D4.10 Set-up Report: Tel-Aviv pilot

Tel Aviv pilot’s mobility solution

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Deliverable

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Executive summary

This deliverable describes the three mobility solutions that will be tested in the framework of SPROUT project in the city of Tel Aviv. These three mobility solutions reflect the municipality's approach to an in-depth, comprehensive, and multidisciplinary planning process emphasized in its latest strategic plan.

The massive, on-going changes in the transport system in Tel Aviv include the construction of a new mass transit system, the prioritization of non-motorized traffic modes, and the promotion of shared mobility. All of those align with the municipality's strategic plan and policy, aiming to create a better quality of life for the city's' inhabitants.

Testing and assessing the mobility solutions will allow the integration of new data-driven methodologies in the decision-making process; will enrich the public engagement processes, leading to better design of the public sphere, a better understanding of the needs of different subgroups of the population, and enable the accommodation of the public sphere to vulnerable road users.

These tools will assess the municipality to tackle key urban challenges. Setting forth the vision for sustainable mobility, the policy assessments, and suggested modifications expected to be derived from the pilot will help tackle the obstacles associated with novel digital mobility solutions.

1 Introduction

1.1 Aim of the deliverable

This deliverable aims to be used as a reference document to guide and monitor the development of the pilot in WP4. It prepares the implementation of the SPROUT pilot in Tel Aviv giving detailed information in terms of (1) the three mobility solutions that will be implemented and tested; (2) the locations and context where they will be introduced; (3) the specific actions required for the implementation and the role of the crucial stakeholders involved; (4) and a tailored evaluation framework to assess the pilot, derived from D4.1; (5) timeline for the implementation and evaluation.

1.2 How this deliverable relates to other deliverables

D2.2 provides the baseline of the current mobility situation in each of the project cities, and D3.2 and D3.3, the definition of the expected impacts of the emerging mobility solutions without policy intervention. D4.1 provides the pilots with a generic evaluation framework to be adapted and tailored for each specific pilot. Deliverable D4.10 will be the basis for deploying the activities under T4.3, T4.4, and T4.5 that will result in the impact assessment and city-specific policy response deliverable (D4.11) and the policy implementation messages from cross-pilot results (D4.14).

1.3 Task Participants and sharing of contribution

The participants for this deliverable are the pilot leader Tel Aviv (TLV) municipality, the Technion and ZLC as T4.2 and WP4 leader. ZLC support the pilot during the whole process for developing the deliverable and CERTH reviewed it.

1.4 Structure of Deliverable

The section that follows (Section 2) first describes the general concept of the pilot mobility solutions that will be tested and assessed in TLV. Section 3 gives detailed descriptions and information about the solutions and locations where the use cases will be tested. Section 4 contains a detailed action plan and an initial description of the pilot assessment activities and indicators. Afterward, section 5 presents the legal and ethical issues that may appear, and how they will be addressed, the risk mitigation plan, and the communication strategy. Finally, section 6 includes a summary and conclusions of the report.

2 Tel Aviv pilot's detailed description

2.1 Mobility solution description

The city of Tel Aviv (TLV) undergoes tremendous transport changes during the construction of its new light rail transit (LRT) system. The city plans to revolutionize major arteries in order to integrate additional (LRT) lines, besides other traffic and public transport changes throughout the city. Planned infrastructure changes as part of LRT integration open up an opportunity to set new priorities and reallocate the public sphere favouring non-motorized road users. However, a great deal of uncertainty is associated with the new mass transit services' impact on mobility patterns in the long term and the impact of the continual construction works that cause traffic disruptions, closure of major arteries, and reduced capacity.

The pilot will adopt a comprehensive approach tackling three different aspects as following

Use case 1 – Strategic level: Data-driven analysis and visualization of current travel behavior mobility patterns using Bluetooth detectors data.

This use case will utilize new information sources and state-of-the-art methodologies of trajectory data mining for identifying and predicting mobility patterns and needs. Tools and methodology to visualize complex data analysis results to support decision-making processes will be developed to allow data-driven decision making to be more approachable.

Use case 2 – Tactic Level: Re-allocating the public sphere - balance between capacity and liveability.

This use case will address the revolutionizing of major arteries due to the new mass transport system while considering all road users' needs. The trade-off between capacity, liveability, and safety will be addressed. The implementation will focus on the separation means between pedestrians and cyclists.

Use case 3 – Operational Level: Identifying and prioritizing vulnerable road users at signalized intersections.

This use case will develop a methodology to identify vulnerable road users at signalized crosswalks and planning traffic management strategies supporting priorities among transport modes favouring vulnerable road users.

2.2 Use cases description

2.2.1 Use case 1: Data-driven analysis and visualization of current travel behavior mobility patterns using Bluetooth detectors data - Mobility solution description

Transportation and traffic planners relay to a great extent on traditional data collection methodologies, i.e., household travel surveys and traffic counting. Utilizing data obtained from Bluetooth (BT) detectors to understand actual travel patterns derived from the analysis of individual movements, brings useful insights, and enriches the decision-making process by providing information that is not currently available to traffic planners and authorities.

Alongside the opportunities, BT data collection embodies challenges to be addressed. Starting from the challenge of collecting and processing data in a way that preserve individuals' privacy to the difficulty to ensure data quality, and the lack of validated quantitative methodologies to evaluate the outcomes.

This use case will analyse road user's mobility patterns based on Bluetooth (BT) data trajectories clustering. The outcomes will assess the expected impact of the planned infrastructure changes (e.g., temporary road closures, lane reduction). Data will be available to policymakers and traffic planners to offer better temporal arrangements and re-organize public transport accordingly. Insights gained by advanced data analysis are expected to provide the grounds for evaluating the data-driven urban mobility planning setting.

Recent advances in traffic identification systems, positioning, and tracking technologies allow automatic collection and storage of large-scale mobility data quantities from various data sources. One of the most valuable road mobility data is trajectories, i.e., recorded movement of people or vehicles as a sequence of sampled data that include moving object's ID, location, timestamp, and in some cases, additional relevant information (Zheng 2015; Toch et al. 2019). The process of analysing this type of mobility data, i.e., trajectory mining, has the advantage of capturing various mobility patterns of travellers at different scales and resolution, which in turn has a direct impact not only on the understanding of existing traffic network dynamics, but also modelling and predicting travellers' response to transport policy, infrastructure changes and traffic management measures (Toch et al. 2019).

