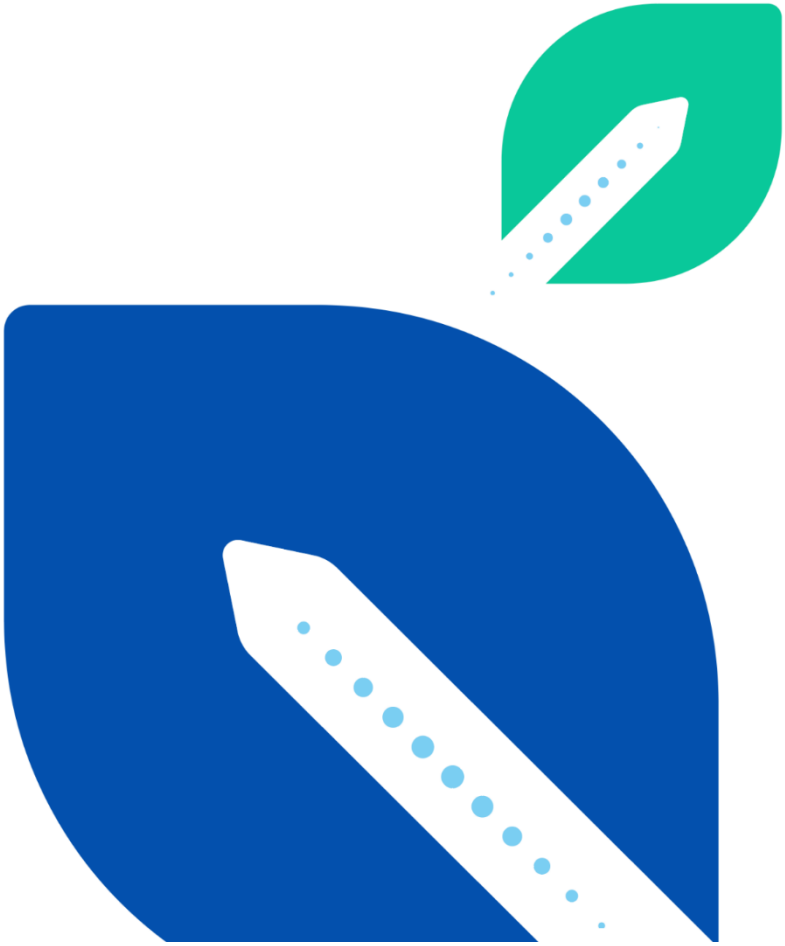
D4.6: Set-up Report Kalisz

IoT-enabled urban logistics



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 814910.

Deliverable

Work package	4
Work package title	Pilots' setup, running & testing
Date	26.02.2021
Author	ILiM
Status	final
Version	4
Dissemination level	Public

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Executive Summary

On average, urban freight is responsible for 25% of urban transport related CO_2 emissions[1]. Kalisz is not an exception in that statistics. The distribution of goods in urban areas is heavily increasing and, therefore, it strongly contributes to the increase of traffic in the city centre.

Within Kalisz pilot, it is planned to develop and validate the concept of introducing a digital mobility solution for improving the organization and management of the loading/ unloading operations in the city centre.

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

The planned reloading will allow the trucks to go directly to the booked place on the specific time, and parking and reloading close to the designated place. This should result in the reduction of unnecessary trucks traffic and manoeuvring, and growing safety for pedestrians and other drives during the whole transport operation.

[1] ALICE, Research and Innovation Roadmap - Urban Freight, https://www.etp-logistics.eu/?page_id=96, access 2020-06-20

Table of Contents

Figures

Tables

1 Introduction

1.1 Aim of the deliverable

The aim of this deliverable is to be used as a reference document to guide and monitor the development of the pilot in WP4. It prepares the implementation of the SPROUT pilot in Kalisz giving detailed information in terms of: (1) the mobility solution that will be implemented and tested; (2) the location, area and context where it will be introduced; (3) the specific actions required for its implementation and the role of the crucial stakeholders involved; (4) the identification of additional stakeholders to further enrich the pilot's ecosystem; (5) and a tailored evaluation framework to assess the pilot, derived from D4.1.

1.2 How this deliverable relates to other deliverables

D2.2 provides the baseline of the current mobility situation in each of the project cities, and D3.2 and D3.3 the definition of the expected impacts of the emerging mobility solutions without policy intervention. D4.1 provides the pilots with a generic evaluation framework they can adapt to the pilot specific case. Deliverable D4.6 will be the basis for deploying the activities under T4.3, T4.4 and T4.5 that will result in the impact assessment and city-specific policy response (D4.7) deliverable and the policy implementation messages from crosspilot results (D4.14).

1.3 Task Participants and sharing of contribution

The participants for this deliverable are the pilot leader (ILiM) and ZLC as T4.2 and WP4 leader. ZLC supported the pilot during the whole process for developing the deliverable. The pilot leader is cooperating with pilot partners including the City Hall Kalisz and Fundacja Kaliski Inkubator Przedsiębiorczości.

1.4 Structure of Deliverable

The section that follows (Section 2) first describes the pilot mobility solution. Section 3 gives further detailed information about the location. It includes a description of the area, identified challenges. Section 4 contains a detailed action plan and an initial description of the pilot assessment activities and indicators. Afterwards, section 5 presents the legal and ethical issues that may appear and how they will be addressed, the risk mitigation plan and the communication strategy. Finally, section 6 includes a summary and conclusions of the report.

2 Pilot in Kalisz description

2.1 Mobility solution description

The distribution of goods in urban areas is heavily increasing and, therefore, it strongly contributes to the increase of traffic in the city centre. Goods deliveries require unloading spaces that are convenient enough to unload the cargo fast and do not cause additional disturbances when the activity is on-going.

The city of Kalisz has not introduced any system for managing goods deliveries yet. It has not even defined any methodology for managing deliveries as part of the logistic functioning element of urban planning.

Within this pilot, it is planned to develop and validate the concept of introducing a digital mobility solution for improving the organization and management of the loading/unloading operations in the city centre.

2.1.1 Digital mobility solution

The concept is based on implementing a sensor network using Internet of Things (IoT) technology (see annexe 1 for more technical details), which enables the access to transport data in real-time, and the dynamic management of unloading operations in the city.

The communication between application and sensor without intervention of human is an example of Internet of Things. The communication between data base, application and sensors gives the online status availability for users and city services and means automatic communication of infrastructure with stakeholders. Described IoT is a support for managing urban space, some bays can be blocked, some can be optionally connected with visual monitoring to verify correctness of the booking.

