D4.14: Policy implementation messages from cross-pilot results

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Executive summary

The SPROUT project aims to produce new and practice-based knowledge & tools to navigate urban mobility policy through transition and to use this to contribute to evidence-based policymaking. To this end, five pilots have been working on testing different innovative urban mobility business models and identifying the city-led policy response capable of harnessing their positive impacts and turning them more attractive to the users, and feasible and sustainable for society.

The five SPROUT pilots' cities represent a wide variety of geographies and cultures with the same aim: lead the transition towards the new urban mobility and become more environmental, inclusive and liveable cities while sustaining the economic growth and tackling the 21st-century challenges (cities population growth, decarbonization, climate change, migration, pandemics).

The SPROUT pilots' cities deployed nine mobility solutions and defined the city-led policy response to harness the adoption of these innovative implementations. The activities followed and adapted the guidelines as described in the SPROUT Evaluation Framework (EF). It consists of three phases: testing and assessing the results and the experiences for defining different types of interventions or policy measures, prioritizing the list of alternative responses and evaluating the operational feasibility and user acceptance of the policy responses. It helped define the policies transferability messages.

The lack of baseline data and access to financial information and the COVID-19 safety measures and lockdowns created a delay in the implementation, and forced an adaption to the underlying SPROUT EF methodologies and proposed impact assessment. At all events, the experiences and work developed since June 20212 have helped these cities to introduce and test innovative mobility solutions, conduct intense data collection activities for defining the city-led policy responses and produce policy transferability messages to accelerate the transition towards the new urban mobility.

The second layer cities will validate the results during the final phase of the project and help worldwide cities to shape the future mobility for passengers and freight.

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1 Introduction

1.1 Aim of the deliverable

The objective of this deliverable is to present the key elements that explain differences and or commonalities among the pilot implementations in the different cities.

1.2 How this deliverable relates to other deliverables

This deliverable is the final step of the work developed by the SPROUT pilots and the starting point of the SPROUT second-layer cities to validate the results and transferability messages. It summarizes the work developed and reported in the following deliverables:

- (D4.3: Impact assessmenta and city specific policy response. Valencia pilot, 2022)
- (D4.5: Impact assessment and city-specific policy response: Padua pilot, 2022)
- (D4.7: Impact assessmenta and city specific policy response: Kalisz pilot, 2022)
- (D4.9: Impact assessmenta and city specific policy response: Budapest Pilot, 2022)
- (D4.11: Impact assessmenta and city specific policy response: Tel-Aviv pilot, 2022)

D5.1 will use the summary of the pilots, the commonalities and differences found and reported in this document to present the pilot city-specific policies to the validation cities. More specifically, SPROUT will take advantage of the common issues (where they exist, as shown in section 3) among the pilots to gain a deeper understanding of their results and the impact of the characteristics of each urban mobility environment on them. The work will help quote the key policy implementation messages linked to the tested pilot mobility solutions for informing the second layer cities.

1.3 Task participants and sharing of contribution

ZLC, VUB and CERTH, are the main contributors to this deliverable. Pilot leaders, VPF, VIU, ILiM, BKK and Technion, ensured the successful deployment of the WP4 task and delivered the essential sources of information of this final document. POLIS and WI subsequent WP5 and WP6 leaders are the reviewers and gave constructive advice to create a solid report with the pilot implementation messages from cross-pilot results.

1.4 Structure of the deliverable

The deliverable is structured as follows:

- Chapter 2: Pilots summary and categorization
- Chapter 3: Pilots differences and commonalities
- Chapter 4: Cross-pilots policies transferability messages
- Chapter 5: Conclusion
- Annexes

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2 Pilots summary and classification

This section presents the work and results of the SPROUT nine use cases (see Table 1) during the implementation and testing phase, the identification of the veto players[1] and supportive policy measures to facilitate the scalability and transferability of the mobility solutions.

Table 1.SPROUT Pilots, use cases -mobility solutions.

Pilot	Use case	Mobility Solution
P1 Valencia Intermodal urban Passenger/ freight node for collective public & private transport	UC1: Parking for private bicycles into intermodal nodes	Ciclopark (2 metro stations in Valencia, 1 in Alicante)
	UC2: Smart lockers at intermodal nodes (Citypaq[2])	Parcel lockers (2 metro stations in Valencia, 1 in Alicante)
P2 Kalisz IoT-enabled urban logistics	UC1: IoT enabled urban logistics	IoT network and app for drivers' time planning and booking
P3 Budapest Shared passengers' mobility	UC1: Planned traffic regulation changes	Public space reallocation- not cars in favour of active mobility and leisure activities
	UC2: Creation of Micromobility points	Space reserved for parking
P4 Padua Self-driving pods for cargo-hitching	UC1: Self-driving pods	Lane with self-driving pods for passengers and freight
P5 Tel Aviv Data-driven urban mobility planning and traffic management strategies to	UC1: Data-driven analysis and visualization of current travel behaviour mobility patterns using Bluetooth detectors data	Passengers mobility patterns identification (BT detectors, trajectory clustering, visualization techniques)

[1] Veto players are individual or collective actors whose agreement (by majority rule for collective actors) is required for a change of the status quo (Park & van der Alast, 2021). Commonly from political institutions. However, this report embraces a wider scope to include the whole community with some influence in urban mobility.

[2] https://www.correos.es/es/en/individuals/receive/our-drop-off-and-collection-points/citypaq

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Pilot	Use case	Mobility Solution
prioritized non-motorized transport modes and vulnerable road users	UC2: Re-allocating the public sphere - balance between liveability and capacity	Methodology for supporting policymakers considering all users' needs (sidewalk vs bike lane design) – (liveability vs safety)
	UC3: Identifying and prioritizing vulnerable road users at signalized intersection	Algorithm to identify vulnerable users and green light extension if needed to ensure safe crossing.

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2.1 P1 Valencia: Intermodal urban Passenger/ freight node for collective public & private transport

The city of Valencia is promoting a change in citizens' mobility behaviour, focusing on mobility policies towards more environmentally friendly modes of transport. The implementation of this pilot is aligned with the overall strategy of deploying of an *"Intermodal urban passenger/freight node for collective public & private transport"* in Ferrocarrils de la Generalitat Valenciana (FGV) that includes two use cases with specific objectives (Figure 1). Use case 1, acknowledge as "Cicloparc" consists in the integration between bikes and public transport means into an intermodal node by the installation of secure bike parking at metro stations. Use case 2 it the integration between passenger and last-mile freight transport through the co-location of new advanced services (e-lockers) into an intermodal node (metro station).

Use case 1: Parking for private bicycles into intermodal nodes	Use case 2: Smart lockers into intermodal nodes
• Improve Metrovalencia's quality of the service • Improve intermodality in metro stations, complementing the use of public transport with the use of sustainable private transport modes (bicycle) • To increase the station's radius of attraction, especially in low-density residential areas or in urban stations with population (urban or dispersed) located more than 1 km from the station	• Improve in the quality of the service provided by Metrovalencia • Promote the use of stations as picking points of parcels, reducing the number of vehicles doing last-mile deliveries in the city

Figure 1. Valencia Pilot: use cases objectives.

With the development of these two use cases the city of Valencia aimed to reduce the GHG emissions and increase the intermodality behaviour. Table 2 presents the initial targets of the city of Valencia and the final results obtained after the pilot implementation.

Table 2. Valencia target KPIs vs Valencia pilot values.

Target KPI		Measured KPI		Deviation
Name	Value	Name Value	Value	
GHG emission reduction (I404) (UC1+UC2)	2%	GHG emissions reduction Cicloparc Citypaq	2.8%	+0.8%

solution needs to become more mature in its implementation. For the solution to be fully implemented in the market it is necessary to: 1) gain the confidence of the users (demonstrate that it is a safe solution and that their bikes will not be damaged or stolen) 2) make it widely known (strengthen communication channels) 3) improve the awareness of citizens towards the environment. **Assuming an average bike park occupancy of 75%, which would mean 12 daily users of Cicloparc, the CO2 savings would rise to 2.8%.**

The operation feasibility distinguishes among the five Cicloparcs installed: the two initial metro stations (Empalme and Torrent Avinguda) included in the SPROUT project, and it was transferred to other two stations in the metropolitan area of Valencia (Alboraya-Palmaret and Quart) and one in another city on Valencian Region, Benidorm Station in Alacant city.

Concerning **usability**, there is scope to increase the number of users. The most used Cicloparc is the one in Alboraya Peris Aragó (which does not belong to SPROUT) with an average of 4 bikes per day in October 2021, 7 simultaneous users at the most and a growing trend of users. Of the two included in SPROUT, Torrent Avinguda had an average occupancy of 2 daily users although it is rising and in October 2021 several days there have been 3 users. The maximum has been 4 users per day, although with lower growth than in Alboraya. The Cicloparc of Empalme (included in SPROUT) has not had any success. There is only one user and not every day. Finally, the Cicloparc de Quart (not included in SPROUT) has been used regularly since the summer. The maximum daily occupancy detected is 2 users. The facility od Benidorm is not in use at present.

Regarding the profile of users, considering all the Cicloparcs, 74% are occasional, 12% frequent, and 14% regular users. Therefore, the use of Cicloparcs is not completely linked to commuting to work, but also other reasons for travel. Users tend to leave their bicycles early in the morning and pick them up in the afternoon. Finally, regarding the profile of users, considering all the Cicloparcs, 74% are occasional, 12% frequent, and 14% regular users.

About **reliability**, there have been only 4 incidences during the first week of implementation of the Cicloparc, due to errors detecting the cards for opening. Additionally, a small fire in one of the station's manholes affected several services and equipment, the station was out of service for two days (4 and 5th May 2020). No **security** problems for people, bicycles or facilities happened during the testing period.

The ***main problems encountered*** during the implementation were two. First, the insufficient dedicated space inside the metro station required the installation on the municipality territory managed by the City Hall. Second, well connected bike lanes and infrastructures are required and not managed by FGV either. These problems were further analysed following the SIS methodology in T4.4. This process helped to identify the following veto players:

- Fundación Valencia Port;
- Ferrocarrils de la Generalitat Valenciana (Public Transport Operator)
- Ayuntamiento de Valencia (Valencia City Council)
- Ayuntamiento de Torrente (Torrente City Council);
- Empresa Municipal de Transportes (Municipal Transport Company);
- Autoritat de Transport Metropolità de València (Metropolitan Transport Authority of Valencia)
- Asociación ciclista local (Local bike association);

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Then, the stakeholders above defined the policy package based on collaboration agreements between municipalities to collaborate in the implementation of sustainable mobility measures that include: 1) use the land of any of the public Authority for sustainable mobility purposes; 2) sharing information to co-create new mobility services; 3) regulations to facilitate the installation of mobility services promoted by public entities; 4) free access to public land for sustainable mobility purposes; 5) the agreement should also include the responsibilities of each public authority (maintenance, insurances, surveillance, cleaning...); 6) development of infrastructures needed (for instance the bike parking installed in metro station should be well-connected to the bike lane network and the authority competent of this infrastructure is different from the public company managing the metro stations and installing the parking).

The results presented the advantages and disadvantages of developing additional infrastructure to the Cicloparc with bike parkings well connected to the bike lane network and the authority responsible for the infrastructure to be different from the public company managing the metro stations and installing the parking. The results showed positive effects for most stakeholders. Security and accessibility are the positive impacts. The cost of investments is deemed as a minor negative impact where Torrent city has a greater degree of opposition.

Figure 2 presents the three policy responses that may support Valencia's use case 1 mobility solution identified by the city with the support of the SPROUT experts. The list sorts the alternative policies based on the implementation feasibility and user acceptance assessment conducted during the last step of the pilot implementation. Although the methodology evaluated four alternative policy measures, the results raised that the establishment of low emissions zone does not have any effect on enhancing the adoption of the Cicloparc.

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•Most feasible and accepted measure to enhance the addoption of the Ciclopark but it requires more internal institutional support to convey information to potential users.

Building protected and well-maintained bike lanes

- Despite its high cost, disemination is a priority on the administration's agenda due to the indirect benefits
- It requires more collaboration, coordination and clear guidelines on the Metropolitan Mobility plan

Improvement of existing bike network by connecting with interurban bike lanes as well as with urban intermodal modes

- Similar to the previous supportive measure but more expensive
- Need to increase safety awareness among the citizens and improve the application of punitive measures (sanctions for non-compliance with traffic rules often go uncollected and therefore the offences have no consequences for the offender.)

Figure 2 Valencia use case 1: alternative policy responses benchmark.

Finally, Table 3 presents the essential learnings to be considered by other cities for transferring the experience of the Valencia city.