Traditionally used by transport authorities for traffic monitoring. Roadside point-to-point sensors are installed at a fixed location in a road network and collect unique identifiers- unique BT MAC[1] addresses, which allows reconstruction of travellers' movements by matching the unique identifier in space and time, capturing individuals' trip patterns.

[1] MAC: a unique identifier assigned to a network interface controller for use as a network address in communications within a network segment

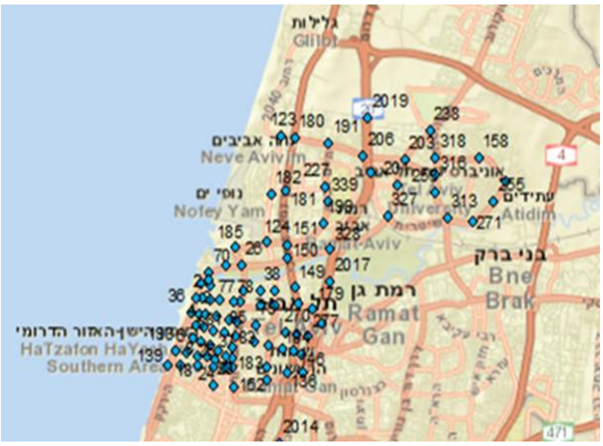

Figure 1. Bluetooth detectors in Tel Aviv

The pilot will utilize a network of Bluetooth (BT) detectors data deployed in the city of TLV (Figure 1).

The core in measuring mobility patterns is spatial variability and relies mostly on the process known as trajectory clustering, resulting in clusters of trajectories similar to each other but different from trajectories in another cluster (Mazimpaka et al. 2016). Trajectory clustering enables to find various aspects of human trips patterns, e.g., estimation of Origin-Destination, route choice distributions, deriving different subgroups of travellers and how those travellers are similar to each other with respect to their spatial behaviour.

The spatial coverage of Tel Aviv network by BT units enables us to evaluate the feasibility of using BT's re-identification ability to recognize current road travellers trajectory patterns, reflecting road users mobility patterns and travel demand distribution, and thus available road capacity, across the network. This information may serve as an input to estimate future mobility patterns changes as a response to infrastructure changes imposed by the LRT project. The overall framework of road users travel patterns identification and network capacity estimation relies on trajectories clustering. Management of raw BT records and trajectories database construction is performed with SQL Server. Based on the literature review, in order to fully utilize the sequential nature of BT records, extracting traveller's trajectory patterns will be based on applying Pairwise Sequence Alignment on trajectories database as a similarity measure and using the results as an input for Multiple Sequence Alignment with ClustalTXY software[2].

In addition to major traffic patterns changes estimation, BT's unique MAC recording ability allows exploring the possibility of trajectory pattern analysis of focused subgroups of travellers, e.g., frequent travellers or commuters expected to be most affected by infrastructure changes. The current state of travellers mobility needs and estimated future changes in their mobility patterns are vital elements in optimizing transport policymakers' decisions in public transport sphere re-allocation and supporting planning traffic management strategies as a basis for minimizing expected traffic disruption.

Using state of the art visualization techniques, data will be presented and evaluated by policymakers and transport experts.

[2] Wilson, Clarke. "Activity patterns in space and time: calculating representative Hagerstrand trajectories." Transportation 35.4 (2008): 485-499

Location

BT detectors in Tel Aviv are installed on the main off-ramps to the city from highways and suburban roads and cover more than 90 intersections within urban areas in Tel Aviv (Figure 1). The Traffic Management and Control centre stuff continuously uses the BT detectors for network traffic monitoring. The timestamps of vehicles' paired detections across links between two BT equipped intersection are aggregated every 2 minutes and processed by an algorithm implemented in AVIVIM – the Traffic Management System (TMS) of the municipality of Tel Aviv-Yafo, providing links' average travel time, delays, Level Of Service (LOS) etc.

This use case chosen location is Arlozorov artery in which significant infrastructure changes are expected as part of LRT construction (Figure 2), such as full road closure and private vehicles lanes reduction.

This artery is one of the main roads in Tel Aviv connecting Ayalon Highway and the city centre and lies near one of the major trips attraction zones in Tel Aviv. The zone contains Sourasky Medical Centre complex serving Tel Aviv and its metropolitan area and the third-largest hospital complex in the country; a complex of several courts, including Tel Aviv district court; the zone also includes numerous office buildings, commercial activity, and entertainment venues.

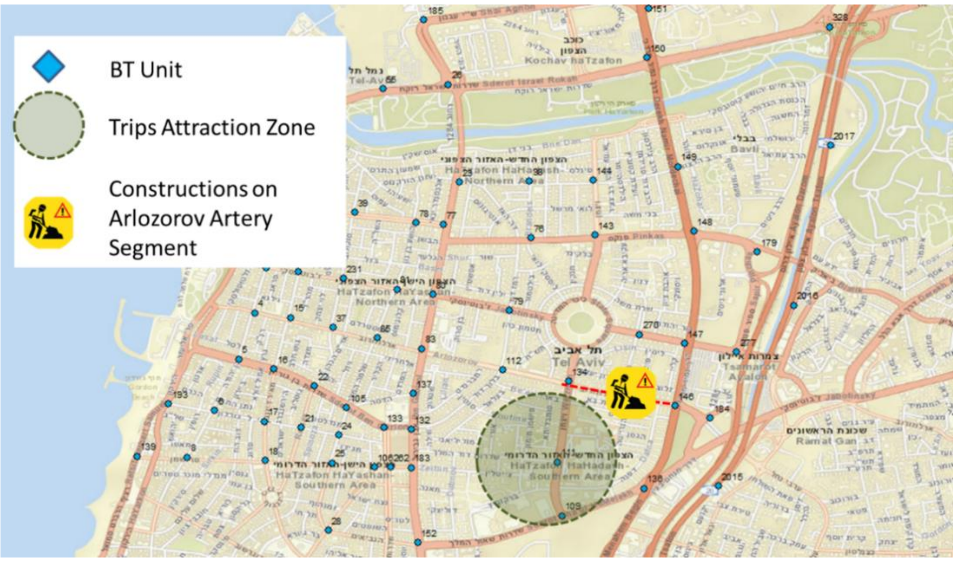

Figure 2. Infrastructure changes on Arlozorov artery as part of LRT construction.

