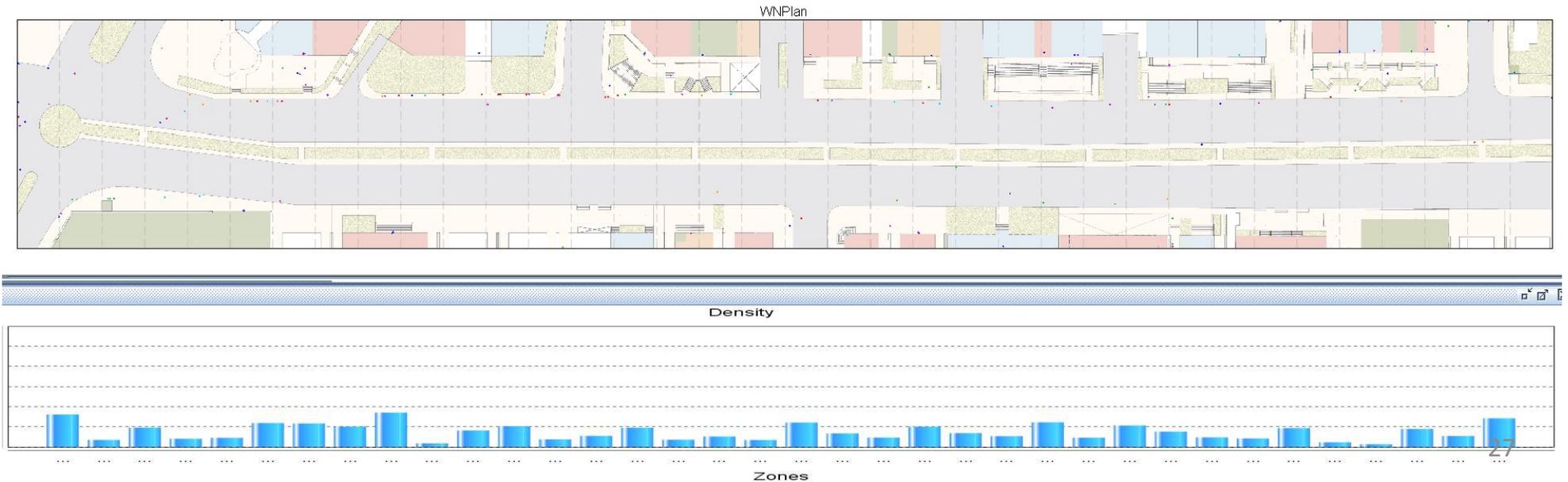
Agent's flow chart.

Agt_Init

- Locates generator points (X,Y)
- Generates Pedestrians

Considering: - Flow rates
- Max pedestrians' count

Agt_Step

- Determines destination (location & direction)
- Goes forward (speed = 100%)

| Faces walls/edges | No | Faces leveled step | No | Faces pedestrians | No | Faces cars | No |

Yes — Avoid (turning left/right)

Yes — Slow-down (speed = 25%)

Yes — Avoid (turning left/right)