Table 3.P1 Valencia – Use Case 1: Learning Outcomes & Conclusions

UC1	Parking for private bicycles into intermodal nodes
Barriers and Challenges	Concerning barriers, the concurrence of public authorities and companies with different competencies that need to act coordinately was the most controversial. Thus, FGV is responsible for the metro service in the city and its metropolitan area and the installation and operation management of the Cicloparc. The different city councils have ceded public land for the Cicloparcs. The regional government promotes policies for the use of bicycles. The cities build their cycling networks and the regional government the interurban bike lanes. The main challenges were location selection and security, the price for users, the connection of Cicloparcs and bike lines. Regarding location, several criteria were considered to select the ones to maximize the positive impact of the initiative: the most crowded metro stations in the metropolitan area, the users' preferences, passengers traffic data. Users considered space availability in the vicinity of the stations and the guarantee of the security of the Cicloparc as determining and essential factors for selecting the

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UC1	Parking for private bicycles into intermodal nodes
	location. To this end, Cicloparcs include surveillance cameras and provide an access system linked to previous online registration for the users. It allowed a more secure operation, and since the beginning of operations, there have been no damages or thefts to the bicycles or the facilities. Another challenge to overcome has been the price of the Cicloparc for users. The analysis demonstrated that it was necessary to offer the Cicloparc for free because any cost for users could be a deterrent.
Practice to avoid	Poor location selection using only traffic data from stations without considering the preferences of users and the collaboration of local councils, which in most cases have to provide space to locate the Cicloparcs.
Drivers and opportunities	Regional and local public policies are aligned in the promotion of cycling in Valencia (and other cities) as a sustainable mode of transport as there is a **lack of initiatives to integrate the cycling network with other modes of transpor**t. **Cicloparcs aim to help close this gap**. The main drivers for kike users are three: 1) Valencia and its metropolitan area are pretty flat; 2) the distances are not very long, so it is easy to ride; 3) there is already an extensive network of bike lanes. Finally, it is relevant to point out that Valencia citizens' environmental awareness and healthier lifestyle interest are growing.
Best Practice **Description**	Institutional support: Cicloparcs' initiative is completely aligned with the current policies of Valencia City Council and the regional government (Generalitat Valenciana) in terms of encouraging the use of bicycles, public transport and, intermodality between them as an alternative to private vehicles. Attention to user needs in terms of preferred locations, security and user-friendliness. As a consequence of the analysis of the price of the service for the user, it is recommended that it is linked to a valid travel ticket and that it is free of charge.
Learnings and recommendations for scaling up to the city level and for second layer cities	For the solution to be fully implemented in the market, under the point of view if policies it is necessary to: 1) gain the confidence of the users (demonstrate that it is a safe solution and that their bikes will not be damaged or stolen); 2) make it widely known (strengthen communication channels); 3) improve the awareness of citizens towards the environment; 4) coordination between public entities about land use, bike lanes network, investment, communication and advertisement initiatives. For example, in this last recommendation,

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UC1	Parking for private bicycles into intermodal nodes
	Metro Valencia is going to include at the new metro maps where the Cicloparcs facilities are located.

2.1.2 Use case 2: Smart Lockers into intermodal nodes

The use case 2 of Valencia or the installation of e-lockers by Correos and acknowledge as Citypaq was deployed in two metro stations (Colón and Xativa) in the centre of Valencia. Target users are metro travellers who may find the use of the Citypaq more convenient to pick up the e-commerce parcels and reduce the operators' delivery failure rate and the consequent GHG emissions.

After overcoming a series of challenges for installing the locker (see D4.3 and Table below), the pilot testing and data collection processes started in June 2021 and finished in November 2021, although the service is still running. The pilot compiled usage data from Correos and the IT system of the Citypaq after signing data sharing agreements. It collected complementary information based on F2F surveys conducted to the current and potential e-locker users.

As it is a solution dependent on a private company external to the consortium, a financial analysis has not been performed since it is linked to the company's global business model and therefore there are not enough disaggregated inputs to be able to perform this analysis.

The data from the IT system showed that the usage rate is 1% for the Citypaq in Colón and 3% for the CItypaq in Xativa. This information complemented with the surveys helped to calculate the CO2 emissions and corrective measures to promote the use of this measure.

About the former, Valencia calculated the GHG emission savings using some results of the SMILE project[3] of the Interreg MED programme[4]. In that project, interesting data was collected for this case, such as the average kilometers traveled per package until its last mile delivery, which can be assumed to be the kilometers saved by leaving the packages at the Citipaq points in the stations for the customers to pick them up. The conclusion is that the potential year GHG emissions saving by using the Citypaq is.around 4 Tons per year.

The ***main problems encountered*** during the implementation were the long process to reach the agreements with Correos for installing the Citypaq and the lack of users. Different policy measures were identified to overcome these hurdles. The implementation feasibility and the user acceptance were evaluated by the users and the stakeholders below.

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[3] https://www.fundacion.valenciaport.com/en/project/smile-smart-green-innovative-urban-logistics-for-energy-efficient-mediterranean-cities/

[4] https://interreg-med.eu/about-us/what-is-interreg-med/

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- Fundación Valenciaport
- Ferrocarrils de la Generalitat Valenciana (Metropolitan Metro Company, public transport operator)
- Metropolitan Mobility Authority (AMTV)
- Municipal Transport Authority (EMT)
- Citypaq – Correos (logistic company)
- Mobility technological company
- Consultancy company

Figure 3 presents the policy responses that may support Valencia's use case 2 mobility solution identified by the city with the support of the SPROUT experts. The two first ones would make the implementation process more agile and shorten testing times, the last two ones may increase the adoption and good practices once the mobility solution is running.

Establishing public-private collaboration mechanisms to facilitate the adoption of measures to improve sustainability in cities

- Minor costs related to the need of creating tailored contracts for parties involved
- Potential mitigation strategies are protocols to make the implementation more agile.
- May attract private companies improving their profit margin, or reducing the implementation time of the measure

Legal mechanism to include clauses on data sharing privacy policies

- Costs are low (software, hardware, manteinance) and balanced by the benefits as user confidence is improved if confidentiality is well protected and by data protection law.

Establishing loading and unloading zones as close as possible to the intermodal hub

- Costs are low and balanced by the benefits that avoid disorganized stopping of vehicles for loading and unloading on corners, double lines, sidewalks, etc

Provision of mobility hubs to enhance connectivity and multimodality

- The least affordable option, but benefits may overcome the costs
- Requiring good planning and shortening concession contracts

Figure 3 Valencia use case 2: alternative policy responses benchmark.

Finally, Table 4 presents the essential learnings to be considered by other cities for transferring the Smart lockers into intermodal nodes from the experience of the Valencia city.

Table 4. P1 Valencia – Use Case 2: Learning Outcomes & Conclusions

UC2	Smart lockers into intermodal nodes
Barriers and Challenges	About barriers, the most important is the need for a contract to the cession of space from FGV (public company) to Correos-Citipaq (a private company).

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UC2	Smart lockers into intermodal nodes
	For implementing the e-lockers, on the one hand, the main challenge was the duration of the negotiation of the contract. On the other hand, from the user's point of view, there has been recently a high increase in the number of delivery points in locations such as stationery stores, kiosks, gas stations, etc. even to friendly neighbours without too much identification, and the use of Citypaq is less agile than any of the above-mentioned options.
Practice to avoid	Not anticipated planning of the negotiation process between logistics operators and intermodal hub managers
Drivers and opportunities	Consumerism patterns related to COVID-19 have arisen new needs. On the one hand, electronic sales, which can be received at home easily, increased during the lockdown. By the time the safety measures were not so hard in Spain, either the fear or the habit made electronic purchases not to decrease but to complicate their collection at home or in the workplace. This situation was an opportunity to gain users of e-lockers
Best Practice Description	The selection of the location followed the same approach that the Cicloparcs. The factors to consider were: 1) passengers' traffic at metro stations in the city; 2) users' preferences; 3) space availability at the hall of the stations. On the other hand, Citypaq is integrated with the e-commerce of the most important brands in Spain and they are constantly in the process of integration with new stores. Public-private agreements on the implementation of measures with a positive impact on GHG emissions could be encouraged at the political level.
Learnings and recommendations for scaling up to the city level and for second layer cities	The main recommendation to scale-up the pilot in other cities are as follows: 1. Speed up the contractual process between the logistic operator and the public authority managing the space 2. Include data clauses on the agreements and define protocols to data sharing 3. Support the measure with other last-mile policies on the neighbourhood. 4. Promote and disseminate the measure implemented

2.2 P2 Kalisz: IoT-enabled urban logistics

One of the weaknesses indicated in Kalisz's Sustainable Urban Mobility Plan is the significant share of heavy freight traffic on the urban road network. In response to this challenge, the city

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of Kalisz implemented and tested an intelligent loading bay and improve the loading/ unloading operations performance and last-mile negative externalities for the city (Figure 4).

Use case 1: IoT enabled urban logistics
• Improving the organization of the loading/ unloading operations • Improving the management of the loading / unloading operations • Reduce delivery time • Reduce road congestion • Increase safety

Figure 4. Kalisz Pilot: use cases objectives.

2.2.1 Use case 1: IoT enabled urban logistics

The concept is about implementing a sensor network using Internet of Things (IoT) technology, which enables access to transport data in real-time, and the dynamic management of unloading operations in the city. The target users were urban freight transport drivers who book a reloading bay by installing an application in their mobile phones, which provides the interface between the users and the IoT management system.

Table 5 presents the targets of the city of Kalisz and the final results obtained after the pilot implementation.

Table 5. Kalisz target KPIs vs Kalisz pilot values.

Target KPI		Measured KPI		Deviation
Name	Value	Name Value	Value	
reduction time delivery (I401)	20%	Efficiency	66%	+46%
Reduction road congestion (I402)	10%	Reduction of road congestion	25%	+15%
Growth of safety	Not specified	Growth of safety	22%	Not applied
Cargo delivered by using the app (I411)	30 %	Cargo delivered by using the app	28%	-2%

About the cost-benefit analysis performed by the city, the large number of drivers avoiding paying fees did not allow measuring the real impact on the financial sustainability of the operators.

Concerning operation feasibility, the drivers responding the survey, and from the data compiled with the system, the pilot presents the following results in terms of usability (27%), effectiveness: (33%), efficiency (66%), satisfaction (33%) and reduction of truck-kilometres: (25%). This reduction in the distance driven and the increased efficiency were the main reasons for the participants responding the survey to consider a reduction in the impact of environmental externalities (e.g., noise, pollutants, GHG emission).

The implementation allowed compiling data and understanding the freight operation patterns. From the information compiled (occupation rates, parking times, etc), Kalisz found out that around 67% of reloading are unauthorized. These operations are usually taking less than 5 minutes. Drivers explained that they prefer pay the low fees rather than spending extra time in finding a bay, booking, parking and paying.

The ***main problem encountered*** during the implementation was that the loading bays are used only for a limited time during delivery hours. For the remaining time (e.g. night hours) the place is not used and at the same time unavailable to residents. This problem was further analysed following the SIS methodology in T4.4. This process helped to identify the following veto players:

- Kalisz Municipality;
- Infrastructure (Road and street lighting, Municipal Roads Administration);
- Business incubator;
- School;
- Entrepreneurs and companies (Photovoltaic company, Design office);
- Logistics Service Providers;
- Local shops and restaurants.

Then, the stakeholders above defined the policy package that includes: 1) the modification of rules allowing to park private cars during indicated hours and / or days (for example weekends); 2) further cooperation with drivers/ forwarders to exclude parts of the weekdays from delivery (indicated bays), for example 3 days for deliveries, 2 days (plus weekends) for parking.

The results presented the advantages and disadvantages of implementing the policy package in comparison with the do-nothing scenarios which basically has mostly positive effects for most stakeholders. On the one hand, accessibility, adaptability to demand and varying conditions are the most important advantages. On the other hand, the most disadvantaged stakeholders are entrepreneurs and companies, especially because they consider it negatively affects accessibility for logistics service providers (when time for unloading is lower than 5 minutes).

Figure 5 presents the list of policy responses to support the Kalisz mobility solution identified by the city with the support of the SPROUT experts. The list sorts the alternative policies based on the implementation feasibility and user acceptance assessment conducted during the last step of the pilot implementation.

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- Most feasible and accepted measure to incrase the low occupancy rate

Weight and/or size restrictions for delivery vehicles

- If introduced gradually, it may help to create more social environments while reducing stakeholders' opposition

The provision of inner-city micro-consolidation centres

- Before implementing this policy measure, the city needs to increase the efforts for building the knowledge gap and the ICT and logistics infrastructure

Introduce an environmental criterion in public delivery contracts (bike delivery, e-vehicles, etc.)