2.2.2 Use case 2: Re-allocating the public sphere - balance between liveability and capacity - Mobility solution description

Distribution of roadway right of way among road users and transport modes dictates the character of the city to a large extent. It has a significant effect on transportation patterns. The ongoing changes in TLV streets due to the construction of the LRT system provide an opportunity to major changes in the streets design making the city more liveable and safer.

Proposed changes in road space distribution frequently stimulate public debates, especially shifting a road space devoted to private vehicles to other modes. Different stakeholders hold various perceptions of how the public sphere should be allocated. Shifting road space to pedestrians and cyclists decreases the capacity while, in many aspects, increasing the liveability. Safety concerns are of great importance as well, particularly means of separation between road users. Using strict separation means may increase safety; however, in some cases negatively affect liveability and capacity.

This use case focus on balancing three measures: capacity, liveability, and safety. Providing decision makers with a methodology that encompasses the engagement of multiple stakeholders (road users' and experts from different domains). The methodology incorporates:

- Road users preferences and perceptions (how they perceive positive walking/cycling experience)
- knowledge and experience of transport professionals (professional experts)
- needs and constraints set by the municipality (regulation, policy)

The use case will be applied at a specific location in TLV to demonstrate its use. The application will focus on the physical attributes of the sidewalk and cycling lanes. Particularly the types and attributes of separation means between pedestrians and cyclists used to eliminate the conflicts between them. Different types of separation means will be explored, such as physical, psychological, visual, and legal means.

To address the conflict between road users' needs the design tool House of Quality (HoQ) (Figure 3) – will be used. HoQ is a decision-making structured technique used for planning and design, based on the understanding that products should be designed to reflect customers' desires. The outcomes will not only reflect the synergies and conflicts between pedestrians and cyclists but also different sub-groups among pedestrians or cyclists, for example, vulnerable pedestrians that might have different needs and perspectives.

			Design Attribute	Design Attribute 1	Design Attribute 2	Design Attribute 3	Design Attribute 4	Overall weight
			Design Value 1	Value 1	Value 1	Value 1	Value 1	
			Design Value 2	Value 2	Value 2	Value 2	Value 2	
			Design Value 3	Value 3	Value 3	Value 3	Value 3	
		Needs	Relative importance of Customers Needs					
Customer Needs	Pedestrians	P. Need 1	X%					
		P. Need 2	X%					
		P. Need 3	X%					
		P. Need 4	X%					
	Cyclists	C. Need 1	X%					
		C. Need 2	X%					
		C. Need 3	X%					
		C. Need 4	X%					
		Technical importance						
		Relative technical importance						
		Option1 - Livability						Value 1
		Oprion2 - Capacity						Value 2

Relationship Matrix (between customer needs and design attributes)	
Strong Positive	5
Moderate Positive	3
Weak Positive	1
Neutral	0
Weak Negative	-1
Moderate Negative	-3
Strong Negative	-5

Figure 3. House of Quality.

The methodology will be further developed to provide a tool for decision-makers to consider in other sites and types of conflicts.

Location

This use case will be demonstrated in Ben Yehuda St. in which the average right of way of 25 meters. The street is characterized by mixed uses, commercial activities, residency, and leisure. The future road section will include two LRT tracks on the east side, a car lane, and a bike lane. Detailed planning of the road section is not finalized yet.

Figure 4: Current typical cross-section Ben Yehuda St.

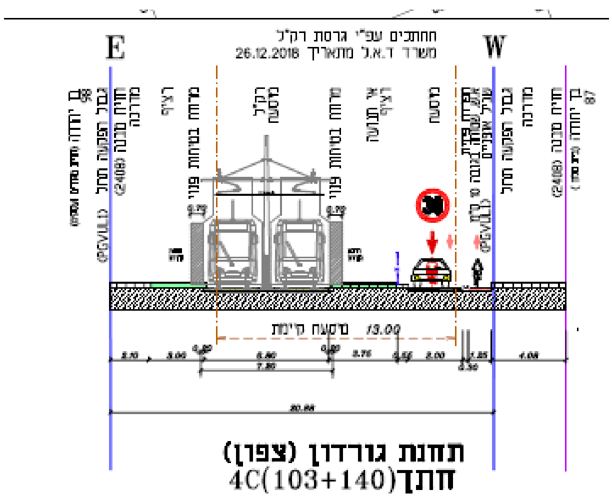

Figure 5: Initial cross-sectional design Ben Yehuda St.

2.2.3 Use case 3: Identifying and prioritizing vulnerable road users at signalized intersections - Mobility solution description

This use case focuses on developing, validating, and evaluating a method to effectively identify vulnerable pedestrians and use this information to increase their safety at signalized intersection crossings.

The current traffic control design guidelines dictate that the safe pedestrian crossing time is calculated based on the width of the crossing and a relatively fast crossing speed (1.2 m/s in Israel). Vulnerable pedestrians might encounter increased chances that crossing period duration will be insufficient, which might lead to a potentially unsafe situation. The use of novel technology tools and algorithms might increase the crossing safety for vulnerable pedestrians.

Vulnerable pedestrians will be identified by recognizing the aids they use. This include wheelchairs (people with reduced mobility), walking aids, and strollers (baby strollers or shopping strollers used by elderly people).

Novel computer vision and image processing techniques enable training algorithms to recognize objects (deep learning/machine learning). The algorithm must be trained so it can recognize a specific object with maximum accuracy. Several common object detection systems are available to train the detection algorithm to identify the object, such as such as You Only Look Once (YOLO) - a state-of-the-art, real-time object detection system. One of the available real-time object detection systems will be used, customized, and trained to identify aids used by vulnerable pedestrians.

The model will be trained. An experiment will be held using the trained model. Due to restriction and uncertainty associated with COVID-19, it will not be feasible to demonstrate this use case as a field experiment. Alternatively, testing, validating, and evaluating the algorithm will be held in a simulation environment.