The target users are urban freight transport drivers who will be able to book a parking place by installing an Android application, which provides the interface between the users and the IoT management system. After the installation on the mobile devices they will register (by truck registration number) in the system database, and start to carry out the booking operations of reloading bays. It is essential to have a reliable connectivity or Internet communication between IoT reloading bays and the central system via a base station, informing about the use of the bay. Comparing the information from the sensor and the pre-booking on the database the system will determine the bay status as one of the following four possibilities:

- free – booked (although it is booked for a specific time slot, the truck has not arrived),
- free - not booked,
- occupied - booked,
- occupied - no booked.

The statuses of each of the bays will be available on the application level in the form of a multi-coloured icon. Individual statuses will also be available in the reservation mode - availability or not of a particular bay will be communicated to the application user on the desired date and time.

The online statuses will be helpful:

- for planning future reservations (for drivers planning reloading in the near future),
- for actual reservations (for drivers not planning, but just coming to reload),
- optionally for verification of parking correctness (for city services).

In the second case driver, to be correct, have to check availability before parking.
Summarising, drivers will be able to verify (actual and future) availability of bays and book space using the mobile application, with the information from their statuses. The city will be able to manage the public space more efficiently and responsively.

2.1.2 How does it work?

From the user point of view, the only connection with the system is the mobile application (SPROUT application), which can be free downloaded on Android mobile device from Google Play Store. It allows users to:

- check actual and future status of the bays,
- book the free bay,
- check the own bookings,
- cancel own bookings,
- inform about the unavailability of the booked bay.

Another essential functionality of the application is to register and login users. Due to practical reason, the fields requested have been minimized to the driver's telephone number, vehicle registration number, and access password.

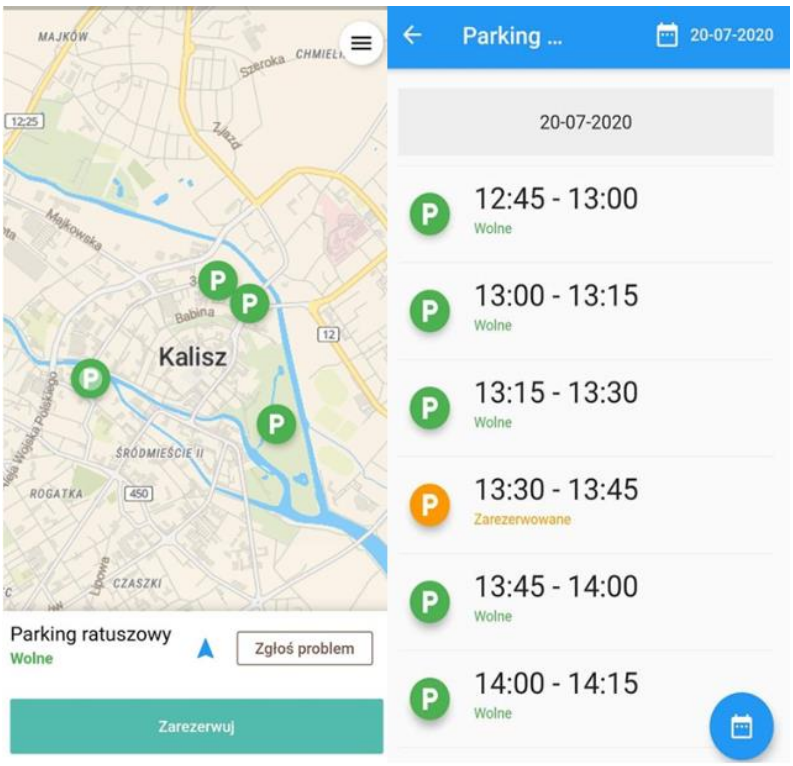


Figure 1. Example screenshots from the application

The application is prepared not only for booking the bays according to the planned route, but additionally for flexible managing of bookings, in case of unexpected changes in route, which can be done only by the direct user – driver.

The application can also be used for controlling of the bookings, and for gaining statistical data. The data base of bookings can be shared with municipal services, optionally to compare the bookings with the payments. And depending on the gap between the bookings and the payments an introduction of a monthly subscription substituting the current system of charging per actual operation would be much more preferred both by drivers and municipalities.

2.1.3 Expected benefits from using solution

First of all, the solution enables planning and booking of the reloading spaces. It is then assumed that the planned reloading will allow the trucks to go directly to the booked place on the specific time, park and reload close to the designated place. This should result in **the reduction of unnecessary trucks traffic and manoeuvring**, and **the growth of safety of pedestrians and other drivers** during the whole transport operation.

More specifically, Table 1 shows the different perspectives of the expected benefits from using IoT bays solution: a) from the users' point of view (mainly commercial drivers); and b) other stakeholders (citizens, pedestrians, other drivers, city representatives) point of view.

Table 1. SPROUT IoT parking management solution expected benefits (users, others).

Drivers	Other Stakeholders
• possibility of reloading planning • time savings for reloading operations • no risk of penalties for illegal parking • full control of parking expenses • safety of drivers during reloading • paperless solution in near future	• traffic and congestion reduction • growth of safety for pedestrians and drivers • noise reduction • emissions reduction • regulation and more control of freight flow in the city centre

2.1.4 Identified barriers

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 or passenger cars occupying bays,
- the need to pay parking fees and billings.

In this specific pilot, an additional barrier is the modernization plan of one of the main street in the city centre, which might limit a number of available locations from the reloading bays.

The potential solutions for overcoming barriers can be:

- allowing private/passenger cars parking on bays during, for example, night hours,
- incentives for drivers (points, awards etc.),
- possibility of ad hoc booking just after parking, if the bay is available,
- strict control of municipal services towards illegal bays occupation,
- development of application and its introduction as part of the management system enabling planning and booking of reloading bays in cooperation with the city.

2.2 Use case description

2.2.1 Urban freight transport information and measures

On average, urban freight represents between 10% and 15% of the kilometres driven by vehicles in urban areas and is responsible for 25% of urban transport related CO_2 emissions[2]. Kalisz is not an exception in that statistics.

As already stated in the Description of Work the data available in the city of Kalisz is very limited. There are almost no measures and data available on “urban traffic” and “urban passenger & active transport”. There were some measures taken in terms of “urban freight transport” mainly connected with establishing few parking spaces dedicated to loading/unloading operations in place but with no evidence on the impact assessment.