Yes — Stop/Wait

Reach destination

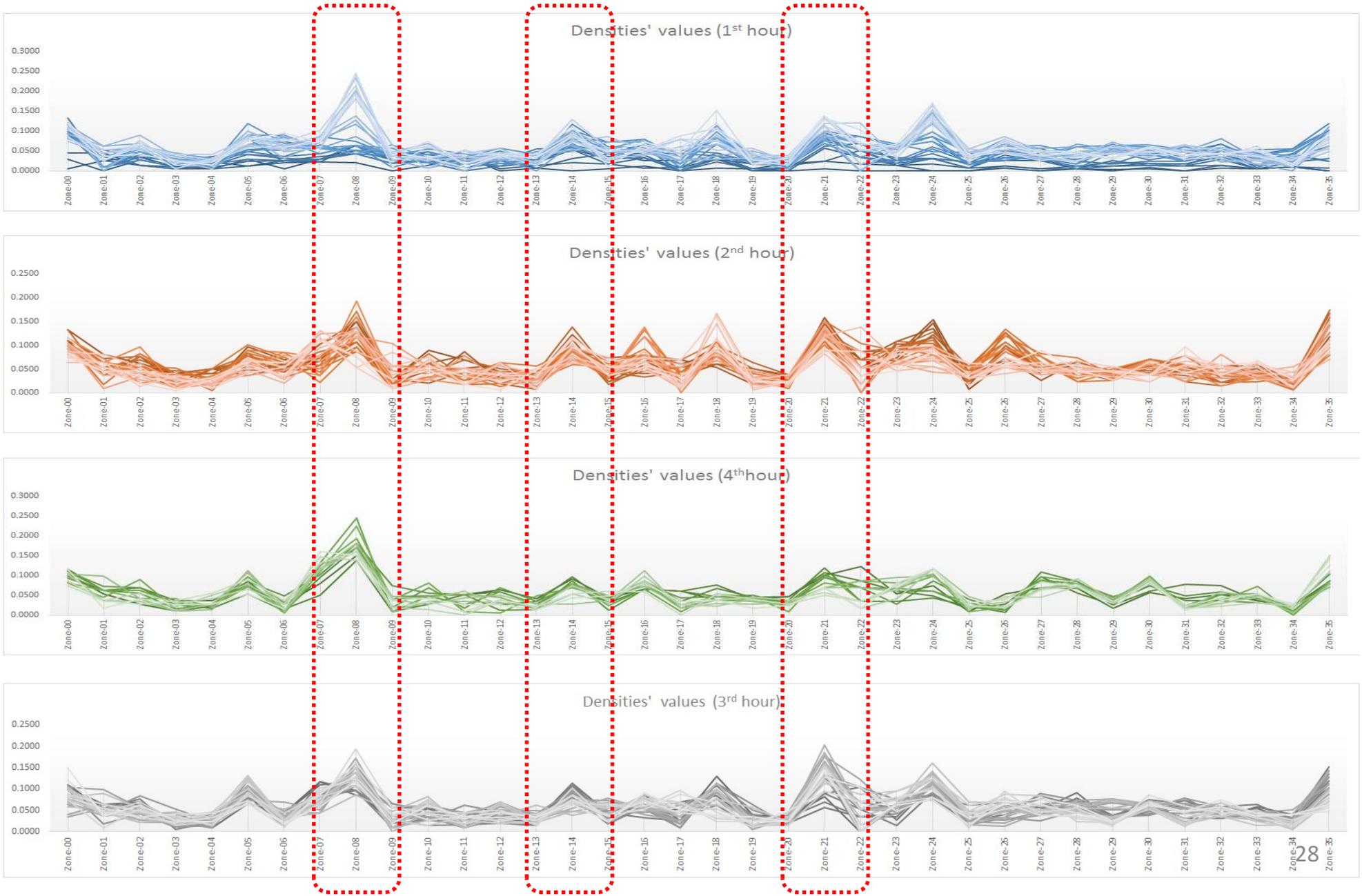**Kill Agent**

Simulation Running
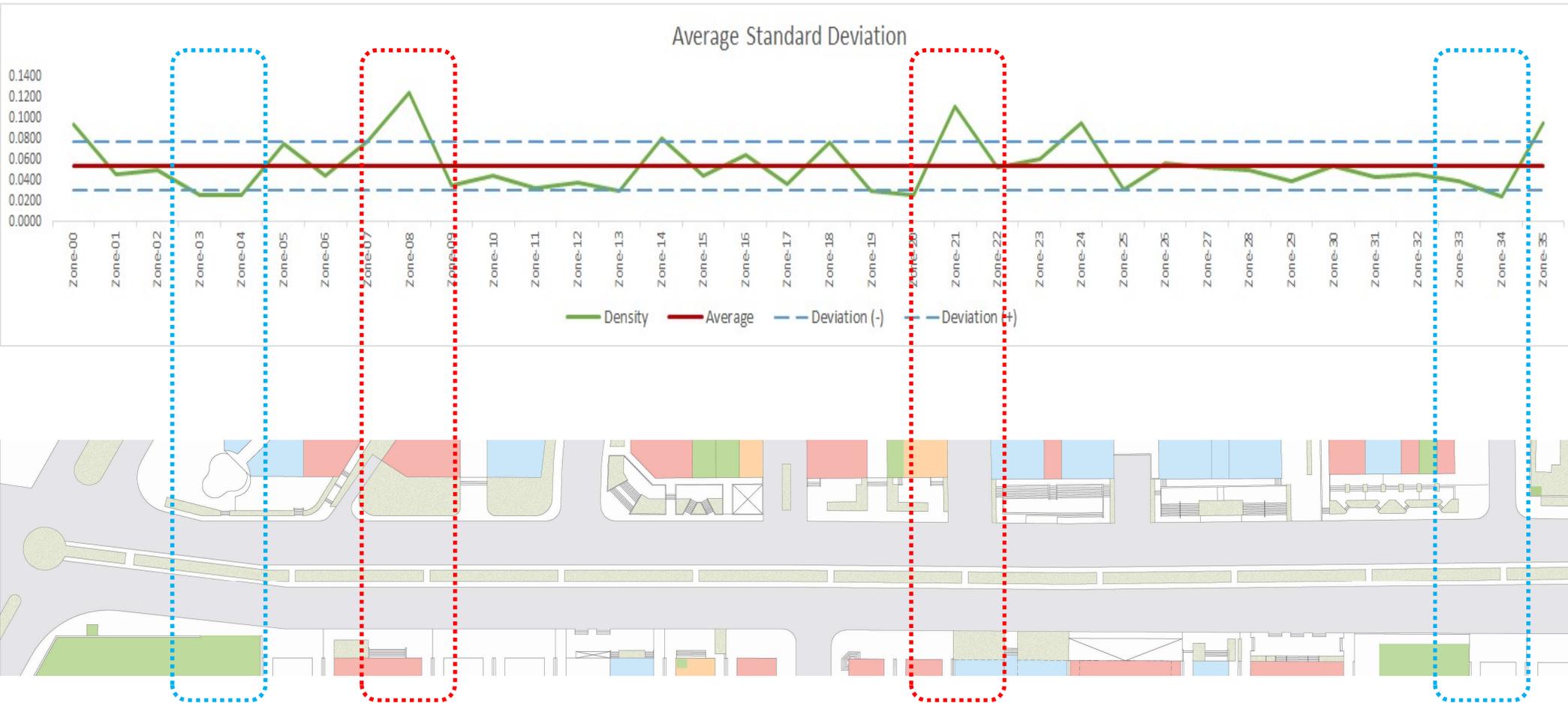
5.9- Densities calculation:

- The street was divided to 36 zones equally, then areas of walking area at each calculated.

- The model has been recoded to:

  - Calculate density at each section which appears every 120 seconds in bar charts.

  - extract all data in a CSV format sheet, read by MS. Excel.

WNPlan

Density

Zones

5- RESULTS:

Densities' values (1st hour)

Densities' values (2nd hour)

Densities' values (4th hour)

Densities' values (3rd hour)

5- RESULTS:

8- FURTHER WORK:

- Conducting a wider survey therefore and expanding the study.

8- FURTHER WORK:

- Considering more types of obstacles.

8- FURTHER WORK:

- Adding more pedestrians' characteristics.

THANK YOU