- It might not be an appropriate policy measure in the short run. Revisited once the last mile logistics awareness increases.

Figure 5. Kalisz use case: alternative policy responses benchmark

Finally, Table 6 presents the essential learnings to be considered by other cities for transferring the IoT network and app of managing freight loading/ unloading operations from the experience of the Kalisz city.

Table 6. P2 Kalisz – UC1: Learning Outcomes & Conclusions

UC1	IoT enabled urban logistics
Barriers and Challenges	The main barriers identified for the successful adoption of this system are: • occupation of car parking places on the 24/7 basis, • on average longer distance of manual goods handling from vehicle to a place of delivery, when comparing with "illegal" parking, • necessity of planning, • undisciplined drivers of truck or cars occupying bays, • the need to pay parking fees and billings, lack of budget for parking fees in operators' companies. The main challenges are: • locate bays in appropriate places, • convince drivers to use and book the bays, • find the technical solution, resistant to local climate conditions working properly in highly urbanized areas.
Practice to avoid	• assuming the range of the base station, which in an urban area differs significantly from the nominal one, • lack of bidirectional communication with the bays' sensors,

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UC1	IoT enabled urban logistics
	• elimination of significant incentives for drivers
Drivers and opportunities	• traffic and congestion reduction, • growth of safety for pedestrians and drivers, • noise reduction, • emissions reduction, • regulation and control of freight flow in the city centre.
Best Practice Description	The Kalisz pilot gave opportunity to test prototype of outdoor sensored loading/ unloading bays in real conditions. The aim of the solution is to enable planning and booking of the reloading spaces. It is assumed that the planned reloading operation would allow the trucks to go directly to the booked place at the specific time, park and reload close to the designated place, reducing the load from delivery vehicle traffic. The installed system included sensors, communication devices and base station. Additionally, a dedicated application was developed. Both the sensory network and the application were preliminarily tested, implemented, and tested again in the form of a living laboratory in the centre of Kalisz City. This way the solution has been successfully verified as possible to implement in real conditions, apart from some limitations, indicated above. The success of the implementation in other city centre is related with proper location of the bays, elimination of manual payment of parking fees, incentive system for drivers and/or operators, acceptance of local stakeholders and support of municipalities.
Learnings and recommendations for scaling up to the city level and for second layer cities	The main learnings include: • 40% of reloading operations were within a very short time slot, • increased illegal parking activity outside the designated spaces, • avoidance of parking fees. The main recommendations after the pilot includes: • introduction of the change of truck-parking charging method towards subscription instead of fees, • enabling of the reloading bays for temporary parking of private cars during night hours and at weekends, • use two-directional communication with the sensors to react quick in case of their failure.

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2.3 P3 Budapest: Shared passengers' mobility

The city of Budapest is promoting shared passengers' mobility. The pilot location is in the city centre of Budapest in districts 6 and 7, which prohibits leaving shared vehicles in public areas. There are a few trolleybus lines and many metros, tram and bus lines on the border streets. With the implementation of use case 1 and use case 2, the pilot in Budapest is contributing to the development of the Budapest Active and strategy. The first use case introduced "planned traffic regulation changes" in a low calming traffic zone, and use case 2 aimed to create a "network of 86 points". Figure 6 shows the objectives of these two use cases.

Use case 1: Planned traffic regulation changes	Use case 2: Creation of micromobility point
• Reduce traffic congestion • Increase public space for leisure activities	• Increase shared passengers' mobility • Increase active modes of transport • Improve the use of public space

Figure 6. Budapest Pilot: use cases objectives.

With the development of these two use cases the city of Budapest aimed to increase the modal share of shared mobility solutions. Table 7 presents the initial targets of the city of Budapest and the final results obtained after the pilot implementation.

As the examination is primarily aimed at the benefits of providing an alternative for walking, we specified first and foremost the demand for walking within the examined area. Walking can be realised along the network in two ways: as an independent walking layer and also as a partial journey of public transport (last-mile trips). After the new layer for was defined, the ratio of modal was specified in relations, where the assignment has lower costs, enabling faster trips. At last, with the help of elasticity, the re-calculated demand was re-assigned to the network. The results of the analysis are in the next table.

Table 7. Budapest target KPIs vs Budapest pilot values.

Target KPI		Measured KPI		Deviation
Name	Value	Name Value	Value	
Increase in the modal share of shared mobility solutions (I414)	10%	Increase in the modal share of shared mobility solutions regarding the modelling (optimistic, average, pessimistic)	17.2%, 11.9%, 6.1%	+7.2%, +1.9%, -3.9%

2.3.1 Use case 1: Planned traffic regulation changes

In the case of the "Use case 1", a short section of car traffic along Király utca in District 6th was restricted. Only authorised and load traffic was permitted within the new pedestrian zone,

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and around 40 parking places were closed by using traffic signs. In addition, there were traffic management changes, such as the reorganization of some streets' directions in District 7th. The changes have been active since the 15th of August, 2020. As the use case 1 aimed to understand the impact of reallocating public sphere for leisure activities and COVID-19 safety measures did not allow to build public furniture or create green spaces, the pilot in Budapest decided to include three streets (Tompa, Ráday and Lövőház street) with the planned layout and features in the analysis.

Different data collection methods were used. Gehl's stationary activity mapping allowed measure the usage of public space; conventional traffic counting for measuring the different types of vehicles; air pollution measured with data on airborne dust and NOx concentrations Finally, surveys and local workshops were conducted to collect feedback from citizens and stakeholders to measure the effects of the pilot and compile relevant information for understanding how cargo loading methods and behaviours changed. These data were the inputs for simulation model in UC2.

Examining the results during the pilot period, it can be concluded that the changes achieved by transforming the area are operational and can be operated properly. If the street were completely redesigned, the operation would become more complicated, but it would be a known task for the municipalities. With that method the benefits of the free-floating and the station-based system was combined. In the target area there will be Mobility Points in every 150 meters. The usage of the Mobility Points will be open for the shared mobility providers and the citizens as well. According to the surveys and the workshop, the operational costs of the shared mobility providers that used to operate free-floating systems are going to decrease.

The operational feasibility showed that the number of users is expected to increase due to the easier access of the shared micromobility vehicles. The system reliability and efficiency are expected to improve with the implementation of Mobility Points, as users can find vehicles easier at the given locations. We took it into consideration that free-floating parking might be the most convenient for users – as they can park the vehicles right at their destination, however, it negatively affected other factors, such as maintainability or portability as vehicles are parked randomly within the given zone. Therefore, in order to provide an optimized system, Mobility Points are placed in every 150 meters, which ensures that users can park the vehicles within a few minutes' walk from their destination – therefore usability and satisfaction did not decline – yet maintainability and efficiency could be maintained.

The ***main problem encountered*** during the implementation was the strong criticism the project received at the very early stage. Local residents and visitors complained at the district municipality about the difficulties when entering the area with the private car. However, within a few months, the number of criticisms decreased and locals started to support the project, as they realized streets became calmer, safer and more liveable. Several decision-makers, who opposed the project in the beginning, also changed their opinion about the project. There are plans now to extend the traffic calming area and create a so-called super block with streets only open for pedestrians, cyclists and authorized vehicles. Therefore, the pilot help to increase the citizens and local authorities' acceptance. The list below presents the veto players participating during the last step of the pilot activities. They help to analyse how a list of policy measures can support the creations of low calming zones.

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- Public transport operator;
- Mobility operators;
- Infrastructure operator;
- Walking or cycling associations;
- Experts from Budapest University of Technology;

Figure 7 presents the aforementioned policy responses that may support Budapest's use case 1 mobility solution. This list was identified by the city with the support of the SPROUT experts and sorts the alternative policies based on the implementation feasibility and user acceptance assessment.

- Essential for creating a good relationship among the stakeholders and support the creation of low calming zones.
- It may support the deffinition of the rest of alternative policy responses.

Resolving legal issues related to the regulation of market-based services

- To avoid fully transferring the cost to users, avoid operators losing market share and make it sustainable for the city, the operator may partially assume the costs.
- Regulations and cooperation required.

Construction of protected and well-maintained bicycle lanes and main lines

- New taxation mechanisms are required for maintaining the infrastructure and balancing the fees from conventional private vehicles

Establishment of low-emission zones (emission-based recovery restrictions)

- New taxation mechanisms are required for maintaining the infrastructure and balancing the fees from conventional private vehicles
- Close cooperation between the private and public entities and shared financial structures to ensure a good mobility service in this area (public administration infrastructure, operators shared vehicles).

Figure 7 Budapest use case 1: alternative policy responses benchmark.

Finally, Table 8 presents the essential learnings to be considered by other cities for transferring the traffic regulation changes from the experience of the Budapest city.

Table 8.P1 Budapest – Use Case 1: Learning Outcomes & Conclusions

UC1	Planned traffic regulation changes
Barriers and Challenges	The main barriers identified for the successful adoption of this system are: - Load traffic for shops and restaurants, - Checking entry permits for vehicles, - Enough place to create green areas and community places,

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UC1	Planned traffic regulation changes
	- Permit for restaurants to create terraces. The main challenge is: - prevention of prohibited crossings.
Practice to avoid	- drivers ignore the signboard, a system with greater retraction must be built - not only change the traffic regulation of the street, but also change its design
Drivers and opportunities	- traffic and congestion reduction, - growth of safety for vulnerable road users, - noise reduction, - emissions reduction.
Best Practice Description	The Budapest pilot gave opportunity to see the result of a downtown district's traffic calming. The focus of the traffic calming was to make the district more liveable and to divert through traffic to the main roads bordering the district. The additional goal was to make the inner district streets used by cyclist and users and to increase safety of vulnerable road users.
Learnings and recommendations for scaling up to the city level and for second layer cities	Recommendations for second layer cities: - set up benches, street furniture, bicycle racks, points on the place of closed parking slots, - to issue permits to restaurants to build terraces before the traffic calming, so after the calming is introduced, the restaurants will be able to replace the vacated parking spaces with their terraces, - camera inspection of streets blocked from traffic to check entry permits.

2.3.2 Use case 2: Creation of micromobility points

The use case 2 of Budapest aims to develop modal shift opportunities between public transport and shared mobility services setting up points (parking sites) to make shared services reliably available in a concentrated area. The design plans 86 Mobility Points for the vehicles in district 6 of Budapest to avoid unregulated appearance of the micromobility services, especially e-scooters and understand if the already overloaded public space by motorist traffic is getting worse (mainly due to street parking).

COVID-19 caused financial damage on this pilot. Moreover, the lack of coordination among the different local authorities postponed the implementation to the last months of 2021. Therefore, the analysis of the impacts was based on simulating the networks and users' behaviours.

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To collect data, the Unified Transport model of Budapest was used, which is a macroscopic transport model with all the mobility modes (public transport, private cars, cycling, walking). According to the analysis the usage of the micromobility modes will be increased by 11,9 %, in the most probable scenario (Table 7. Additionally, a comprehensive method was developed, which defines the measurements of the utilisation and traffic of (micro)mobility points to be established in the framework of the SPROUT Project. This method could be used after implementing the Mobility Points.

The ***main problems encountered*** during the implementation were two. First, the high car traffic volume in the pilot area where there is not enough place for pedestrians and users. Second, as currently there is no regulation for micromobility vehicles storage, shared devices are denied. Different policy measures were identified to overcome these hurdles. The implementation feasibility and the user acceptance were evaluated by the users and the stakeholders below. These problems were further analysed following the SIS methodology in T4.4. This egess helped to identify the following veto players:

- Public transport operator;
- Mobility operators;
- Infrastructure;
- Walking or cycling associations;
- Users of services.

Then, the stakeholders involved defined the policy package based on collaboration agreements between municipalities to collaborate in the implementation of sustainable mobility measures that include: 1) Create city specific planning regulations, that contains regulation to plan spaces for all modes of mobility; 2) Create an additional regulation for in the topic of public place reorganization from the road operator and owner side. The pilot thinks that it can be a capital decree in the future.

The results presented the advantages and disadvantages of introducing this package of measure. All the participants believe it will have a positive environmental impact and increase the coherence of public space. However, they do not think the additional package of measures will increase the use of the mobility as a service (MaaS). No stakeholder reported any negative impact or disadvantage.