The questionnaire held in the first phase of the project among companies operating in the city center (see Figure 14) originally designed to obtain information on bay locations also included some general questions in terms of urban freight transport. Among other things the “frequency of deliveries” (see Figure 2) and “average delivery duration” (see Figure 3) were declared by respondents.

The results showed that the average number of weekly deliveries in the city center were two deliveries every week per location. However, almost 20% of companies declared more than 8 deliveries weekly.

[2] ALICE, Research and Innovation Roadmap - Urban Freight, https://www.etp-logistics.eu/?page_id=96, access 2020-06-20

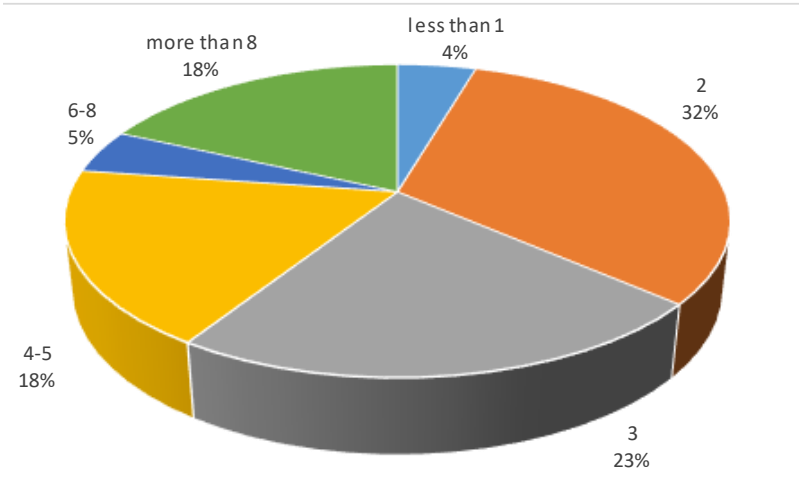


Figure 2. Number of deliveries per week in the city centre of Kalisz

In terms of the average time of the reloading operations most often the trucks are reloading 15-20 minutes. It is worth to underline, that close to 10% of reloading operations take only less than 5 minutes, which is the potential incentive for avoiding the fees and bookings.

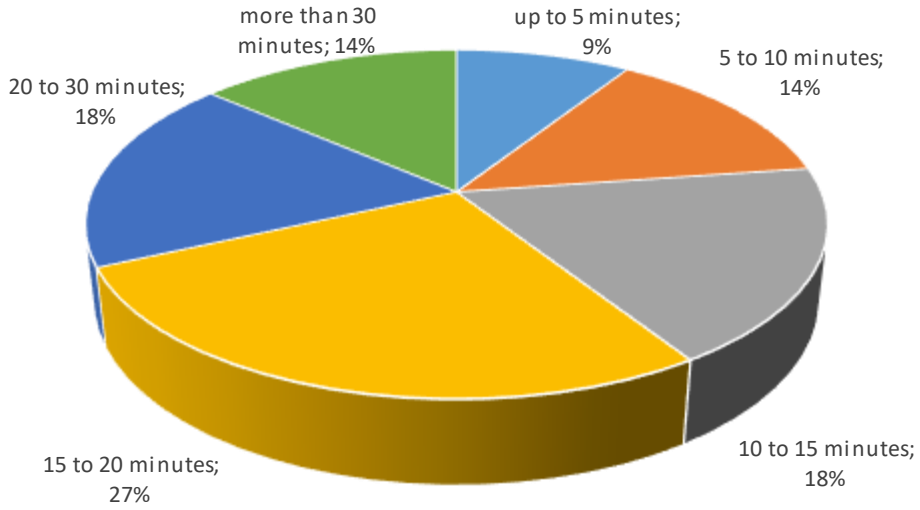


Figure 3. Shares of average time of delivery

The implementation of IoT solution and sensoring of selected parking bays enabled to provide more data and monitor such indicators as traffic and congestion. These indicators might be reflected by the frequency of deliveries in specific days and day times.

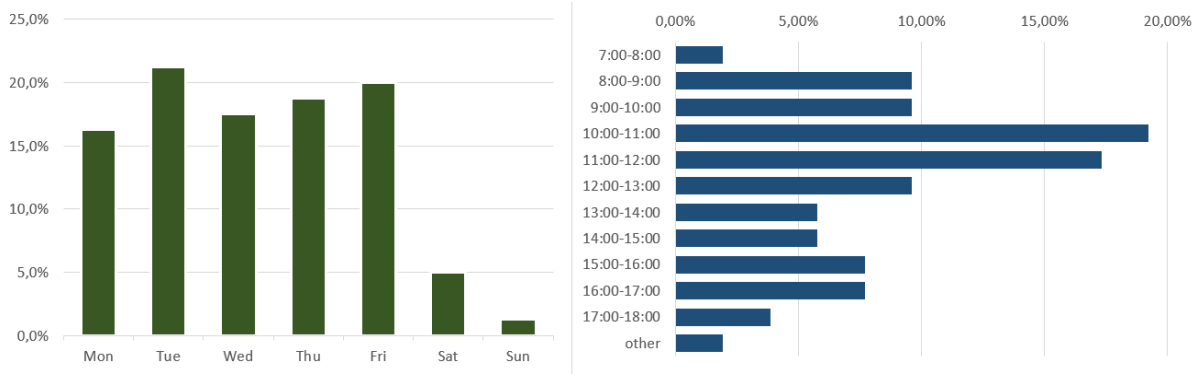


Figure 4. Declared actual most frequent days and times of deliveries

As presented in Figure 4 the difference between the weekdays in number of deliveries is insignificant. The number of deliveries decreases heavily at weekends, which might be caused by the covid situation and closed restaurants and bars. In most cases the deliveries are conducted from 10:00 till 12:00. There are practically no deliveries before 7:00 am and after 6:00 pm.

The second indicator is the share of types of delivering vehicles, which is shown in Figure 5. In most cases the deliveries are supplied by vans.