Location

The use case will be examined in an intersection in a busy pedestrian area at Alenby St. / King George St. in Tel Aviv Centre. The crosswalk in this area is wide. Activities in the area attract pedestrians of different types, such as elderly people using walking aids, shopping strollers, baby strollers, and wheelchairs. The area surrounding the crosswalk includes commercial activity, services, cultural and recreation activities, restaurants, and an active nightlife.

Figure 6. Use case 3: An aerial view of Alenby St. /King George St. intersection

3 Stakeholders identification and involvement

Table 1 contains the pilot partners' contribution and likewise inputs coming from other stakeholders that will participate in the pilot activities too (see annexe 1 for further details).

Table 1.Tel Aviv pilot stakeholders contribution.

Experts working for Tel Aviv Municipality

- Use case 2 validation
- Participate in interviews to determine the design attributes
- Participate in surveys and workshops

BT detectors providers

- Provide raw rata during the implementation phase in use case 1

Cyclists' associations

- Contacted and invited to send representatives to participate in the focus groups
- Distribute the online survey among their members (use case 2).

Vulnerable users (older people, reduced mobility, women and caregivers)

- Participate in the focus groups and online surveys

4 Implementation and evaluation plan

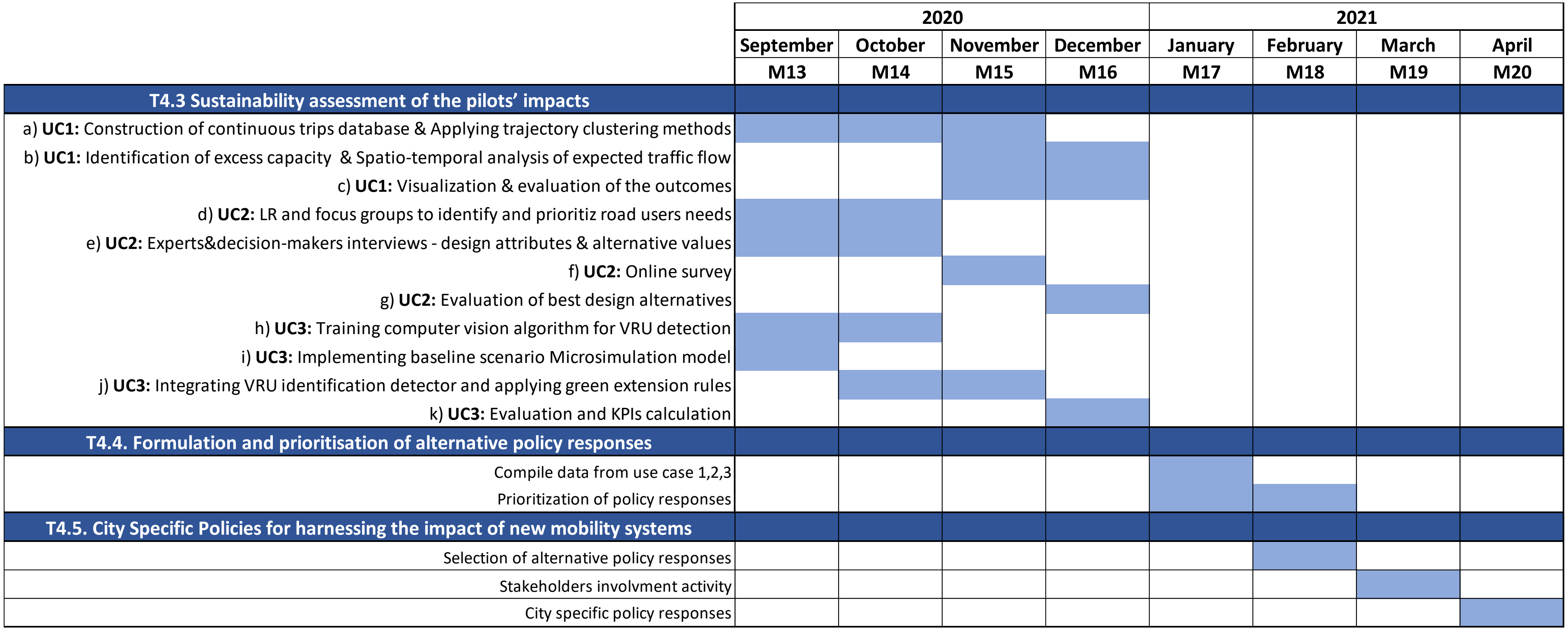

Figure 7. TLV pilot activities timeline.

4.1 T4.3 Sustainability assessment of the pilots' impacts

4.1.1 Use case 1: Data-driven analysis and visualization of current travel behavior mobility patterns using Bluetooth detectors data - Description of activities

Raw BT records from a representative two-month period were collected prior to major LRT construction works. Transforming the raw data collected into travel behaviour patterns requires various data analysis techniques and involvement of traffic experts knowledge. The hierarchical structure of the clustering results will enable high-resolution analysis of the clustered trips and testing different cut-off points as a basis to deriving the final clusters. Afterward the trajectory clustering results will serve as an input to evaluating current travel patterns and estimation the impact of future changes in travel patterns, as described below:

- Preliminary data cleansing
- Construction of continuous trips database from raw BT records within a defined grid in TLV. Parameters for differentiating whether two consecutive records of given encrypted user ID are linked to one continuous trip will be derived from representing travel times during peak/off-peak hours and historical database of travel times measured by BT sensors.
- Applying trajectory clustering methods on continuous trips database as a basis for identification of trips clusters and volumes per cluster
- Identification of excess capacity on alternative routes
- Spatio-temporal analysis of expected traffic flow: results from steps 2 and 3 in conjunction with expected capacity reduction imposed by infrastructure changes in the chosen scenario will serve as an input to estimate future traffic volumes re-distribution across the network.
- Identification of potential hot spots/bottlenecks: results from step 3 will be evaluated as a source for potential traffic disruption spots.
- Developing adequate visualization techniques to illustrate and present the obtained mobility patterns.
- Conducting domain experts and policy makers experiment that will examine (1) clarity of the visualized outcomes, (2) ability to extract significant patterns (3) reliability of the obtained insights.

4.1.2 Use case 1: Assessment preparation

The results forecasting future patterns and changes of travel behaviour due to infrastructure changes cannot be evaluated within the timeframe of SPROUT project. The assessment of this use case will focus on the operational feasibility:

- Ongoing evaluation during the data analysis process: integrating traffic experts' knowledge.
- Policy makers visualization experiment: Adequate visualization techniques to illustrate the obtained mobility patterns will be used to assess the obtained results' useability. An experiment will be conducted among planners and policymakers to shed light on whether experts and policymakers can utilize this data for insightful decision-making, besides qualitative evaluation of the obtained results.