The two measures analysed by using the SIS methodology were complemented with the list of alternative policy measures in Figure 8. It presents the four policy responses that may support Budapest use case 2 mobility solution. The list was identified by the city with the support of the SPROUT experts. During the last step of the mobility solution analysis, the pilot explored the implementation feasibility and users' acceptance of these measures. The conclusion is that all of them support the implementation of the creation of points. Furthermore, the combination of these policy measures with the creation of points will ensure and speed up the transition towards udapest new mobility in the long term

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Definition of measures and guidelines for transport in favour of certain modes of transport

- Essential to support the creation of micomobility points

Advantage of active transport over individual motorized transport

- Specification of the previous policy measure
- Reduce the healthcare costs

Provision of leisure activities, green surfaces, street furniture

- Cost is the most controversial factor but balanced by the benefits
- Increase commercial areas attractiveness that will require spaces to park the micromobility vehicles
- Standardizataion of the design of the micomobility points

Measures taken to give priority to public transport

- Ensure a good passengers mobility coverage complementing the micromobility seasonality and enlarging the distances
- High investment will be outbalanced as this measure reinforces the micromobility points and the cultural change towards more active, shared and eco-friendly mobility.

Figure 8 Budapest use case 2: alternative policy responses.

Finally, Table 9 presents the essential learnings to be considered by other cities for the experience with the use case of the city of Budapest.

Table 9. P1 Budapest – Use Case 2: Learning Outcomes & Conclusions

UC2	Creation of micromobility points
Barriers and Challenges	• Financial situation of the local municipalities • Planning and licensing process
Practice to avoid	• Identifying only one investor. The initial one financial capability changed due to COVID-19 and it was hard to find a new one.
Drivers and opportunities	• Regulate the public space usage of the vehicles and the shared mobility services • Utilize the advantages of the shared mobility services • Create cooperation between the public transport and the shared mobility modes
Best Practice Description	The Budapest Pilot created the opportunity to utilize the advantages of the free-floating shared services, besides regulating the public space usage of the vehicles. Furthermore, the implementation of the Mobility Points could make the junction safer. To understand the effect of the Mobility Points, a simulation method was used, to know in advance if the locations for the micomobility points will perform

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UC2	Creation of micromobility points
	successfully, understand the environmental impacts and showcase the benefits and behaviour of the network.
Learnings and recommendations for scaling up to the city level and for second layer cities	Recommendation for second layer cities: • Create contracts with the privately-owned shared mobility providers • Regarding the design of the Mobility Points, "less is more" because of the financial needs of the city level network and the operational requirements • Open for the local stakeholders (Municipalities, schools, shops, etc.)

2.4 P4 Padua: Self-driving pods for cargo-hitching

The new SUMP outlines the policy framework and driving factors addressing changes and evolution of Mobility until 2030, setting sustainable goals. Among these, relevant issues clearly emerge which represent key-goals as strong focus on innovation of urban transport, development of e-mobility solutions in order to reduce emission and carbon footprint, improvement of urban mobility efficiency and effectiveness and environmental sustainability. In this framework, the Padua pilot aimed to test an innovative transport solution combining passengers and freight transport in a real urban ecosystem (the “NEXT” scenario) in order to assess the impacts of this new business model.

Use case 1: Self-driving pods for cargo-hitching
• Develop and test innovative e-mobility solution and assess the impacts • Reduce carbon footprint and emissions • Improve urban mobility efficiency and effectiveness and environmental sustainability • Move towards the integration of passengers and freight transport in the urban environment

Figure 9. Padua Pilot: use case objectives.

2.4.1 Use case 1: Self-driving pods

The pilot in Padua tested a modular self-driving pod acknowledge as the Next system. It allows the integration of passengers and freight to achieve optimized urban mobility efficiency and effectiveness (see D4.5). The trials to test this new disruptive mobility solution were conducted on a 3-months period in a selected urban area in the city of Padua, where a reserved lane was

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realized for technical assessed, testing up to 2 pods. During trials, on-the-field technical data was collected and the environmental assessment was performed, besides the operational feasibility. The impacts of the new mobility solution were simulated and assessment in a wider area, considering also financial and socio-economic aspects

Table 10 presents the targets of the city of Padua and the final results obtained after the pilot implementation.

Table 10. Padua target KPIs vs Padua pilot values.

Target KPI		Measured KPI		Deviation
Name	Value	Name Value	Value	
Traditional fuel consumption reduction (I405)	3%	Reduction of energy consumption compared to traditional transport means (fossil fuels: bus, private cars, LCV[5])	Bus: 88% Cars: 83% LCV: 47%	Bus: +85% Cars:+80% LCV:+44%
CO_2 reduction (I406)	4%	Reduction of CO2 emissions compared to traditional transport means (fossil fuels: bus, private cars, LCV)	100%	+96%
Environmental quality improvement (I407)	9%	Reduction of air-pollutants compared to traditional transport means (fossil fuels: bus, private cars, LCV)	100%	+96%
E-mobility: recharging points (I415)	+10	E-mobility: recharging points	+30*	+300%

* 10 points in 2019 vs 40 in 2021 Q1

The KPIs were derived collecting data from trials and calculated following the SPROUT EF approach for CO_2 reduction and environmental quality improvement. Similar approach was adopted to assess traditional fuel consumption reduction; data of electric consumptions were the key parameter to compare the efficiency of pods to save fossil fuels, considering the average recorded consumption; this was then compared with traditional means of transport, using data from literature. Also, in this case, the comparison was expressed in terms of cost ("traction-cost", expressed in terms of€/km), using the calorific value to obtain energy equivalence.

[5] Light comercial vehicle

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For the other 2 parameters, a similar procedure was applied; considering that CO_2 and other pollutants related to fossil fuels are equal to 0, since the pods are electric, it was derived that reduction of GHG and the improvement of air quality are 100%.

These are very significant overall improvements, compared to current mobility scenario and they fit the goals set by SUMP.

Then a simulation in a wider area was carried out. The cost benefit analysis highlighted that operational and travel costs can significantly improving the current mobility scenario. This brings net positive social outcomes. The overall financial return from passengers and freight can compensate the initial investment over time-horizon; additional asset investments are counterbalanced by less operational and travelling costs and significant revenues.

Concerning operational feasibility, regarding technological components, this has been provided by manufacturer itself, according ISO/IEC 25010. Requirements have been identified for each of involved categories: driver, manufacturer, service operator. During the tests the software related to the platooning / docking / undocking system was successfully analysed. The users' app has been developed as a prototype mostly by focusing on Users Experience. UX is understandable even for older people.

The next step was to analyse the formulation of the problem and identify the alternatives, with the collaboration of stakeholders. The ***main challenges identified*** during the implementation, and highlighted in T4.4, were: 1) interferences between pods and other vehicles; 2) the deployment of the NEXT system as "regular" mobility service in the wider urban area; 3) the possibility that the so-defined mobility service does not match the transport demand; 4) the integration of the NEXT system with the existing urban public transport network These problems were further analysed following the SIS methodology in T4.4. This process helped to identify the following veto players:

- APS Holding S.p.A. (city parking, car sharing, and shared mobility services provider);
- BIV S.p.A. (Public transport operator);
- Padua Municipality- Environmental Department;
- Padua local police;
- Padua Fair;
- Padua Municipality- mobility Department;
- Cityporto (Logistics operator).

Then, the city representatives defined the policy package that includes: 1) creating reserved lanes for pods; reviewing the current traffic decrees that define reserved lanes in the urban areas; 2) designing, developing and deploying NEXT as a regular mobility service (including timetable, tickets, etc,); 3) for the previous point, the planning of the future service should include a careful analysis of the evolving demand. Defining routes, timetables and fares based on peak demand at the future launch of the service. Effective communication campaign; 4) integrating NEXT into the urban public transport network.

The results presented the advantages and disadvantages of implementing the policy package in comparison with the do-nothing scenarios, which basically has mostly positive effects for most stakeholders, in particular for APS and Padua Fair. Accessibility and integration of services/connectivity are expected to be the most significant positive impacts, followed by the

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reduction in air pollution, increased public transport network offer, integration with other systems and the very last-mile accessibility of freight. The only minor negative impact is ‘financial feasibility’ on account of the public transport operator (BIV).

- The implementation may require a reduction in the complexity of the public administration bureaucratic processes
- The benefits for facilitating the introduction of innovative mobility solutions justify the fixed and operational extra costs

Set-up of specific procurement procedures for innovative mobility solution

- The implementation may require a reduction in the complexity of the public administration bureaucratic processes to reduce the
- The benefits for facilitating the introduction of innovative mobility solutions justify the fixed and operational extra costs

Integration of Next with Local Public Transport and development of modal shift

- It reinforces the adoption and acceptance of the pod, especially for BIV

Development of innovative solutions as support for logistic operators

- It reinforces the adoption and acceptance of the pod, especially for Cityporto.

Figure 10 presents the list of policy responses to support the Padua mobility solution. They are the result of combining the measures of the policy package explored with the SIS methodology and additional measures identified by the city with the support of the SPROUT experts. The list presents the alternative policies based on the implementation feasibility and user acceptance assessment conducted during the last step of the pilot implementation. The two formers state the need to reduce the complexity of the public administration bureaucratic processes and are facilitators of the last two ones. Furthermore, they were somehow requested to guarantee a proficient implementation and management of the transport model. The two last ones can help raise the adoption and acceptance of the stakeholders who benefit more from the definition.

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- It reinforces the adoption and acceptance of the pod, especially for BIV

Development of innovative solutions as support for logistic operators

- It reinforces the adoption and acceptance of the pod, especially for Cityporto.

Figure 10. Padua use case: alternative policy responses benchmark

Finally, Table 11 presents the essential learnings to be considered by other cities for transferring the self-driving pods for cargo-hitching from the experience of the Padua city.

Table 11. P4 Padua – UC1: Learning Outcomes & Conclusions

UC1	Self-driving pod
Barriers and Challenges	• The different regulatory framework between passengers' transport and freight. • Lack of regulatory aspects about autonomous driving, smart roads. • Fund-raising for initial investments costs and administrative process.
Practice to avoid	• Avoid using the transport model for too long routes or extra-urban routes.
Drivers and opportunities	• Flexibility and modularity as the main drivers to optimize benefits that can lead to financially viable models. The benefits are furtherly amplified if the integration between passengers and freight is achieved. • Improving the overall transport efficiency and reducing traffic levels, air-pollution – high benefits in terms of sustainability. • The implementation of the transport model generates positive social outcomes and improves accessibility.

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UC1	Self-driving pod
	• Improving/enlarging the reserved lanes network for buses to the pods.
Best Practice Description	• The Padua pilot brought the opportunity to create a collaboration/synergy between public and private entities and develop new procedures to obtain external funds from the private sector. • The creation of reserved lanes increases the overall efficiency and the safety of the innovative transport model.
Learnings and recommendations for scaling up to the city level and for second layer cities	Recommendations for second layer cities: • The implementation of a such disruptive, innovative transport model needs a strong political commitment and coordination with the major stakeholders, • Identify the relevant stakeholders adequately, considering the mobility solution implemented. • Stakeholders shall not be considered as the competition but involved with an active role in the economic return process; • The transport system can be operated from both, either from the public bodies and or from private operators; if the second one, the scaling-up process could be easier and faster from an administrative point of view. • The implementation of the transport model requires solid skills and know-how in logistics matters.

2.5 P5 Tel-Aviv: Data-driven urban mobility planning and traffic management strategies to prioritized non-motorized transport modes and vulnerable road users

The city of Tel Aviv undergoes massive transport changes during the construction of its new light rail transit (LRT) system. Planned infrastructure changes as part of LRT integration opened up an opportunity to set new priorities and reallocate the public sphere favouring non-motorized traffic modes, making the city more liveable. Following the municipality's approach, an in-depth, comprehensive, and multidisciplinary planning process, three uses cases were implemented in Tel Aviv, with specific objectives

Figure 11). Use case 1, acknowledged as "*Passengers mobility patterns identification*" consists in compiling data from 110 Bluetooth detectors installed in Tel Aviv Metropolitan to study road users' mobility patterns based on trajectories clustering. The data obtained was used to build an interactive decision support dashboard that enables the visualization of spatial clustering results. The dashboard and the analysis outcomes will help policymakers and traffic planners better plan temporary traffic arrangements and public transport services to tackle the expected reduced capacity in major arterials due to construction works. Use case 2 "Public sphere re-allocation" focused on using a structured methodology ([6] [HoQ]) to assist decision-makers in resolving conflicts associated with the distribution of roadway rights among road

[6] Hauser and Clausing, 1988
Hauser, J.R., Clausing, D., 1988. The house of quality, Harv. Business Rev., May–June, 63–73

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Calculating UC2 indicators "Quality of public space and road user experience improvement" and "Growth of safety of traffic users and pedestrians, and growth of attractiveness of urban areas" required the actual planned design with the erection of the new LRT purple line, which wasn't finalized yet. However, the results of the HoQ analysis ranked the scenarios presented, considering the weight policymakers assigned to the needs of each road users' group (Needs: safety and pleasantly / Road users' groups: pedestrians and cyclists).