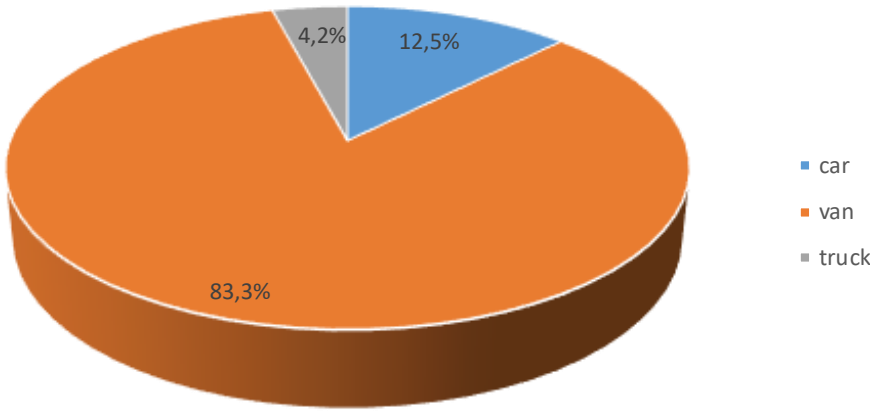


Figure 5. Declared delivery vehicles share

The next indicator is related to volumes of deliveries (see Figure 6). Above 70% of deliveries are “a few boxes” deliveries, which require manual reloading, without the necessity of truck-lift.

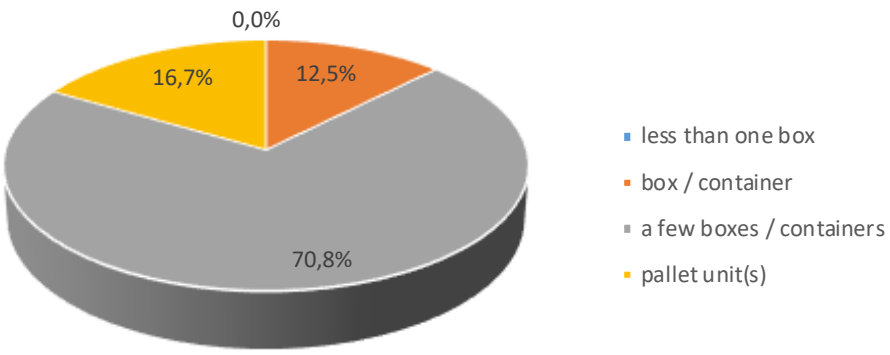


Figure 6. Deliveries volumes share

Having almost no data available before the project set-up it becomes difficult to define clearly the baseline for the traffic level in the city, or even more specific data such as vehicle flow per time window or rate of parking occupancy, etc. The City of Kalisz does not have any data or statistics related to delivery vehicle traffic in the centre of Kalisz. Hence, there is no reference point which would allow impact assessment of the implemented solution. The potential way to assess the expected impact of the implementation of the new solution is to evaluate it in the form of data KPIs provided by the sensors from the application databases and to compare with the results collected from the stakeholders based on the questionnaire. This action would enable to get feedback from stakeholders after the system implementation and pilot period and compare it to the past situation.

To sum up, based on the planned questionnaire the real data, obtained from sensors, will be confronted with past situation. The comparisons will include the following KPIs:

- rate of parking occupancy on weekdays (the most occupied days),
- rate of parking occupancy per time window (the most occupied hours),
- the average time of loading / unloading operations, which will be indicate the size of delivery and type of the vehicle,
- size of delivery (estimated on the basis of the time of reloading),
- type of the vehicle (estimated on the basis of the time of reloading),

Moreover, based on the collected responses the additional analysis will be enabled:

- delivery time reduction
- proportion of cargo deliveries using the tested infrastructure,
- traffic and congestion reduction
- growth of safety for pedestrians and drivers
- noise reduction
- emissions reduction

The expected impacts are presented in the following table:

Table 2 Expected impacts with nature of their outcomes

#	Expected impacts	Nature of outcome	Estimated value
1	rate of parking occupancy on weekdays	quantitative	See Figure 4
2	rate of parking occupancy per time window	quantitative	
3	the average time of loading / unloading operations	quantitative	See Figure 3
4	size of delivery	quantitative (estimated)	See Figure 6
5	type of the vehicle	quantitative (estimated)	See Figure 5
6	delivery time reduction	quantitative (based on questionnaire)	to verify
7	proportion of cargo deliveries using the tested infrastructure	quantitative (based on questionnaire)	to verify
8	traffic and congestion reduction	quantitative (based on questionnaire)	to verify
9	growth of safety for pedestrians and drivers	quantitative (based on questionnaire)	to verify
10	noise reduction	quantitative (based on questionnaire)	to verify
11	emissions reduction	quantitative (based on questionnaire)	to verify

It is assumed that the area covered by sensors can be a sample which might represent the entire city centre of Kalisz, as there are no much deviations. Based on partial data, it will be possible to approximate the above information to the entire downtown area of Kalisz.

2.2.2 Impact of reloading operations in urban areas

The problem of truck and their reloading (loading and/or unloading) operations can be seen from three different perspectives.

The *first one* is occupation of available road space causing reduced traffic capacity, causing temporary bottlenecks or even blocking the traffic. The situation happens so often, that was even accidentally “catched” by Google car in the Kalisz city (see Figure 7).

Figure 7. Example reloading operation catch accidentally by Google car on Kalisz Złota street[3]

The *second* problem is manoeuvring trucks. Even if the reloading space is available the time for appropriate parking generates another temporary bottleneck and causes extra travel time for another road users. Additionally, manoeuvring trucks can be a source of threat to pedestrians and other cars. A poorly designed bay can also cause similar risks during the reloading itself.

The *third* problem is the drivers looking for appropriate reloading space additionally reduces the road capacity, unreasonably causing inconvenience for other road users. Direct travel to awaiting empty booked or designated location can significantly reduce the additional travel time and the resulting obstructions.

Excessive commercial vehicle traffic not only causes congestion, but also generates noise and environmental pollution, negatively affecting the health of residents and the state of infrastructure in the short and long term.

Other reloading bays will be operated on current rules – (City of Kalisz authorities decided to implement pilot (bookings) only on sensored[4] part of bays).

2.2.3 Loading space locations

The potential location of reloading bays, as main result of an intensive research (see annexe 2), are shown on Figure 8.

[3] Source: maps.google.com
[4] Sensored: equipped with sensors

Figure 8. Potential locations of reloading bays as result of the research

With the support of Kalisz city representatives there were indicated 3 locations for sensored reloading bays, one existing, two to be newly created (see Figure 9).

Złota Street location (upper left corner of Figure 9) main reason for this selection was the grocery shop on the other side of the bays. The supplies to the shops are usually made once a day with a few pallet units' capacity. There are other potential destinations of supplies, but with much lower potential. This will be the new bays, prepared especially for Sprout project pilot. There is no parking place before (from the direction of driving) on a one-way street, so there will be no barrier to manoeuvre the truck.