4.1.2.1 Use case 1: Research questions

This use case will address the following research questions:

1. How to use the insights gained during the pilot to identify where policy-related and regulatory barriers would enhance the usability of new sources of data?
2. What components should be used to make data clearly accessible to planners and decisionmakers?
3. To what extent the methodology demonstrated can contribute to reduce traffic congestion during transition periods and major construction works?
4. What are the potential environmental impacts of new traffic arrangements derived from the outcomes?

4.1.2.2 Use case 1: Performance indicators, data collection and assessment methods.

This use case will use the ISO/ IEC 25010 quality measures. The indicators that will be considered (contingent on the availability of data) presented in Table 2.

The data that will be used to calculate the indicators will be collected on an ongoing basis during the data analysis process, and the evaluation process that will be part of the visualization experiment.

Indicator	Description and data collection method
Operational feasibility	
Functional suitability	The overall evaluation of the outcomes and to which extent they serve the purpose they were destined to. Traffic experts' qualitative evaluation
Usability	Potential consumers of the outcomes i.e., policymakers and planners will evaluate the clarity of the data presented and its contribution to insightful decision-making
Portability	How easily the methodology can be applied in different location / different parameters
Environmental & Social KPIs	
Traffic congestion	External costs produced by delay costs and deadweight loss costs

Table 2: Use case 1 - List of potential KPIs

4.1.3 Use case 2: Re-allocating the public sphere - balance between liveability and capacity – Description of activities

This use case will demonstrate a decision-making process regarding the division of the allocated public sphere between pedestrians and cyclists to better engage relevant stakeholders using a structured methodology. This use case will be composed of 4 phases as illustrated in Figure 8.

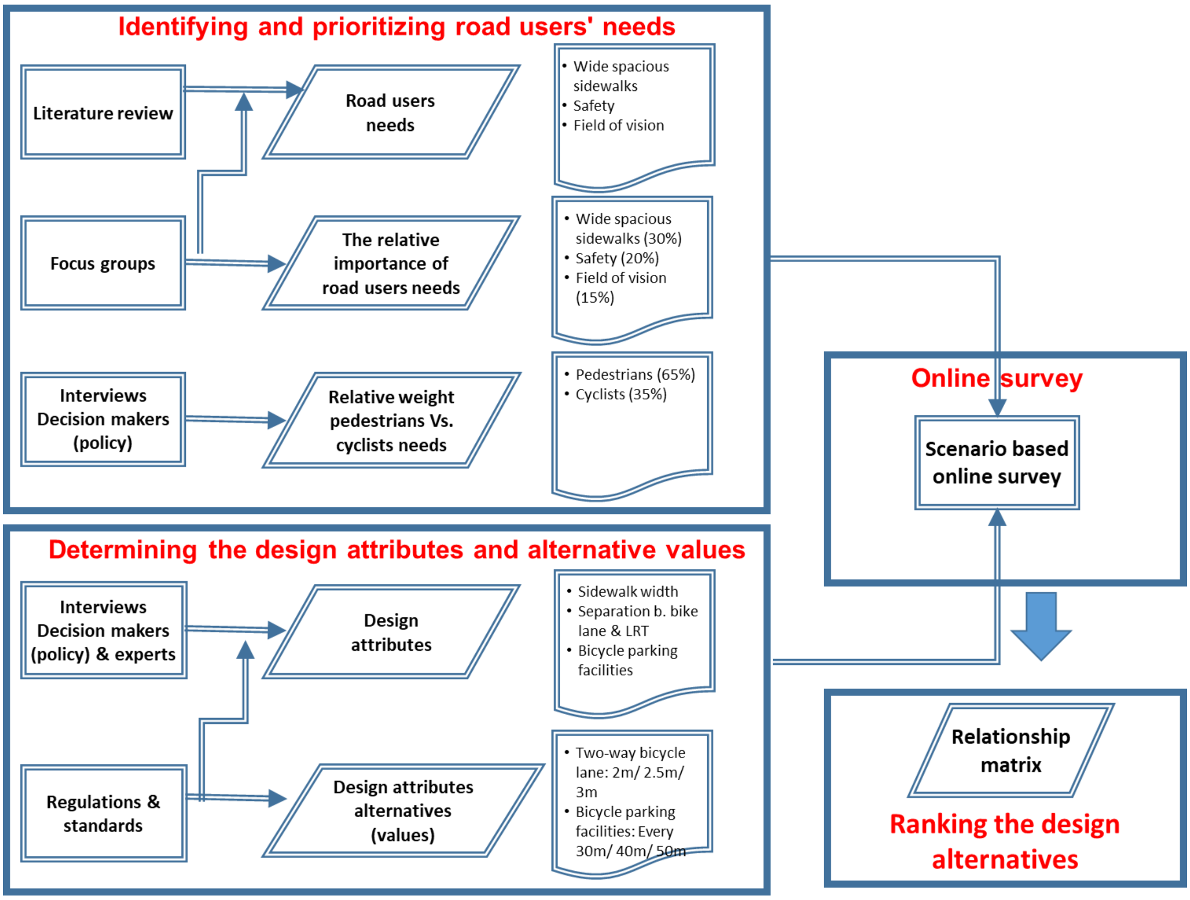

Figure 8. Re-allocating the public sphere - phases.

- Identifying and prioritizing road users' needs

1. An initial set of measures representing pedestrians and cyclists' needs will be identified by reviewing existing literature and interviewing experts.
2. A focus group, engaging pedestrians and cyclists will be conducted. During which, the list of road users' needs will be reviewed and fine-tuned, and participants will be asked to prioritize the different measures (prioritizing methodology will be determined later).
3. Policymakers will be asked to determine the relative weight of pedestrians Vs. Cyclists needs.

This phases' outcome will be an agreed set of road users' needs for both pedestrians and cyclists, the relative importance of each need, and the relative weight of the pedestrians and cyclists' needs.