In addition, the outcomes revealed to what extent each design attribute contributes to each need. While some design attributes had a similar contribution for both pedestrians and cyclists, others had opposing impacts. Some attributes had an opposing impact on each need (e.g., contribute to safety but impair the walking/cycling pleasant experience).

Table 12. Tel-Aviv target KPIs vs Tel-Aviv pilot values.

<table>
<tr><th colspan="2">Target KPI</th><th colspan="2">Measured KPI</th><th rowspan="2">Deviation</th></tr>
<tr><th>Name</th><th>Value</th><th>Name Value</th><th>Value</th></tr>
<tr><td>Quality of public space and road user experience improvement (UCx)</td><td colspan="4" rowspan="2">Due to the final configuration and the timeline of the pilot these KPI's were not evaluated in before-after setting. However, the components impacting the experience were revealed, including the extents of the contribution of each component.</td></tr>
<tr><td>Growth of safety of traffic users and pedestrians, and growth of attractiveness of urban areas (UCx)</td></tr>
<tr><td>Reduction of the frequency of potentially unsafe crossings of VRU at signalized crosswalks</td><td>8%</td><td>Number of "False Negative events" (events in which VRUs weren't identified or didn't get a required green extension)</td><td>0%</td><td>-8%
(100% safe crossing)</td></tr>
<tr><td>Eliminate the maximum vehicle delay for the conflicting traffic movements due to green extension</td><td>5%</td><td>Impact on conflicting vehicle movements. (green extension, comes at the expanse of vehicle signal)</td><td>2.6%</td><td>-2.4%*</td></tr>
</table>

*the delay of the conflicting traffic due to applying green extension was less than the value of the target KPI

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2.5.1 Use case 1: Data-driven analysis and visualization of current travel behaviour mobility patterns using Bluetooth detectors data

The methodology was demonstrated by focusing on trajectory clusters associated with the chosen trip attraction zone in Tel Aviv Central Business District. The zone is characterized by high demand during morning peak hours. One of the leading roads into the chosen zone, Arlozorov artery, is expected to undergo significant revolutionization to integrate LRT lanes, causing lanes closure and reduced capacity during the construction period.

Raw BT records database of trips passing through at least one of the BT detectors located in the trip attraction zone during morning peak hours for two months allowed the reconstruction of individual road users continuous trips by matching the unique user ID in space and time. BT's re-identification ability with the goal to recognize road travellers' trajectory patterns allows identifying focused subgroups of travellers, such as commuters. Following creating a database of continuous trajectories for each user ID, the Sequence Alignment Method (SAM) method was applied to create the trajectory clusters. Applying the trajectories clustering technique required visual exploration and network expert knowledge to finalize the set of resulting clusters.

A decision supporting tool - an interactive dashboard - was built in QlikView[7] software, which enables visualization of spatial clustering results in accordance with filters representing different clusters attributes. Traffic experts and decision-makers experienced and evaluated the tool in two aspects, the insights derived from the data analysis and the dashboard as a decision-making tool.

The **functional suitabilit**y was positively evaluated. Indicating the additional insights that the data analysis and its visualization contributed to temporary traffic re-arrangement due to the expected capacity reduction. Geo-visualization of the revealed clusters overlooks the traffic patterns and volumes, which was another advantage of the interactive tool. Some drawbacks were pointed out regarding the partial deployment of detectors that caused missing information regarding the exact origin of some of the trips; additional data will contribute to better planning of public transportation services. Regarding **usability**, the dashboard was designed to tackle the challenges of spatial data visualization by guiding the users to extract the insights through the filters and cluster attributes. However, users' impression is that the tool can be enriched with additional attributes in accordance with location-specific spatial structure. Despite some drawbacks, the outcomes enhance traffic experts and decision-makers understanding, which contributes to reducing the impact of temporary traffic disruptions.

All parts of the methodology are **portable** to other locations in this sub-network and substantial parts are adaptable to other sub-networks. Given the sub-network specific parameters, e.g., travel time threshold values and map with traffic network specifications, the process of continuous trajectories reconstruction and extractions of relevant to scenario trips is general and applicable to other sub-networks.

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[7] https://www.qlik.com/es-es

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The assessment of the financial aspects of the methodology conducted based on **Cost-Benefit Analysis (CBA).** The methodology proposed by SPROUT EF could not be completely followed since using the data analysis methodology demonstrated in this use case the benefits are measured in terms of savings as a result of the delay reduction at intersections after implementing a traffic management strategy (traffic management strategy involves mainly managing traffic flow at signalized intersections), and the Daily Kilometres per Passenger were not calculated. However, simplified methodology was used to evaluate **Cost-Benefit Ratio.**

Delays at intersections were calculated for three scenarios (1) **Before** road closure (2) **Do-nothing** scenario **after** road closure (3) **After** implementation of traffic management strategy **after** road closure (traffic management strategy is implemented if Volume/Capacity (V/C) ratio in scenario 2 is greater than 0.95).

The benefit is measured through monthly savings due to delay reduction in scenario 3. Israeli local guidelines provided the "Value of Passenger Time" for commuters (90% of the trips, ~ 7.5 Euro) and professional trips (10% of the trips, ~ 24.5 Euro). Average occupancy per vehicle as per data provided by the municipality is estimates by 1.3 persons per vehicle. The benefits were calculated for two levels of effectiveness of the traffic management strategy (60% and 80%). The Monthly savings due to reduced delays at intersection for 60% and 80% traffic management strategy effectiveness are 86,805 Euro and 138,887 Euro, respectively.

The Costs included in the calculation are labour salary for senior and junior staff, hardware, software, and devices maintenance costs. The devices costs were not included in the calculation since they were acquired long before the project and served other purposes in Tel Aviv municipality's Traffic Management Center.

Assuming traffic management strategy effectiveness of 60%, the Benefit-Cost ratio is 2.67, and for the effectiveness of 80%, the ratio is 4.27 (Detailed specification of the calculation included in D4.11). The potential effectiveness of the traffic management strategy is related to the quality, accuracy, and completeness of the data. Thus, data quality and better deployment of detectors contribute directly to the benefits.

The ***main problems encountered*** during the implementation were associated with partial data availability. The two aspects of this problem included the insufficient deployment of BT detectors (raw data) and GIS data needed for calculations (such as travel time threshold values). Other issues that need to be taken into account are the considerable efforts required to ensure data privacy regulations and the data validation processes required to ensure the quality of the data used for analysis. Different policy measures were identified to overcome these hurdles. The implementation feasibility and the user acceptance were evaluated by the users and the stakeholders below.

- Traffic experts - public administration
- Legal experts - public administration
- Traffic experts – private sector
- Tel Aviv Living Lab
- Data/tech company

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Figure 12 presents the list of policy responses to support the use case 1 in Tel-Aviv. They were identified by the city with the support of the SPROUT experts. The list presents the alternative policies based on the implementation feasibility and user acceptance assessment conducted during the last step of the pilot implementation.

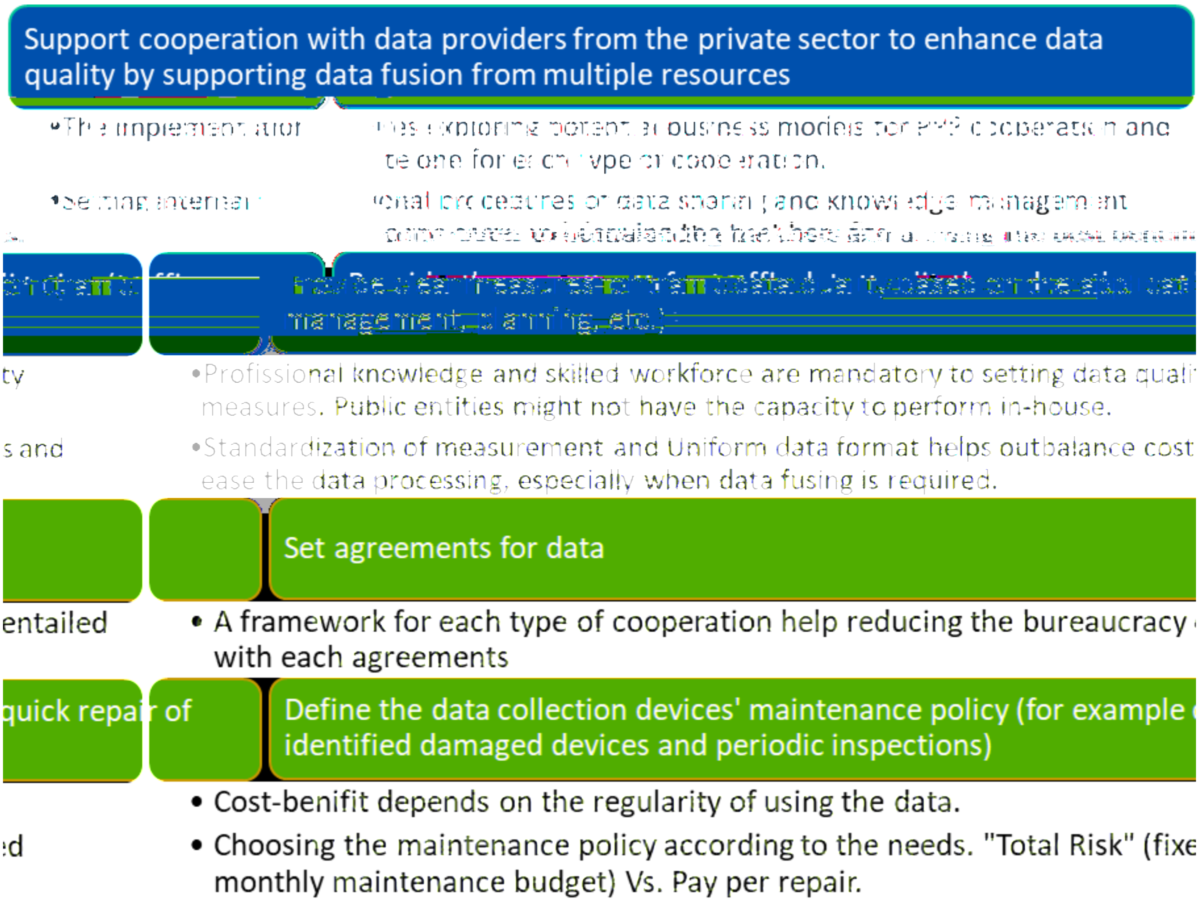

Figure 12. Tel-Aviv use case 1: alternative policy responses benchmark.

The use of data-driven and visualization techniques from passengers compiled automatically to make informed urban mobility plans and real time decisions represent the city's ambition to merge the physical and digital worlds seamlessly. The mobility solution will benefit of the combination of supportive policy measures above. Nevertheless, this ambition requires embracing radical changes in the silos-working paradigm embracing the collaborative culture, defining knowledge sharing mechanisms, acknowledging a leader to coordinate the transition to the new paradigm, deploying standardization for sharing data (protocols, agreements), ensuring data quality and maintenance operations, and providing capacity building programmes.

Finally, Table 13 presents the essential learnings to be considered by other cities for transferring the DSS from the experience of the use case 1 in Tel-Aviv.

Table 13. P5 Tel-Aviv – UC1: Learning Outcomes & Conclusions

UC1	**Passengers mobility patterns identification**
Barriers and Challenges	• Incomplete network coverage by BT detectors and missed detections • Difficulty to obtain data from other sources such as private providers. (Including GIS data needed to calculate shortest paths and threshold values) • Missing data due to damaged detectors • Choosing the most appropriate software for spatial data visualization, and interactive decision supporting tool (including software licence considerations)
Practice to avoid	• DATA: Rely on single data source, lack of data quality measures.
Drivers and opportunities	• Increased awareness to the potential of novel data sources to provide traffic insights. (Considerations of cost-effectiveness and relatively simple logistics procedures to collect data). • Data-driven decision-making process enhances the quality of the decisions • Potential to public-private partnership. Data accumulated by the private sector can serve the public sector. • Start-up companies tend to share their capabilities in exchange for testing and validating their products and methodologies.
Best Practice **Description**	• Apply in locations with sufficient data availability. • Set threshold values for data quality according to pre-determined measures • Explore available software for visualisation and chose the suitable tool • Involve stakeholders from different disciplines in setting the decision-support tool specifications
Learnings and recommendations for scaling up to the city level and for second layer cities	• Study the appropriate business model for data acquirement. Data collection equipment, frequency of data collection, data accuracy, and technology maturity are part of the criteria's that should be considered. • GIS data layer of the network is essential, including all traffic arrangements. • Integrate the local knowledge of traffic experts throughout the process. • Advanced data analysis capabilities, and acquaintance with big data analysis techniques are mandatory. • Determine the characteristics of the decision supporting tool, and address challenges related to visualisation of geospatial data, and BI systems.