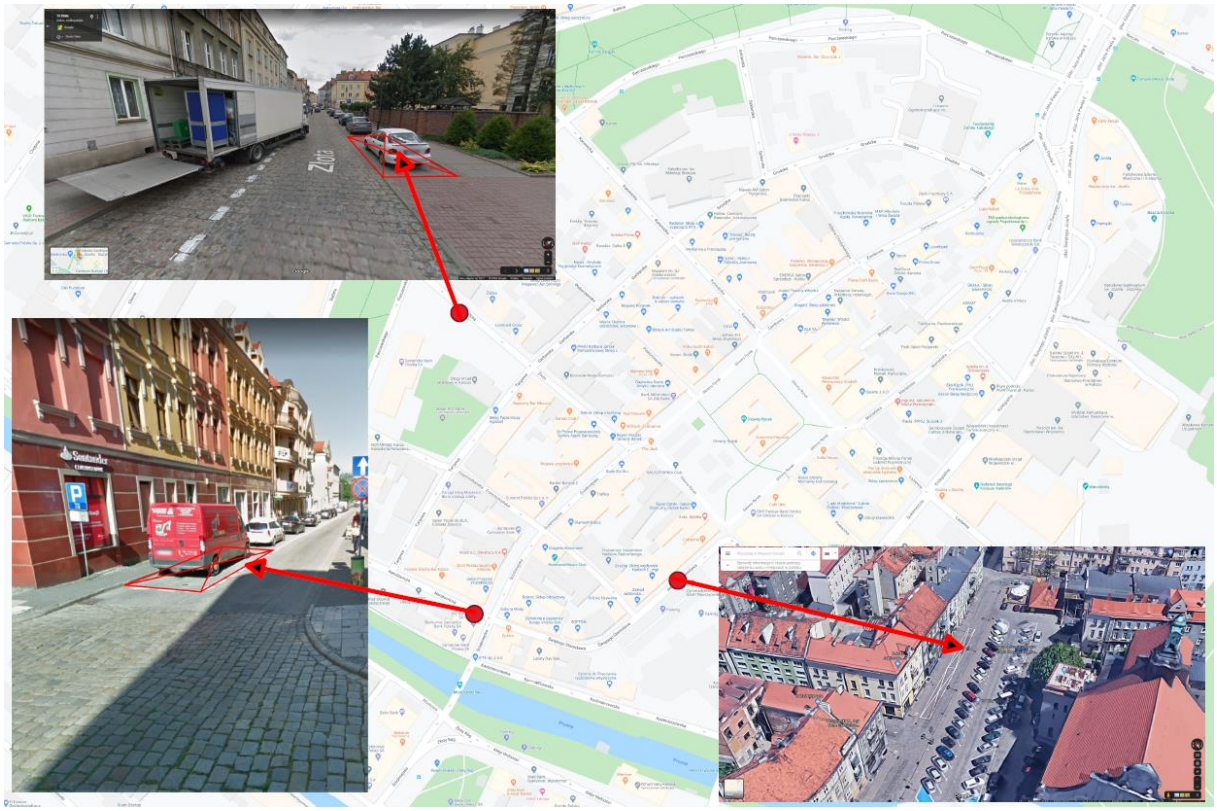


Figure 9. Selected location of sensored reloading bays

All considered bays will be equipped with one sensor. In this case flat area of bay covered with paving block will be good ground for installing the sensor.

Narutowicza street location (lower left corner on Figure 9) has lower total expected capacity of reloading, but there are a few more potential destinations of delivery. Additionally, the bays lay in front of the street under construction, which is the only chance to park the truck and move deliveries manually. Like the previous one, it will be a new location with easy access for a truck driver. The limitation will be the access to the left cargo doors directly from the street, not pavement. The area of the bay is covered by historic cobblestone, which can cause some difficulties during the process of sensors gluing and can be more vulnerable to breakage – the block is not flat.

Third location on Św. Stanisława street is the biggest one (lower right corner on Figure 9). The bay already exists and lays directly close to the second bay, not intended to be equipped with sensors. The bay is the longest one and the research of sensor location will be necessary, and maybe one sensor will be not enough. The area of the bay is covered by asphalt, which should be the good base for installing the sensor. The reloading potential of the bay is the lowest, but there are some expected destinations. The location close to “standard” bay will be an interesting site for comparing utilization of the different bays.

2.3 Policy framework

In terms of the statistics there are over 470 shops and over 133 restaurants located in the entire area of the city of Kalisz. Freight traffic accounts for just under 20% of total traffic, calculated by the number of vehicles entering the city. According to statistics, in 2019 there

were 147 road accidents, resulting in 171 injuries and 8 fatalities[5]. In 2020 the statistics may significantly differ because of the closure of the restaurants in response to the introduced pandemic restrictions.

In terms of the city's long-term strategy it considers the provisions set out in the climate and energy package i.e.:

- reduction of greenhouse gas emissions,
- increase of the share of energy from renewable sources,
- reduction of final energy consumption to be achieved through increased energy efficiency,

as well as improvement of air quality in accordance with the Air Protection Programme for the Kalisz zone in order to the attainment of the PM10 admissible level and the short-term action plan.

The main objectives and obligations arising from the Development Strategy of the City of Kalisz for the period 2014-2024, which fit into the PGN (low emission management plan), are the following:

1. A functional city, including strategic goals:
    a. Improve external accessibility and quality of transport infrastructure.
    b. Improve the quality and comprehensiveness of public transportation.
2. Natural space:
    a. Strengthening the system of incentives to change the heating systems to more energy efficient.
    b. Supporting energy efficiency and the use of renewable energy sources.
    c. Increasing ecological awareness of inhabitants.

Within the framework of the agreed objectives, particular measures and support will be provided above all for infrastructure projects that aim at improving the state of roads and air protection, particularly in the areas where acceptable concentrations of pollution are exceeded. In the context of air protection, special attention should be paid to the energy efficiency of residential and public buildings. The possibility of using renewable energy sources for the production of electricity and heat should be taken into consideration.

In terms of transport infrastructure, it is proposed to limit the negative influence of transport on the natural and living conditions, which is directly addressed by the loading bay sensoring project, which will propose a preliminary management system for freight transport operations and provide some rough statistics on the amount of freight traffic in the city center[6].