- Determining the technical/ design requirements (attributes) and alternative values

Experts interviews will be conducted to determine the relevant technical requirements and the alternative values that will be used. The full list of requirements will be reviewed to determine the attributes included in the survey. This phase's outcome will be a list of technical requirements and their values to be included in the survey

- Formulation of the design alternatives scenarios, designing and conducting on-line survey

Combinations of the alternative design attributes and values will be formulated and visualized (example in Figure 9) as a basis for the on-line survey. An online survey will be conducted. The survey will present a couple of scenarios that represent different design alternatives and form the basis for calculating the relationship matrix between the road users' needs and design requirements.

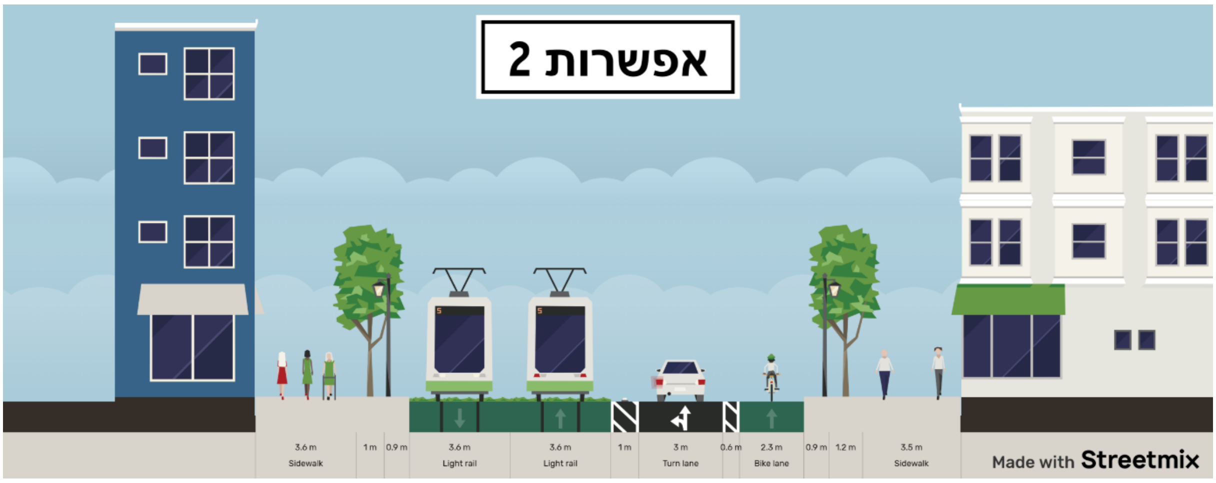

Figure 9 example of the visualization scenario to be introduced in the online survey

- Calculation of the relationship matrix and the overall weight of the design alternative

The overall weight of each design alternative will be calculated, and the alternative best matching the needs of the road user's will be identified.

4.1.4 Use case 2: Assessment preparation

This use case utilizes a platform of public engagement events conducted regularly by the municipality of TLV. Nonetheless, these events will be further enhanced using the structured methodology mentioned above. Throughout the focus groups and the online survey, subjective and objective measures will be discussed and prioritized. both platforms will be used to collect data to assess the outputs focusing on these aspects:

- Residents/ road users: The online survey and the focus groups will provide feedback from stakeholders. Both will be designed to assess participants' attitudes regarding the re-allocation of the public sphere and to evaluate proposed changes.

- Experts: Experts from different domains will participate in setting the design attributes, their values, and combinations of values that will be assessed in the online survey. They will also evaluate the chosen designs from their perspective.
- Methodology evaluation: the overall methodology will be evaluated. Examining the resources needed to execute the process vs. the benefits. Measuring the potential of the methodology to be used to solve other conflicts and trade-offs.

4.1.4.1 Use case 2: Research questions

This use case will address the following research questions:

1. How can public engagement be better integrated into decision-making processes regarding the reallocation of the public sphere?
2. What are the guidelines to follow when allocating the public sphere?
3. What are the environmental impacts of the new design alternatives prioritizing non-motorized modes?
4. How to assess the social impact of new design of the public sphere

4.1.4.2 Use case 2: Performance indicators, data collection and assessment methods.

This use case will utilize the ISO/ IEC 25010 quality measures. The indicators that will be considered (contingent on the availability of data) presented in Table 3.

The data that will be used to calculate the indicators will be collected on an ongoing basis during the implementation, and final evaluation among officials and experts that will be held after the results are analysed.

Indicator	Description
Functional suitability	The overall evaluation of the outcomes and to which extent they serve the purpose they are destined to
Usability	estimation of the usability of the methodology considering the resources needed vs. outcomes.
Portability	The portability of the methodology to be applied in different locations, type of conflicts, or populations with minimal adjustments
Satisfaction	Overall satisfaction based on evaluation to be conducted among municipality officials and experts that will be involved.

Table 3: Use case 2 - List of potential KPIs

4.1.5 Use case 3: Identifying and prioritizing vulnerable road users at signalized intersections - Description of activities

Using deep learning techniques an algorithm identifying vulnerable road users at signalized intersections will be developed. Using state of the art simulation model an experiment testing the model will be conducted.

The identification process outcomes will be stored in Vulnerable Road Users (VRU) database so that the computer vision algorithm will serve as a pedestrian presence detector. The four phases of this use case are illustrated in Figure 11. The simulation model will apply green extension role based on the identification.