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2.5.2 Use case 2: Public Sphere re-allocation

Tel Aviv municipality maintains an ongoing dialogue with the city's residents and various stakeholders. However, outcomes are not incorporated into the decision-making processes methodologically. Use case 2, "public sphere re-allocation," adapted the "House of Quality" (HoQ) into the urban planning process. HoQ is an analysis tool used in the management and design industries to reflect customers' needs. Despite the declared policy regarding the hierarchy of road users, re-distribution of roadway rights among road users arouses conflicts between needs and preferences of different road user's groups, let aside constraints arising from limited recourses (e.g., narrow streets), existing infrastructure, and design constraints mainly in terms of inflexible safety requirements.

The demonstration focused on pedestrians' and cyclists' needs. Focus groups, expert interviews, and an online survey were used to identify the needs, the design attributes, and the contribution of each design attribute to fulfilling the needs. Policymakers determined the weight granted to each need of each road users' group. The survey results revealed the identities and conflicts between the various road users' needs.

Incorporating the outcomes into the HoQ, revealed the preferred design. Policymakers could examine how a change in prioritizing the needs of certain road users or an emphasis on a particular need (e.g., liveability versus safety) changes the preferred design.

The results of the HoQ analysis ranked the street design scenarios considering the weight policymakers assigned to the needs of each road users group. In addition, the outcomes revealed to what extent each design attribute contributes to each need.

The **Functional suitability** and **Usability** of the tool were evaluated by urban planners and decision-makers. The tool provided its purpose to reveal the needs and preferences of different road users as well as the methodological approach to resolve conflicts. Reflecting identities and opposing perceptions toward each attribute separately contributed to the overall understanding of the preferences.

The main problems encountered during the implementation regarded the many dimensions of the dilemma of optimal distribution of roadway rights. The number of variables and attributes needed to study the trade-off between capacity, safety, and liveability is large. To demonstrate the methodology some simplification was needed. Also’ despite the defined policy of the hierarchy between road users in urban settings there are no detailed guidelines for transportation planners to prioritize transport modes, taking into account all aspects and limitations in the public sphere. COVID-19 restrictions hindered the option to conduct a field experiment, where participants would have experienced the different streetscape designs focusing on revealed preferences rather than stated preferences. Different policy measures were identified to overcome these hurdles. The implementation feasibility and the user acceptance were evaluated by the users and the stakeholders below.

- Public Administration
- Urban planning expert
- Public transportation operators
- Providers of new mobility services

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UC2	Public Sphere re-allocation
Drivers and opportunities	• Integrating new mass transport system is an opportunity to set new priorities and reallocate the public sphere favouring non-motorized traffic modes • Increased demand to liveable public sphere and awareness to non-motorized modes. • Criticism of non-transparency in the implementation of recommendations from public consultation processes. • Promote policy to encourage the provision of adequate and safe public space for pedestrians, cyclists, and other non-motorized modes • Lack of agreement among stakeholders and decision makers regarding the best design choice (competing needs)
Best Practice Description	• Define the specific conflict, and the relevant stakeholders. • Consider the available resources, and timeframe. • Each phase builds upon the outcomes of the previous one. Defining stakeholders needs, design attributes and their values are essential to plan the survey. Some iterations might be required. • Chose software that can clearly present the desired road section designs, including all the relevant details. Used Streetmix[8] which had some drawbacks regarding some details.
Learnings and recommendations for scaling up to the city level and for second layer cities	• Detailed visual representation of the street design is crucial for the survey. It is essential to choose software representing the attributes related to the specific survey clearly and accurately. • Methodological design of the survey. Not to compromise regarding the minimal number of respondents needed to achieve significant results. • Involve decision makers and professionals in all phases of the design. • Balance the experience and judgment of professionals with the preferences of the stakeholders/road users (Professionals may have concerns involving the implementation of the outcomes).

2.5.3 Use case 3: Vulnerable Road Users prioritization

A common approach to managing the crossing opportunities at signalized intersections is to provide a predetermined pedestrian green light duration for each signal cycle. The duration is calculated based on the crossing length of the crosswalk and an estimated crossing speed, representing a normal walking speed of a healthy individual. For VRU, however, the current

[8] https://streetmix.net/

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state of practice may lead to an increased frequency of dangerous crossings – situations where the pedestrians are still present at the crossing when conflicting vehicular traffic is starting to enter the intersection. In this use case an VRU detection tool was developed. Interface between the detector and signal control algorithm was developed as well. The main principle of the prioritization is to detect the late crossing start by the VRU and prolong the green light by few seconds in order to ensure a safe crossing. This algorithm allows to prolong the green light only if needed, minimizing the delays of conflicting traffic. While the detection algorithm and traffic control algorithm were developed using real-world data, the use case implementation and evaluation were carried out in a simulation environment.

The **Functional suitability** is measured by the extent the algorithm identifies and prioritizes vulnerable road users according to the specification defined. **No "False Negative" events occurred at the end of pedestrian green period, meaning there were no events where VRUs didn't get a required green extension.** On the contrary, the extension was activated due to a false alarm during 4% of the cycles, in addition to 15% of the cycles that required green extension due to unsafe crossing. The algorithms assessments included two aspects:

(1) video detection algorithm accuracy evaluation. Three measures used to evaluate the performances are:

- **Negative prediction –** the ability of the algorithm to correctly identify the cases where no VRUs are present in the detection zone – 96%
- **False Positive Rate –** the frequency of video detection false alarms – 7.6%
- **Recall** – proportion of all positive video detections that were classified correctly – 84.9%

(2) mobility impacts of the suggested traffic control scheme implementation (conflicting traffic delays). Delays were calculated for each conflicting traffic. **The maxuimum delay was 2.6%.**

The **Portability** of the algorithm includes two aspects, (1) **Identify other types of equipment (objects)** Same identification model will be used, however should be trained and validated for the specific object. (2) **Apply the algorithm in other locations/intersection** – the identification model need to be validated in the same location, and the traffic light extension logic should be adjusted to the intersection chractartistics.

High levels of **Satisfaction** were expressed. The pilot is perceived as part of social equality measure for vulnerable road users. Concerns included request to expand the implementation to other types of vulnerabilities not addressed by the current pilot, and concern regarding increased waiting times in other crosswalks.

The ***main problems encountered*** during the implementation were (1) regulatory barriers that prevented integrating the detector in real-word situation. (2) lack of political commitment for widespread application (3) technological challenges such as powerful computation hardware required to apply the identification algorithm in real-time.

Applying the algorithm in a simulation environment helped tackle the objections of other stakeholders and strengthen the political commitment. The outcomes indicated that the impact (delays) imparted to other road users, due to applying the green light extension only if needed, is neglectable. These problems were further analysed following the SIS methodology in T4.4. This process helped to identify the following veto players:

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- Traffic management experts - public administration;
- Traffic management experts – private sector
- NGO - Promote accessibility and inclusion of people with disabilities
- Public transport planner

Then, they defined the policy package that includes: 1) develop and apply a methodological approach to integrate vulnerable road users' priority strategies in the traffic signals logic; 2) apply green extension only when required, e.g. late crossing start by the vulnerable road use; 3) Grant local authorities the option to examine and apply pilots for innovative traffic signals; 4) Political commitment to prioritize vulnerable road users safety at signalized intersections

The results presented the advantages and disadvantages of implementing the policy package in comparison with the do-nothing scenarios, which basically has mostly positive effects for most stakeholders. Contribution to social inclusion, adjustability to varying needs at different times and pedestrian safety are expected to be the most significant positive impacts, followed by the level of public space accessibility and ease of crossing for pedestrians. The only negative effect is the increased delay of conflicting traffic, which was neglectable when applied on one intersection but should be further investigated when applied in an entire network setting.

Figure 14 presents the final list of policy responses to support use case 3 in Tel-Aviv. This list contains the updated set of policy measures after the SIS analysis and is based on SPROUT experts' contribution once the pilot was more mature. The list is sorted after analysing the implementation feasibility and user acceptance during the last step of the pilot implementation.

Develop and apply a methodological approach to integrate vulnerable road users priority strategies in the traffic signal logic

- Benifits of reducing VRU unsafe crossing and improving social inclusion measures for VRU, outbalance the cost involving identification model development, traffic signal logic, and continually activating the model.

Apply green extension only when required e.g. late crossing start by the vulnerable road use

- Adresses stakeholders' concerns about reducing traffic efficiency.

Grant local authorities the option to examine and apply pilots for innovative traffic signals methodologies (such as novel detectors)

- Distribution of authorities between local and national level, to simplify pilots approval process

Political commitment to prioritize vulnerable road users safety at signalized intersections

- Prioritize road users rather than the vehicles (including public transportation)

Figure 14. Tel-Aviv use case 3: alternative policy responses benchmark.

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Use case 3 is one the most controversial Tel-Aviv mobility solution and requires supportive policy measures to overcome the real-implementation concerns. There is not only one supportive policy measure but a combination of several ones. The ones above and examined during the final steps of the pilot implementation may help overcome these barriers. However, they require additional mechanisms to tackle the reasons of unfeasibility and unacceptance (see D4.11). As in the two previous cases, the mobility solution and the package of policy measures require specific labour skills, sharing knowledge, coordination efforts, collaborative and cooperative culture. Indeed, the future city trends that prioritize active and shared urban mobility should be considered the main reason to handle the public transport barriers as the need to cooperate and align the interest and agreements, solve conflicts among the local, regional and national levels

Moreover, the benefits of the simulation testing environments and the neglectable impact on the traffic flows should be communicated to demonstrate the benefits to the stakeholders' concerns of reducing the urban traffic efficiency.

Finally, Table 15 presents the essential learnings to be considered by other cities for transferring the VRU prioritization from the experience of the use case 3 in Tel-Aviv.

Table 15. P5 Tel-Aviv – UC3: Learning Outcomes & Conclusions

UC3	Vulnerable Road Users prioritization
Barriers and Challenges	• Regulatory barriers (applying new methodologies/detectors into the traffic light logic requires approval of the Ministry of Transportation which entails lengthy procedure) • Alignment between the political commitment to prioritize pedestrians and social inclusion of vulnerable citizens and the actual implementation of the policy • The technical and hardware requirements for real-world application • Optimizing the object recognition model capabilities, especially in environmental conditions that might impair identification abilities (Weather, lighting).
Practice to avoid	• Over fitting of the identification model (impairs identification performances) • Under estimating computation power necessary for real-time identification and applying extension algorithm
Drivers and opportunities	• Awareness and commitment to equality and social inclusion of vulnerable groups • Availability of technological equipment and methods to real-time identification of VRU • Improve safety measures, especially for pedestrians • Opportunity to implement with negligible impact on other traffic
Best Practice	• Utilization of the existing infrastructure (traffic cameras) • Allocation of manpower for manual tagging

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UC3	Vulnerable Road Users prioritization
Description	• Periodic object recognition performance evaluation and calibration if necessary • Traffic algorithm redesign to accommodate VRU priority scheme while minimizing negative effects on traffic • Communicate איק KPI's calculated based on the simulation to address concerns regarding the impact on other traffic
Learnings and recommendations for scaling up to the city level and for second layer cities	• VRU identification model need a sufficient number of frames/images for training to improve its performances. (used ~ 1,700 frames/images) • Test the algorithm in a simulation environment based on real-word data to assess the potential impact. • Applying the green light extension only when needed. Improved the performances and decreased the delay of other traffic significantly. • The identification algorithm requires powerful computation hardware. • Utilize existing cameras when possible • Ensure privacy protection, in case any personal details are stored. • Consider regulatory barriers. Experiments entailing changes in the traffic signals logic or algorithm are not allowed without the approval of the government. Approval process might be lengthy.

3 Pilots differences and commonalities

This section will present the commonalities and differences found among the pilots based on the following aspects:

- SPROUT Evaluation framework: level of adoption and adaptations
- Supportive policy measures
- Key stakeholders: advantages and disadvantages from implementing supportive policy measures
- Recommendations: Best practices to replicate, things to avoid

3.1 SPROUT Evaluation framework: level of adoption and adaptations

The SPROUT evaluation framework (EF) reported in the (D4.1: Pilot evaluation framework, 2020) is a methodological pipeline with three sequential steps and one cross step (Figure 15).