Major transportation problems in the downtown of Kalisz include:

- high automobile traffic intensity and the resulting problem of congestion (longer travel times, lower traffic fluidity),

[5] https://poznan.stat.gov.pl/vademecum/vademecum_wielkopolskie/portrety_miast/miasto_kalisz.pdf
[6] Above part based on *Plan Gospodarki Niskoemisyjnej dla Miasta Kalisza* https://bip.kalisz.pl/uchwaly/2017_34_450.pdf

- existing high air pollution, degradation of the natural environment, and deteriorating quality of life for residents (emissions of dust pollutants, generated noise, degradation of urban space, etc.)
- lack of pedestrian and bicycle infrastructure (including e.g. lack of continuity) and degradation of the existing infrastructure (e.g. by parked cars),
- excessive number of parked vehicles in the city center,
- too attractive travel and parking conditions for private vehicles in the city center in relation to the public transportation offerings organized by the local government
- significantly limited space in the central part of the city which limits greater expansion of road infrastructure - e.g. by adding additional lanes for public transportation,

The consequences of the problems described and solutions proposed constitute the subject for further expertise and observation of adaptation of solutions commonly applied in Polish and Western European cities to the local conditions of Kalisz. In the case of Sprout pilot innovative solution based on IoT technology will be tested.

3 Stakeholders identification and involvement

Table 3 contains the pilot partners contribution and other stakeholders will participate in the pilot activities (see annexe 3 for further details).

Table 3. Kalisz pilot stakeholders' contribution.

City Hall Kalisz
• Support during the whole project (especially initiation phase) • Support during data collection • Validate the new regulatory framework (participation in surveys)
Instytut Logistyki Magazynowania (Insititut of logistics and warehousing - R&D)
• Pilot leader: most activities involvement (coordination, deployment, data collection, policies deffinition) • Application developer and technological integrator
Regionalna Izba Gospodarcza (Chamber of Commerce)
• Potential feedback (surveys)
Residents
• Pilot's beneficiaries may be informed to participate in the different activities of the pilot (service usage, surveys, workshops) • Participation in surveys • Social media
Local business
• Pilot's beneficiaries may be informed to participate in the different activities of the pilot (service usage, surveys, workshops) • Direct contact of local (close to the bays) companies

Besides the stakeholders above, operators in the region of the bay are invited to test the solution, participate in surveys and review the application, they will be notified via delivered shops about the pilot. The police will be informed about the pilot activities to safeguard and support the implementation testing phase with the verification of bays state (occupied, not occupied).

4 Implementation and evaluation plan

Figure 10 shows the pilot in Kalisz activities since month M13 (September 2020) until M20 (April 2021). This period is divided in three tasks.

During ***T4.3***, the real time dynamic reloading bays in Kalisz will be implemented to test in practice the assumption that, the identified emerging mobility solutions are feasible and sustainable, and can benefit from an appropriate policy response.

The law and construction regulation have had influence on solution implementation, despite the earlier start of the pilot task. Required design of reloading bay and installation of base station on historical building have negative influence on expected schedule. This will result in starting the pilot just on time, starting with test and implementation in M12, to start real tests in M13, with a high degree of probability.

Then expected 3-months long test period can be too short to adopt the solution in everyday deliveries and convince drivers to book bays, so test period can be prolonged (option – see Figure 10) in case of insufficient response, what can have influence on schedule of next tasks.

The next steps of project will be in accordance with the project. The aim of ***task 4.4*** – Formulation & prioritisation of alternative policy responses, which will be developed, by using the respective input from the WPs. Alternative policy responses will include, relatively to test results: adaptation of urban policy elements/instruments, integration in urban mobility policy with other policies and support for urban mobility innovators to overcome regulatory obstacles.

During the final **task 4.5** - City-specific policies for harnessing the impact of new mobility systems, the pilot result will be used to test in practice the assumption that, an appropriate urban policy response can be implemented to harness the benefits of the emerging mobility solution within each pilot city. Local policy makers will agree on the prioritised policy responses, and a subset of those will be introduced in a limited scale.

						2021			
	August	September	October	November	December	January	February	March	April
	M12	M13	M14	M15	M16	M17	M18	M19	M20
T4.3 Sustainability assessment of the pilots impact									
a) Implementation and preliminary tests									
b) Testing of the new mobility solutions							option		
c) Assessing solution									
T4.4 . Formulation and priorisation of alternative policy responses									
a) Compile data fom T2.4, T3.3. T4.3									
b) Prioritization of policy responses (MAMCA)									
c) T3.4 graphic/ narrative update to reflect policy intervention									
T4.5. City Specific Policies for harnessing the impact of new mobility systems									
a) Selection of alternative policy responses to implement									
b) Survey design									
c) Survey conducted									
d) Results analysis									
d) Draw city specific policy responses from the assessment									

Figure 10. Kalisz Pilot activities timeline.

4.1 T4.3 Sustainability assessment of the pilots' impacts

4.1.1 Description of the activities to test the mobility solution

Preparation of the test required some legal (design, permissions) and technical issues (project of base station installation) resolution. This was connected with location of the base station and creation of two new reloading bays.

The most important decision of Kalisz City Hall was not to include in the test area all the existing reloading bays. Only three of them were analysed, the sensored one on Św. Stanisława street will be the subject of booking and implemented into application. This makes the process of evaluating and comparing implementation more difficult, as comparable data from “standard” bays cannot be directly referred to.

The planned three-month testing period for the application may be too short to convince drivers to use the application. An optional extension of the test period is assumed if there are no satisfactory responses within the assumed period. Furthermore, the policy framework affecting the mobility solution will be analysed to identify the barriers that might hinder the drivers’ acceptance and wide adoption.

All the activities in application will be monitored and archived. A database will be the source of information for storing data for a later analysis. The information about utilization of every sensored bay will be collected, but there will not be any data from others bays in the system to be compared. The external source about all reloading bays utilization scheme and real data will be gathered, if available.

The test will not involve any partners employees. The exception can be staff for conservation of equipment (eg. damage of sensor) and application (possible errors, identified during the real usage). The municipal services employees can use application and data base, but this will be unverifiable during process conduction.

4.1.2 Assessment preparation

Assessment of operational feasibility can be done in three layers:

- technological: communication with all sensors regardless the urban development, communication with application,
- operational: functionality / ergonomics of application,
- acceptance: number of everyday user and bookings.