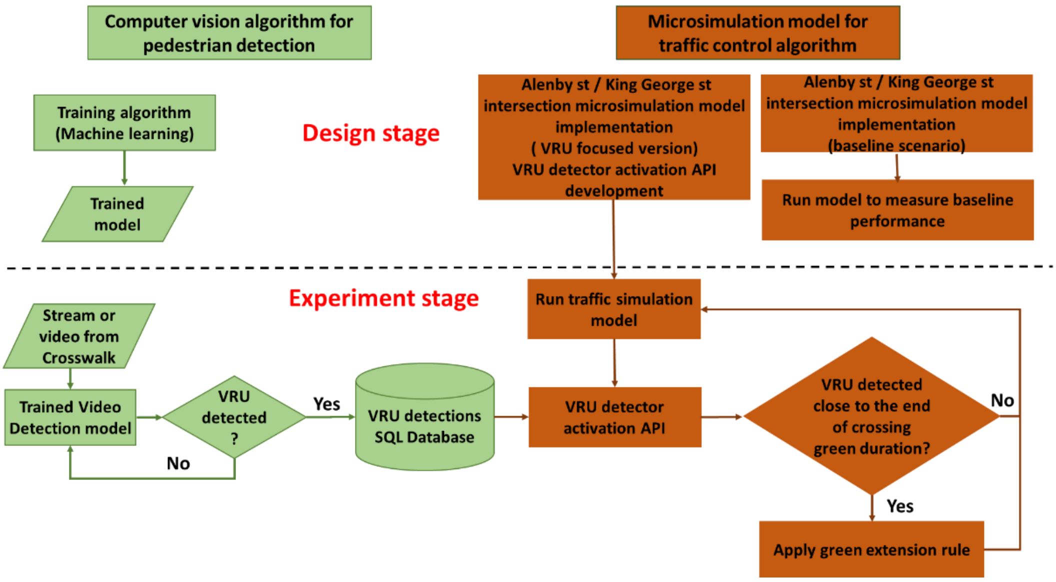

Figure 10.Vulnerable road users' identification and prioritizing phases

- Development of computer vision algorithm for vulnerable pedestrians' identification

The first step towards pedestrian friendly traffic control is the development of the ability to identify the pedestrians at risk.

For this purpose, a machine learning method will be used to train the computer vision algorithm to identify the pedestrians using the following items: wheelchair, baby stroller, and a market cart typically used by elderly people. This type of pedestrians is expected to have a lower walking speed and, therefore, be more vulnerable during the crossing. The model's training is carried out by manual tagging of the objects in the video feed obtained from Tel Aviv Municipal Mobility Management Centre traffic cameras.

Once the model is trained, it will be validated and evaluated using the separate video feed from the traffic cameras. The following measures of performance will be calculated:

1. Correct/True Identification Rate – the percentage of correct vulnerable pedestrians' identifications by the algorithm divided by the total number of their appearances.

2. False Alarm Rate – percentage of False Positive identifications by the algorithm divided by the total number of vulnerable users' appearances.

In a case of insufficient performance, the model will be retrained and recalibrated.

- Development and calibration of the intersection microsimulation model

As a test site application is not feasible in the given timeframe due to COVID-19 and other restrictions, the use of microsimulation tools for the methodology evaluation is a common practice. The simulation model of the intersection will be implemented in VISSIM[3] state of the art microsimulation tool. For the baseline scenario, the intersection's current state model will be built using traffic counts of vehicular and pedestrian flows and the traffic control logic design files obtained from Tel Aviv Municipal Mobility Management Centre.

At the next step, the traffic control logic will be modified to increase the safety of vulnerable pedestrians' crossings. This can be achieved by implementing a green extension rule – if the computer vision algorithm identifies a vulnerable pedestrian close to the end of crossing green duration, it will be extended by few seconds to ensure the safe passage. The green extension for the pedestrians comes at the cost of reduced green duration for the vehicular traffic, and the impact of the reduced capacity will be evaluated.

- Integration between computer vision algorithm and microsimulation model

The computer vision algorithm serves as a pedestrian presence detector. Once it identifies the presence of a vulnerable pedestrian in the designated area (Figure 11) moving towards the centre of the crossing, this information is relayed to the microsimulation model logic. For this purpose, a dedicated interface will be developed using VISSIM API – VISCOM.

Figure 11.Vulnerable pedestrians detection areas.

[3] VISSIM: https://www.ptvgroup.com/en/solutions/products/ptv-vissim/

- Evaluation of the integrated model

The proposed pedestrian biased traffic control will be evaluated with a series of simulation runs. For each run, the basic traffic performance measures such as delay for all the road users and actual green duration will be calculated. An additional measure of performance will be a percentage of signal cycles when the crossing's green duration was extended due to a vulnerable pedestrians' presence. These measures will estimate how frequent the cases are when intervention is required to provide a safer passage for vulnerable pedestrians and the possible negative effects on the other road users.

4.1.6 Use case 3: Assessment preparation

The performance of the algorithm developed within this use case will be evaluated in different phases of the development and implementation:

- Training phase – the algorithm performance will be measured using two indicators: true identifying and false alarm rates. The model will be repeatedly evaluated and trained until a certain accuracy is achieved.
- Experiment phase – the integrated model will be evaluated using simulation runs calculating traffic performance measures (1) delay for all the road users (2) actual green duration (3) percentage of signal cycles when the crossing's green duration was extended due to a vulnerable pedestrians' presence.
- Performance measures such as response time and reliability

It will not be feasible to measure the algorithm's social impact since it will be tested in a simulation environment and not in a real-life setting.

4.1.6.1 Use case 3: Research questions

This use case will address the following research questions:

1. To what extent prioritizing vulnerable road users at signalized intersections can influence other road users (reduce level of service/more delays)?
2. To what extent this mobility solution contributes to the social equality of vulnerable road users?
3. How to use this information to identify where policy-related and regulatory barriers should be modified to integrate algorithms prioritizing vulnerable road users?

4.1.6.2 Use case 3: Performance indicators, data collection and assessment methods.

This use case will utilize the ISO/ IEC 25010 quality measures. The indicators that will be considered (contingent on the availability of data) presented in Table 3.

The data that will be used to calculate the indicators will be collected on an ongoing basis during the experiment in a simulation environment.

Indicator	Description
Functional suitability	To what extent the algorithm identifies and prioritizes vulnerable road users according to the specification defined.
Performance efficiency	Resources performance
Reliability	Degree to which identifying algorithm responds as expected during a period time and specific conditions
Security	Degree to which the algorithm protects data
Portability	Degree to which the algorithm is transferable to other location, conditions, and to identifying other types of pedestrians' aids
Satisfaction	Since the implementation is in simulation environment two approaches will be considered: • perspective of traffic engineers/experts • stated preferences survey of road users

Table 4: Use case 3 - List of potential KPIs

4.2 T4.4. Formulation and prioritisation of alternative policy responses

4.2.1 Use case 1, 2 & 3: Description of the activities

The outcomes received from the implementation and assessment of the three use cases in TLV integrated with the results of T3.3 will provide the inputs needed to the formulation of a list of alternative policy responses.

Using the MAMCA methodology, the policy responses will be prioritized. The outcomes will enable to assess the updates that can be adapted in the policy elements/instruments (TLV strategic plan).