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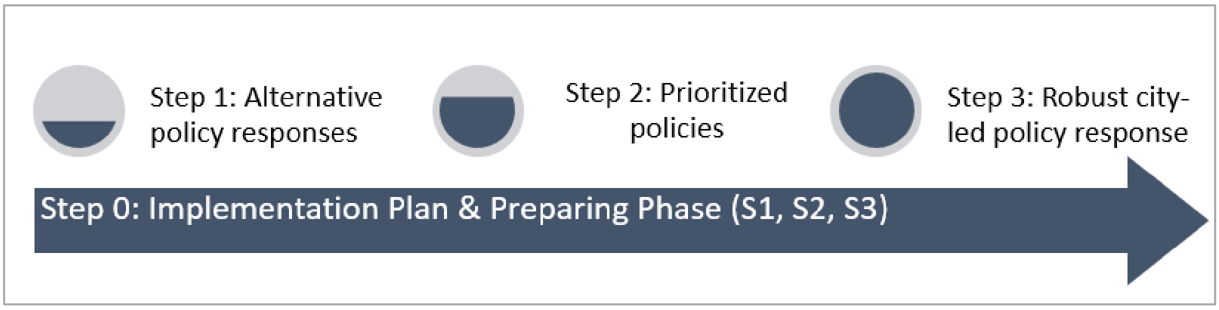

Figure 15.SPROUT Evaluation Framework (EF): Methodological pipeline (own source)

The S0 consists of defining the pilot implementation, data collection and evaluation activities and reflecting this information and the times required in a Gantt diagram for the three sequential steps. It is a cross-functional step to include all the potential changes and adaptions reflected in the pilots' step reports (D4.2, D4.4, D4.6, D4.8, D4.10) as described below.

The S1 refers to the pilot implementation, testing and data collection to perform the sustainability impact assessment, operator's financial sustainability and operational feasibility and use this information to identify a list of alternative policy responses that supports the implementation of mobility solution. The SPROUT EF proposed a list of Key performance indicators, data collection and calculation methods and default values for transforming activity data in sustainability costs based on well-known and recognized methodologies. However, the level of adoption and adaptation were not homogenous among the SPROUT pilots' use cases. One of the biggest hurdles was the lack of baseline data. Moreover, COVID-19 safety measures reducing the use of mobility solutions and the lack of data sharing agreements did not allow the collection of high levels of detailed data from the source. This situation forced the formulation of many assumptions, performing surveys to assess the sustainability impacts and operational feasibility and, finally, omitting the financial analysis. The use case in Padua was the only one following the methodologies for S1 as proposed by the SPROUT EF for measuring the transport cost externalities. The main reason encountered for the Padua is that the field operation tests were in a control testing environment using two experimental vehicles (pods). It allowed daily activity data (daily kilometres per pod) collection as previously agreed with the pods' manufacturer, formulate comprehensible assumptions based on literature review or the pod's systems checked values. The first use case of Tel Aviv adapted the methodology proposed in SPROUT EF to the available data, and calculated congestion costs based on "delays at intersections" rather than relying on "daily kilometres per passenger". However, the rest of the use cases did not have direct access to this activity data and were not able to calculate these externalities costs.

It is essential to outline that COVID-19 had a high impact on the pilots' mobility solutions. In some cases, as Valencia's parcel lockers, Budapest's points and Padua's autonomous vehicles for cargo hitching, it postponed the financial availability and reduced administrative workforce delaying the implementation until March 2021 for Valencia city packs, August 2021 for Padua and December 2021 for Budapest points. About the latter, this situation forced to deploy T4.3 based on adapting the physical into a simulation environment. In all use cases, the safety and distance measures delayed the data collection or required methodological adaptations to collect data using digital tools instead of field research. The level of uncertainty of the pilots' use cases finalization and the initial experiences were the reasons to start Step

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2. As pilots were not mature enough to identify mutually exclusive alternative policy responses and define packages of policy measures for only the most controversial use case by the time this step was planned (December 2021), the methodology proposed in the SPROUT EF was slightly modified. Instead of following MAMCA methodology and providing a list of alternative policy responses, the list of selected use cases followed the SIS methodology which allowed identifying the veto players and the advantages and disadvantages for them and the community to justify the adoption of the packaged of policy measures to support the implementation of the mobility solution and reduce the potential deployment or long-term sustainability barriers.

The final step required that the pipeline followed a minor adaptation. As observed in Figure 15, the S3 input is a list of prioritized policy responses while S2 was providing a "package of measures" for some selected use cases.

To produce the S3 input, the SPROUT experts and pilots' stakeholders worked on adapting the policy measures proposed by the S2 or identifying the ones and the veto players for the pending use cases. This process was as follows:

1. SPROUT experts identified a list of supportive policy measures and veto players from the S2 and D3.3
2. SPROUT partners evaluated the lists and selected the top-three ones in the workshop celebrated during the third consortium meeting on 7th June 2021 using the Mentimeter tool.
3. The results were analysed and shared with the pilots which fine-tuned or adapted the proposed lists.

Afterwards, the pilots followed the same process for exploring the policy measures user acceptance and implementation feasibility to define the city-led policy response that enhances the adoption of the mobility solutions. All the pilots use cases implemented two-stages methodologies. During the first stage, the pilots identified stakeholders and users. Both responded to specific surveys shared with Qualtrics. Then, the measures with the feasibility and acceptance values below the threshold (2.5 in a 1 to 5 Likert Scale) were discussed during a workshop. The participants were the pilots' local partners who responded to specific questions to identify the reasons for misalignments and unacceptance and proposed mitigation strategies. Only Padua adapted the methodology. It conducted the workshop during the first stage and bi-lateral interviews with the essential agents during the second stage.

In conclusion, pilots tailored the SPROUT EF proposed methodologies and KPIs to their idiosyncrasies based on data availability and granularity during the S1. COVID-19 caused enormous delays during this first step, data collection tools adaptations and migrations to digital tools (eg. Mentimeter). It had consequences to the subsequent steps S2 and S3. About S2, the SPROUT EF methodology MAMCA was slightly modified to the information available by the time it was planned. The final methodology, SIS, provided the pilots with meaningful information and a better understanding of the selected further explored mobility solutions. All pilots use cases followed exactly the same steps and timelines during S2. Finally, all the pilots use cases identified the list of alternative policy measures following the same approach and explored the implementation feasibility and user acceptance to define the city-led policy response to facilitate the transferability and scalability of the mobility solution.

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3.2 Supportive policy measures

This section presents all the policy measures to support the nine SPROUT use cases mobility solutions identified by the pilots. The list of policy measures is classified into the following identified categories:

- Collaborative agreements
- Data sharing and data privacy clauses
- Guidelines/ methodologies
- Infrastructure
- Organizational changes/ leadership commitment
- Subsidies
- New/ adapted regulations

Table 16 maps the list of policy measures and the use cases that selected them to support the scalability and transferability of the mobility solutions. A green colour scale allows identifying the level of support (dark green for the most supportive one, light green for the least supportive one). As observed, there is one red for Valencia use case 2. The reason is that the pilot stakeholders discarded these proposed policy measures during the operations feasibility and user acceptance assessment (S3 of the SPROUT EF).

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Table 16. SPROUT list of policy measures to support mobility solutions categorization.

Policy measures	category	P1 Valencia	P2 Kalisz	P3 Budapest	P4 Padua	P5 Tel-Aviv
Establishing public-private collaboration mechanisms to facilitate the adoption of measures to improve sustainability in cities	collaborative agreements	UC2				
Tools used to strengthen the link between the public and private sectors	collaborative agreements			UC1		
Integration of Next with Local Public Transport and development of modal shift	collaborative agreements				UC1	
Development of innovative solutions as support for logistic operators	collaborative agreements				UC1	
Application of techniques for stakeholder involvement in decision-making process	collaborative agreements					UC2
Legal mechanism to include clauses on data sharing privacy policies/ Set agreements for data	data sharing and data privacy clauses	UC2				UC1
Support cooperation with data providers from the private sector to enhance data quality by supporting data fusion from multiple resources	data sharing and data privacy clauses					UC1
Provide clear measures for traffic data quality based on the application (traffic management, planning, etc.)	guidelines/ methodologies					UC1
Introduce an environmental criterion in public delivery contracts (bike delivery, e-vehicles, etc.)	guidelines/ methodologies		UC1			
Definition of measures and guidelines for transport in favour of certain modes of transport	guidelines/ methodologies			UC2		

Policy measures	category	P1 Valencia	P2 Kalisz	P3 Budapest	P4 Padua	P5 Tel-Aviv
Advantage of active transport over individual motorized transport	guidelines/ methodologies			UC2		
Measures taken to give priority to public transport	guidelines/ methodologies			UC2		
Set-up of specific procurement procedures for innovative mobility solution	guidelines/ methodologies				UC1	
Define the data collection devices' maintenance policy (for example quick repair of identified damaged devices and periodic inspections)	guidelines/ methodologies					UC1
Develop and apply a methodological approach to integrate vulnerable road users priority strategies in the traffic signal logic	guidelines/ methodologies					UC3
Adoption of a structured methodological approach to mediate and prioritize competing needs and conflict resolution between road users/stakeholder needs	guidelines/ methodologies					UC2
Define measures and guidelines for transportation planners to prioritize transport modes	guidelines/ methodologies					UC2
Apply green extension only when required e.g. late crossing start by the vulnerable road use	guidelines/ methodologies					UC3
Building protected and well-maintained bike lanes/ Construction of protected and well-maintained bicycle lanes and main lines/ Provision of adequate and safe public space for pedestrians and cyclists, consisting of wide, shaded sidewalks with urban furniture and protected bike-lanes	Infrastructure	UC1		UC1		UC2

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Policy measures	category	P1 Valencia	P2 Kalisz	P3 Budapest	P4 Padua	P5 Tel-Aviv
Improvement of existing bike network by connecting with interurban bike lanes as well as with urban intermodal modes	Infrastructure	UC1				
Establishing loading and unloading zones as close as possible to the intermodal hub	Infrastructure	UC2				
Provision of mobility hubs to enhance connectivity and multimodality/ The provision of inner-city micro-consolidation centres	Infrastructure	UC2	UC1			
Provision of leisure activities, green surfaces, street furniture	Infrastructure			UC2		
Resolving legal issues related to the regulation of market-based services	organizational changes/ leadership commitment			UC1		
New function/ office dedicated to the development and management of freight logistics and Local Public Transport	organizational changes/ leadership commitment				UC1	
Grant local authorities the option to examine and apply pilots for innovative traffic signals methodologies (such as novel detectors)	organizational changes/ leadership commitment					UC3
Political commitment to prioritize vulnerable road users' safety at signalized intersections	organizational changes/ leadership commitment					UC3
Adapted regulations for the smart bays, with private cars able to park on them during dedicated hours and/or days (like on weekends) with subscriptions	new/ adapted regulations		UC1			

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Policy measures	category	P1 Valencia	P2 Kalisz	P3 Budapest	P4 Padua	P5 Tel-Aviv
Weight and/or size restrictions for delivery vehicles	new/ adapted regulations		UC1			
Establishment of low-emission zones (emission-based recovery restrictions)	new/ adapted regulations	UC1		UC1		
Sustainable public transport: subsidies and promotional campaigns	subsidies	UC1				

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3.3 Key stakeholders: advantages and disadvantages from implementing supportive policy measures

This section summarizes the results of the SIS methodology, the second step of the SPROUT EF.

Table 17 shows the most relevant groups of stakeholders for each use case explored with the SIS methodology. All the pilots use cases think the local government is essential in the addition of policy measures, except Budapest UC2. It is important to stress that the second most common category is the Local cyclist/ walking association. Thee out of five pilots were testing different solutions to raise and improve walking and cycling mobility. It may reflect the trend towards urban micromobility. Urban space reallocation, the provision of new lanes, parking places for the new modes of mobility or urban furniture are some of the requirements to scale the adoption of these mobility solutions. Therefore, infrastructure providers are essential agents in facilitating the transition, as exhibited by the 60% of the pilots use cases following the SIS. There is a miscellaneous category. It states that other stakeholders are crucial in promoting and sustaining this transition as the Mobility and Environment Department in Padua, observed, accessibility is the most predominant advantage, followed by a positive environmental impact and flexibility to adjust the resources to varying needs or the demand. There are other advantages such as security, safety, connectivity and inclusivity.

Table 18. Pilots stakeholders' advantages of implementing packages of policy measures.

Advantages for the stakeholders	P1 Valencia UC1	P2 Kalisz UC1	P3 Budapest UC2	P4 Padua UC1	P5 Tel-Aviv UC3
Positive Environmental impact					
Security					
Accessibility					
Adaptability to demand/adjustability to varying needs					
Coherence of public space usage					
Integration/ connectivity					
Contribution to social inclusion					
Pedestrian safety					
Ease of crossing for pedestrians					

Table 19 reflects the pilots' stakeholders that exhibited that the package of policy measures may create some disadvantages for them. Two pilots indicated hurdles related to financial issues. On the one hand, the local municipality of the UC1 in Valencia considers the investment for building and keeping well-maintained bike lanes may be high. On the other hand, for the public transport operator in Padua (BIV), the new mobility services and policy measures to support all different modes of transport may create some financial feasibility issues due to the initial investment.