Two first aspects are just matter of development and in case of trouble technical modification can assure proper functioning of application. The last layer will be the real challenge. The occupancy of the loading bays and the frequency of login operations into application will give feedback about whole pilot reasonability. It is not easy to estimate the number of users and daily number of occupations and bookings now. However, it is assumed, the most important would be the growing number of those factors, confirming successful spreading of application and booking system.

Relatively small scale of the pilot does not allow to give a definite recommendation for the solution sufficiency in large cities. But the condition of project success is fully operational providing the stable system and stable connection between the base station and the sensors.

The results of the project, especially without information about utilization of other reloading bays will be difficult to measure. The information that we can obtain from the application database will be the number of (active) users, the number of bookings (finalized or not), the number and time of bays occupations (with or without booking). This can supply information about bays rush hours, bay utilisation and share of finalized bookings, but with direct comparison with existing, standard bays. Additionally, two of three bays will be newly constructed one and will require drivers' familiarity with them.

About the financial sustainability, it must be considered that there are not planned incentive programs enabling reduced charging during pilot conduction. The parking on reloading bays will be charged like other bays. Incentive to use loading bays was eliminated. It can be estimated based on drivers' interviews.

The return from investment from the pilot action can't be expected - the charges will stay on the same level, payable on actual rules without any saving from any side.

Concerning the ***sustainability impacts*** to the city level, reduction of traffic obstructions caused by an incorrectly parked truck can be noted, but no indicator can be applied. Additionally, reduction of truck-kilometres (which means reduction of fuel consumption, emissions and depreciation, growth of truck and truck driver productivity) since truck drivers will not have to look for available parking space. Only a qualitative assessment is possible on the basis of local residents and entrepreneurs.

Similarly, with **environmental impacts** such as pollution and noise. Three reloading bays will have, for sure, influence on those factors, but with little accuracy. Bigger scale implementation could bring measurable effects, but in case of small pilot we can estimate environmental sustainability on by calculating reduction in trucks on routes.

Finally, this pilot will also try to respond the following questions

- *Is application stable and user-friendly?*
- *Can improvements in application (functionality, usability) convince potential users?*

All the dimensions and the questions above will be responded with quantitative or qualitative indicators. Table 4 shows some of the already potential indicators will be used for assessing the pilot implementation results.

Table 4 Performance indicators, data collection and assessment methods.

Indicator	Description, type and collection method	
Financial Sustainability Operator		
Financial sustainability	Impact on the short-and long-term financial stability.	Qualitative indicator based on drivers' viewpoint.
Operational feasibility IT system quality & use KPIs (Product's quality – ISO/IEC 25010)		
Functional suitability	Degree to which a product or system provides functions that meet.	Qualitative properties will be measured using quantitative values from the stakeholders' remarks (User complaints)
Usability	Degree to which a product satisfies users expectative effectively and effectively.	
. Operational feasibility IT system quality & use KPIs (Quality in Use Model- ISO/IEC 25010)		
Effectiveness	Accuracy and completeness with which users achieve specified goals	Qualitative properties will be measured using quantitative values from the stakeholders' opinion indicators using questionnaires to a group of stakeholders' users
Efficiency	Resources expended concerning the accuracy and completeness with which users achieve goals	
Satisfaction	The degree to which user needs are satisfied when a product or system is used in a specified context of the use	Number of repeat bookers Application database
Reduction of truck-kilometers	Reduction in fuel consumption, emissions and depreciation, truck and truck driver productivity growth since truck drivers will not have to look for available parking space	Qualitative properties will be measured using quantitative values from the stakeholders' opinion indicators using questionnaires to a group of stakeholders' users
Performance		
New bays utilisation	Confirmation of proper new bays location	Minimum 50% occupations of the existing bay
Installing application ratio	Performance indicators supporting comparing the location and gaining data about popularity of solution	Quantitative Application database (usage data)
Number of booking per bay		
Utilisation of the bays		
Reloading time per bay		

Indicator	Description, type and collection method	
Booked parking per day		
Environmental & social KPIs		
Noise	Perceived noise reduction	Qualitative interview with users (drivers), residents and local businesses
Accidents	Perceived probability of accidents reduction	
Traffic congestion	Perceived delay costs and deadweight loss costs reduction	
Growth of safety	Perceived safety reduction	

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

The next steps of project will be in accordance with the project. The aim of the task 4.4 – Formulation & prioritisation of alternative policy responses, which will be developed, by using the respective input from the WPs. Alternative policy responses will depend on test results and will include: adaptation of urban policy elements/instruments, integration in urban mobility policy with other policies and support for urban mobility innovators overcome regulatory obstacles.

4.2.1 Description of the activities

Based on the results of T3.3, 'Policy impacts of future urban mobility scenarios', and T4.3, 'Sustainability assessment of the pilots' impacts', a list of alternative policy responses will be developed for each pilot city. These alternative policy responses will be ranked and prioritized for each 1st-layer city, considering the preferences of the stakeholders involved. This will be done by using a Multi-Actor-Multi-Criteria analysis (MAMCA)[7].

The MAMCA methodology is made up of seven steps: (i) i*dentification of the alternatives, (ii) Identification of stakeholders and their objectives, (iii) criteria and weights, (iv) indicators, (v) overall analysis and ranking, (vi) results and optional (vii) i*mplementation.

4.2.1.1 Research questions

- *"how to prioritize the policies considering stakeholders preferences?"*
- *"how to select the policy response with a higher degree of consensus?*

4.2.1.2 Performance indicators, data collection and assessment methods

The indicator from the previous chapter will be used. The main stakeholder will include users (drivers), city hall and local (in pilot area) community: entrepreneurs and citizens. Feedback will be obtained on the basis of opinions about the application and the whole system, interviews and knowledge of experts.

[7] The MAMCA methodology (Macharis, 2004) is used in complex projects involving a large number of stakeholders and helps to find a common ground between them. The process is facilitated through the MAMCA software, an online decision-making platform (www.mamca.be). It provides an interactive way to weight stakeholder objectives, to evaluate options, and it provides easily understandable visualisations of the outcomes of the evaluation.

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

The next task (4.5) City-specific policies for harnessing the impact of new mobility systems the pilot result will be used to test in practice the assumption that, an appropriate urban policy response can be implemented to harness the benefits of the emerging mobility solution within each pilot city. Local policy makers will agree on the prioritised policy responses, and a subset of those will be introduced in a limited scale.

4.3.1 Description and objectives

During preparation some limitations of system installation were identified (see 2.1.4 Identified barriers). The implementation and test can bring additional one, which should be taken into consideration and case of system development or possible implementation in other locations. The other barriers and limitation can be emerging and should be recognised.