The policies will address the main challenges expected during the implementation of the use cases.

- Policy to tackle the challenges associated with the integration of new sources of data planning processes. Issues that might be discussed: Lack of standardized formats, privacy, data security, and data quality.
- Priorities regarding the division of public sphere between transport modes and accommodating the needs of vulnerable road users
- Incorporating public engagement processes outcomes in decision making
- Policy to support prioritizing vulnerable road users need in signalized intersection balanced with the traditional traffic management challenges (capacity, prioritize public transport).

4.2.2 Use case 1, 2 & 3: Assessment preparation

4.2.2.1 Research questions

The research question that will be addressed in this task is:

- What measures and policies can the authorities adopt to improve the quality of data obtained from new sources?
- What methods can be used to resolve conflicts between stakeholders when allocating the public sphere to different transport modes?
- What policies can support prioritizing vulnerable road users in signalized intersections with minimal impact on the level of service to other road users

4.2.2.2 Performance indicators, data collection and assessment methods

Performance indicators will be determined in later stages.

4.3 T4.5. City Specific Policies for harnessing the impact of new mobility systems

4.3.1 Use case 1, 2 & 3: Description and objectives

This task aims to assess the different alternative policy responses identified in T4.4. Stakeholders from relevant domains will participate.

In this task the legal dimension, Operational & Sustainability dimension and user acceptance will be addressed.

Financial and economic dimensions will not be addressed in this Pilot. The mobility solutions demonstrated are not stand-alone solutions. They provide valuable inputs to infrastructure and traffic re-arrangements; however, these will not be designed or implemented in the project's framework. Use case 1, 2 & 3: Assessment preparation

4.3.1.1 Research questions

The potential research questions for this task derived from the outcome of T4.3 and T4.4 are:

- Legal dimension: Can the city of TLV, considering the existing legal framework, implement the specific policy?
- Operational & Sustainability dimension: does the city of TLV has the required resources to support the implementation and continuation of the policy?
- User acceptant: Can the city improve user acceptance?

The research questions will be discussed and finalized following the pilot implementation.

4.3.2 Performance indicators, data collection and assessment methods

Performance indicators will be determined in later stages.

5 Pilots management

5.1 Legal & Ethical issues

The pilot in TLV will follow the EU and the local regulations in Israel in all legal and ethical issues (The stricter rules will be applied).

Data will be collected, processed, and stored according to the General Data Protection Regulation (GDPR) and Israel's local policies to ensure privacy and data security.

No data, specifically identifying individuals, will be disseminated. Travel patterns analysis will be disseminated as an aggregated outcome and not as individuals' data.

All participation in any of the project activities, such as online surveys or focus groups, is voluntary. No rewards will be offered to participants. The project and activity purpose will be explained, and participants will be asked to indicate their agreement.

5.2 Risk identification and mitigation plan

Table 5. Risks, contingency and mitigation actions (including COVID-19).

Task#.#	Risk description	Contingency action	Mitigation Action
Task4.3	Delays (COVID-19)	Try to anticipate all the paperwork	Alternative testing area
T4.3, T4.4, T4.5	Lack of stakeholders engagement	Provide them with incentives to participate	Broadcast a new request to involve new representatives
Task4.3 – use case 2	Difficulty recruiting respondents to the online survey	Using existing internet panel	
Task4.3 – use case 3	Difficulty in identifying objects due to hidings	As long as the performances are unsatisfactory the training process will be extended	Allocating another camera

5.3 Communication strategy and channels

The pilot will follow the communication strategy and channels stated in the D4.1.

6 Conclusions

This document sets the details of Tel Aviv pilot. The implementation plan specifies the activities that will be conducted to test each of the mobility solutions. During the planning phase, all activities were re-evaluated to ensure their validity given the situation (COVID-19), and some were altered.

The involvement of different stakeholders was re-considered. Due to COVID-19, it might be challenging to interact with stakeholders face-to-face; therefore, wherever physical interaction is not possible, an online alternative was prepared.

During the implementation data will be collected to evaluate the impact of the solution. Research questions to be addressed were formulated for each mobility solution and relevant KPI's were chosen. Data to calculate the KPI's and answer the research questions will be gathered during the pilot.

References

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Annexe 1: Stakeholders involvement

Table 6**Error! Reference source not found.** contains the stakeholders will be involved in the pilot and a description of the activities they will implement.

Table 6. Pilots stakeholder's identification and involvement.

Type of stakeholder	Name of specific local stakeholder organisation	Involvement
Public administration		
Governmental bodies responsible for transport planning, public works, infrastructure, environment, public space, on local, regional and metropolitan levels.	Planners and safety experts from TLV municipality or working for the municipality. The specific stakeholders will be identified and contacted in the initial stages of the pilot.	Task 4.3,Task 4.4, Task 4.5 Use case 2: Planners and safety experts will be interviewed to discuss the design attributes and the alternative values. They will participate in the evaluation of the outcomes.
Data/Tech companies		
Providers of smart technology for traffic management (e.g. Intelligent traffic management, smart parking and traffic monitoring service providers such as Kapsch, Siemens etc.)	BT detector provider named - א.ב" חיישנים בע"מ" A.B Sensors Ltd.	T4.3 BT detector provider will contribute in Use case 1 (T4.3), providing raw data and assisting in the processing of the data if needed.
Potential Stakeholders		
Cyclists' and pedestrians' associations	cyclists' associations - Israel Bicycle Association	Task 4.3 Use case 2: cyclists' associations will be invited to participate in the focus groups, and to distribute the online survey among their members.

Potential Users as representatives of vulnerable groups		
Older people a) *Perception of public sphere and liveability* b) *Specific needs as pedestrians*	Day clubs for elderly people	Task 4.3 Participating in the focus groups and online survey
People with reduced mobility	Day club for people with reduced mobility	Task 4.3 Use case 2 & 3: Participating in focus groups and online survey
Women and caregivers a) *Mobility with baby's and strollers* b) *Perception of safe and secure public sphere* c) *Perception of public sphere and liveability*	Contacting potential women and caregivers using municipality and neighborhoods communication channels such as WhatsApp specific groups, Facebook groups	Task 4.3 Use case 2 & 3: Participating in focus groups and online survey