For Budapest, the package of policy measures does not have any disadvantage for the stakeholders involved.

Finally, as observed in Table 18, accessibility is considered one of the advantages of the Kalisz UC1. However, entrepreneurs and private companies with a time for delivering below 5 minutes think these policy measures reduce the accessibility as the time required for parking is over the time for loading or unloading.

Table 19.Pilots stakeholders' disadvantages of implementing packages of policy measures

Disadvantages	P1 Valencia UC1	P2 Kalisz UC1	P3 Budapest UC2	P4 Padua UC1	P5 Tel-Aviv UC3
cost of investment	municipality (torrent)				
reduce accessibility (delivery time <5)		entrepreneurs & private companies			
none					

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Disadvantages	P1 Valencia UC1	P2 Kalisz UC1	P3 Budapest UC2	P4 Padua UC1	P5 Tel-Aviv UC3
financial feasibility				BIV (public transport operator)	
increase in the number of traffic lights					pedestrians, cyclist and citizens associations

3.4 SPROUT thematic groups

The SPROUT experts identified six thematic groups to categorize the nine SPROUT use cases. The classification concerns the same subject or theme. As observed in Figure 16, there are three groups with two use cases, as they explored a similar concept or mobility solution. This categorization will be the foundation to build the SPROUT pilots policies transferability messages (section 4) and will serve as input for the system dynamics analysis in the D5.2.

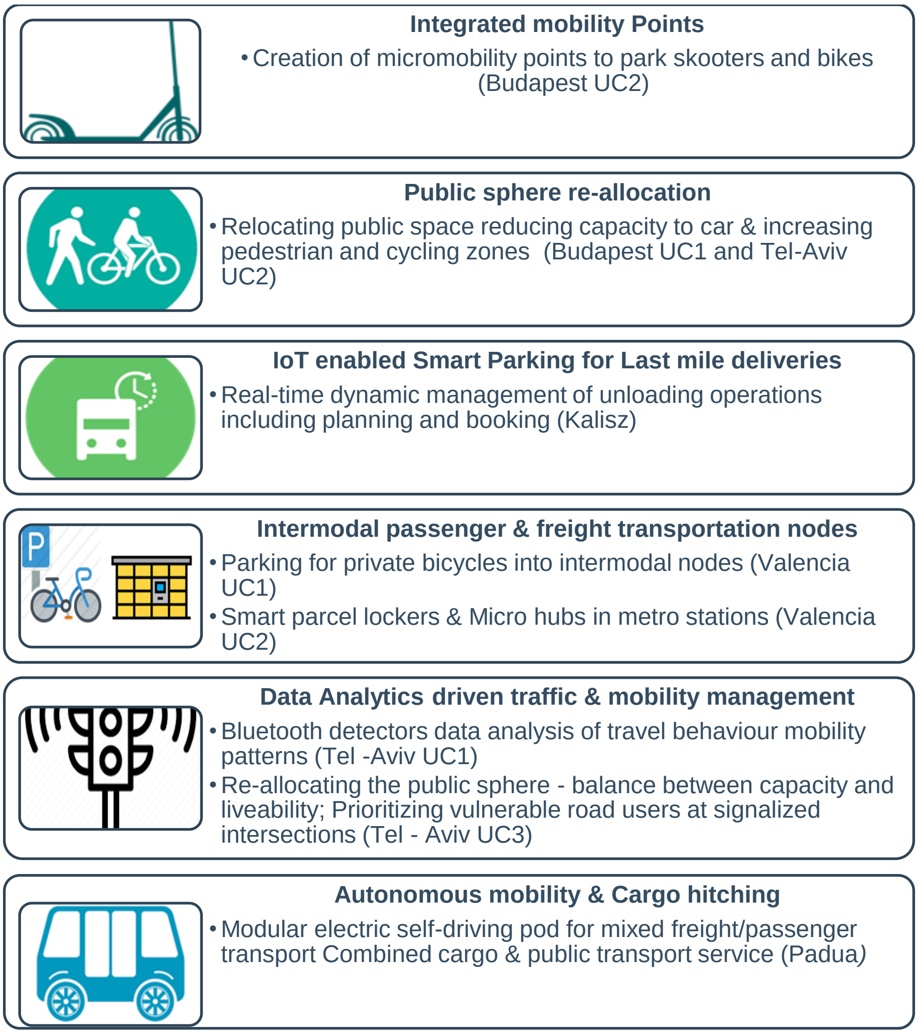

Figure 16. SPROUT pilots' categorization in the SPROUT thematic groups.

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4 Cross -pilots policies transferability messages

This section aims to provide any other city cross-pilot policies transferability messages about the experience, results and know-how acquired during this period. It will help deploy the mobility solutions, grouped into the thematic areas introduced in section 3, smoothly and increase the city's adoption and sustainable implementation in the long run (see Table 20).

Table 20. SPROUT Thematic group - transferability messages.

Thematic Group	Transferability messages
Integrated mobility points **(Budapest UC2)** 	Collaborative agreements and cooperative commitment among different local public entities (e.g. the municipality, districts administration) are essential to promote and support the implementation.
	It is also necessary to have regular exchanges between stakeholders, such as micromobility service providers, mobility managers and the municipalities – especially at the beginning of the process. The dialogue is crucial to avoid misunderstandings and helps create regulations accepted by all stakeholders.
	The Mobility Points help avoid bad parking practices and foster the adoption and acceptance of shared micromobility vehicles for people either in favour or not. It makes parking easier – users can be sure that they park the vehicles in the right place – where it will not disturb pedestrians (especially elderly or people with disabilities) and other road users. Therefore, the overall acceptance of such service can also increase.
Public sphere reallocation **(Budapest UC1 and Tel-Aviv UC2)** 	The introduction of traffic-calming zones and the acceptance take time and require political commitment. It showed the real benefits for the whole city, enhanced with green spaces, street furniture and permissions for terraces. It is essential to keep in mind that the first steps can cause strong criticism from local residents, who need time to adapt to the new rules or environment. Using benches, trees and parklets (even temporary design at the beginning) can help to increase the popularity of traffic calming zones, as people feel they gained benefits and not just lost previous privileges (for example car owners cannot drive through certain streets).
	Co-creation practices and methodologies that consider universal design principles fostering citizens participation helps

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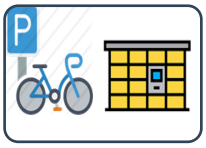
Thematic Group	Transferability messages
	to create a perdurable and universal redistribution of the public urban space for users and non-users. Citizens empowerment is a key to ensuring a successful transition towards future urban mobility.
IoT enabled parking for last-mile operations (Kalisz UC1) 	Understanding of the trade-offs between the time the drivers need for planning, booking, handling of goods from bays to delivery points and just delivering as an essential factor to define supportive policies for avoiding bad parking practices. Consider subscription instead of parking fees. Take into account local weather conditions and possible heavy traffic when selecting the technology. Enable private cars and other mobility vehicles to park on the loading bays during off-hour deliveries to improve the urban space use.
Intermodal passenger & freight transportation nodes **(Valencia UC1 & UC2)** 	The new services into an intermodal node require public-private partnership agreements that demand more agile protocols and data sharing clauses to facilitate the provision, maintenance and adaptations of the new digital mobility services. Time-efficient administrative procedures and data-driven decisions are essential for future urban mobility. Different public bodies with distinct competencies should work together to understand the benefits of new mobility solutions, commit and support the implementation, fund and promote dissemination activities are essential to foster the users' acceptance and adoption.
Data Analytics driven traffic & mobility management **(Tel-Aviv UC1 & UC3)** 	Tel -Aviv: Availability of real-time information from passengers and vehicles with advanced digital analytical techniques truly enhance policymakers understanding when making strategical decisions for redistributing the public space or reorganizing the mobility services and routes to overcome short and medium-term disruptions. Step forward towards the development of a city mobility digital twin. Furthermore, detection of vulnerable users' needs to dynamically adapt traffic lights do not affect the traffic flows efficiency and increases pedestrians' safety. Although the message is based on simulation, it allows showcasing how to make cities more inclusive and mobilize public bodies in charge of changing the status quo.
Autonomous mobility & Cargo hitching (Padua UC1)	The modularity of the innovative self-driving, pods brings proven benefits to enhance urban mobility either for passengers or freight and improve public space use. Disruptive and innovative

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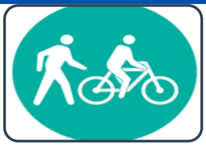
Thematic Group	Transferability messages
	fundamental mobility solutions towards the transition to future urban mobility require dedicated public bodies to fund and create more agile bureaucratic procedures and commitment. It also needs policies to ensure the integration with the existing public and private mobility services that reinforces the adoption and acceptance of the current service providers veto players..

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5 Conclusions

The SPROUT pilots' cities represent a wide variety of geographies and cultures with the same aim: lead the transition towards the new urban mobility and become smarter, environmentally conscious, inclusive and liveable cities while sustaining the economic growth and tackling the 21st-century challenges (cities population growth, decarbonization, climate change, migration, pandemics). The COVID-19 had a high impact on the SPROUT pilots' deployment. It delayed the implementation, the testing and the data collection activities. The pilots learnt to use and introduce digital tools for compiling opinions and organizing workshops. Moreover, one of the cases was based on simulation as COVID-19 postponed the financial resources until the conclusion of the SPROUT project time available.

The work to develop (phases, impact assessment, stakeholders' identification, definition and operational feasibility and user acceptance assessment of alternative policy responses) was divided into three phases as explained by the SPROUT Evaluation Framework. It provided the pilots with detailed guidelines for conducting a light cost-benefit analysis: proposed a list of KPIs, default values for transforming activity data into negative externalities costs and explained the methodologies for the different phases. However, the lack of baseline data and access to financial information required some pilots to conduct surveys or renouncing to assess some impacts during the first phase. Moreover, the pilots could not prioritize the policies identified during the first phase following the SPROUT EF proposed methodologies (MAMCA). Pilots considered that the policy measures are not mutually exclusive and could not evaluate their preference level. To produce the inputs for the final phase, the SPROUT technical and academic experts from CERTH, VUB and ZLC adapted the MAMCA methodology to the SIS methodology. They added one step between phase 2 and 3. The SIS methodology applied on the most controversial use cases (one per pilot) provided the veto players with a better understanding of the mobility solutions problems and the advantages and disadvantages of introducing a package of policy measures. The additional step consisted of a three stages process: first, the SPROUT technical experts identified a list of policy responses for complementing the selected use case and for the pending use cases; second, the SPROUT partners evaluated the level of applicability during the 3rd Consortium meeting; third, the list was refined by the local pilot partners. Finally, once all the use cases had identified four policy responses (either mutually exclusive or not), the final SPROUT EF phase assesses the implementation feasibility and use acceptance and completed the intense and rutted road behind. The result of the last phase is that the implementation feasibility and acceptability of the supportive policy measures require complementary policy measures.

At all events, the experiences and work developed since the beginning of WP4 (June 2020) have helped these cities to introduce and test innovative mobility solutions, conduct the intense data collection activities for defining the city-led policy responses and produce the following policies transferability messages clustered in the six thematic groups.

1. Integrated mobility points (Budapest UC2)
2. Public sphere reallocation: (Budapest UC1 and Tel-Aviv UC2)
3. IoT enabled parking for last-mile operations (Kalisz UC1)
4. Intermodal passenger & freight transportation nodes (Valencia UC1 & UC2)

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5. Data Analytics driven traffic & mobility management (Tel-Aviv UC1 & UC3)
6. Autonomous mobility & Cargo hitching (Padua UC1)

The first layer cities will support the second layer cities in introducing new mobility solutions and defining the correct policy response during the last steps of the project. The interactions and knowledge transfer will be essential. They will help them evaluate whether the mobility solutions and the accompanying policy responses to harness their positive impacts can be transferred and become a widely-applicable policy response.

Finally, based on the experiences and type of policy measures identified, it is important to outline that the transition towards the new urban mobility requires more collaboration between public and private entities, data sharing and data privacy and protection clauses and agreements, more user centric designs and co-creation processes that take into account all the agents and users' needs, public sphere adaptations with investments in new infrastructures and shared assets, new regulations, standards. guidelines, methodologies and agile administrative procedures to specify and define how facing and solving the different challenges.

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