During the operation of the system all the outcomes and daily cost can be identified, the same like possible benefits. This would convince future users to consider implementation of similar solution.

4.3.2 Assessment preparation

The main stakeholders will be the drivers and the local community. This audience will probably not take part in workshop activities, their feedback will be the base of reviews of application and interview. The scale of the project will allow direct contact with local community. Attempts will be made to collect information from the drivers either directly (if available) or by telephone. Drivers will also be asked to pass on their comments directly to the entrepreneurs served.

4.3.2.1 Research questions

- *Is there any additional regulation (not taken into account in pre-pilot phase) that hinders the policy adoption that cannot be modified?*
- *Can city assume the investment costs require for widely adopting sensored reloading bays?*
- *Will user accept of the project in pilot and developed scales?*
- *Can small scale pilot how meaningful influence on city centre sustainability?*
- *Can limited area of pilot attract bigger part of drivers, delivering to city centre?*

4.3.2.2 Performance indicators, data collection and assessment methods

Table 5. List of recommended KPIs for SPROUT pilots.

Indicator	Description, type of indicator and collection method	
Policy implementation feasibility (legal)		
Legal framework compatibility	Any additional limitation, not considered before starting the pilot.	Qualitative - Surveys and open discussion with policymakers and experts.
Policy implementation feasibility (operational)		
City Investment costs	The information about possible cost per one reloading bay.	Qualitative - Surveys and open discussion with policymakers and experts.)
City Operational cost	The level of additional cost per reloading bay	
City Revenues	Level of monthly city additional revenues per reloading bay (if any)	
User acceptance		
Probability of using the service	Potential users' subjective likelihood that they will use the mobility solution with the alternative policy framework	Qualitative: Users opinion Surveys and open discussion (drivers)

5 Pilots management

5.1 Legal & Ethical issues

From the legal point of view the implementation of the pilot solution is connected with:

- technical and technological project of reloading bays, required approval of local authorities,
- installation of base station requires a building design and permission from the monument restorer office.

The complication with base station installation is that the place of installation is under supervision of monument restorer office, which takes care about historical valuable buildings and even the road surface. Usually city centres are the historical centres too, so in many reloading bay locations will require similar permitting process, which has to be taken into consideration. In Poland this process is usually long-lasting, and support of city council authorities was in that situation very important.

The base station requires access to the network (wired access, wireless can be insufficient) and power supply. This is usually connected with additional installation, required by outside services and fees.

Additionally, the base station should be located as high as possible, which will probably increase the range of equipment. This kind of location is connected with the risk of unexpected disassembling (e.g. in case of strong wind etc.). This means installation (and final uninstallation) of base station requires building design and authorization of the owner's service support, which can be connected with additional cost.

In the case of bays, installation of sensors should be done by a company authorised by road administration. Additionally, a sensor can be destroyed during vehicle manoeuvring or as a result of vandalism. This requires the additional intervention of an authorised company, which potentially causes delays and additional costs.

5.2 Risk identification and mitigation plan

Table 6. Risks, contingency and mitigation actions (including COVID-19).

Task#.#	Risk description	Contingency action	Mitigation Action
all	Delays (COVID-19)	Try to anticipate all the paperwork	Alternative testing area
T4.3	Lack of stakeholders' engagement	Provide them with incentives to participate	Broadcast a solution
T4.3	Authorised concept of bays	Strict verification of concept timing	Earlier start of the authorisation

Task#.#	Risk description	Contingency action	Mitigation Action
T4.3	Building project of base station installation	Strict verification of installation timing	Earlier start of project order
T4.5	Sensors mechanical damages	Use screw connection in place glued (when possible)	Spare sensors installation
all	Vandalism	Use screw connection in place glued (when possible)	Spare sensors installation
T4.5	Instability of the system in case of huge number of bookings / users	Continuous verification of application and system stability	Service interventions
all	Avoiding of fees in case of short parking	Quick reaction municipal services / video monitoring of bays	Allow free 5 minutes operation after booking

5.3 Communication strategy and channels

The information campaign has been set up to enable broad communication of information on the pilot implementation to the target audience. The main objective of these actions is to approach the drivers with clear information on the available solution to enable them using application and IoT infrastructure for booking all loading/unloading operations. Moreover, the information campaign also includes actions for the promotion of the project among the local government, representatives of the business world and its environment, other inhabitants of the City of Kalisz and other entrepreneurs who may be beneficiaries of the pilot.

Segmentation of target groups

In connection with the assumed promotion objectives, the basic target groups to which the information and promotion message should be addressed were defined. In view of the target groups, the tools were divided into: key ones - including the most important stakeholders, potentially involved in the implementation of the pilot (entrepreneurs, courier companies, suppliers, etc.) and supporting ones - including stakeholders potentially interested in the results of the implementation of the pilot and the whole project.

Table 7. Segmentation if potential targets groups for testing and assessing the pilot.

Target groups	Ways to reach target groups	Actions
Actions involving key stakeholders		
Micro, small and medium-sized enterprises	- Promotion and information campaign in the local and regional press	- meetings/conversations with editors - publications of articles, interviews - distribution of information to the editorial office
	- Direct marketing	- leaflets - individual conversations with entrepreneurs (phone calls, face to face meetings)
	- Social media	- Facebook posts
	- Radio and TV	- provision of information and promotional materials - distribution of information to the editorial office
	- E-mailing	- newsletter - recipients of Kalisz Business Incubator - mailing in cooperation with representative organisations (e.g. GIS)
Supporting activities		
Local NGOs	- Promotion and information campaign	- E-mailing, telephone calls
		- sending information and promotional materials by traditional mail
Local governments	- Promotion and information campaign	- E-mailing
		- sending information and promotional materials by traditional mail

Information campaign activities

A set of actions have been agreed with the main stream of actions dedicated to provide sufficient information on the available solution and persuade its users (drivers) to use it in their every-day loading/unloading operations.

Two main activities have been planned to approach the target group properly.

Table 8. Communication actions concentrated on the main target group.

Communication	Method	Frequency	Goal	Owner	Audience
Dissemination activities	Leaflet for drivers	Once	Information about booking possibilities with information / link to download application	Pilot leader	Drivers (application users)
Team stand-up	Meeting	Bi-Weekly	Discuss what each team member did the week before, what they will do during the week and any blockers	Pilot leader	Pilot team

Moreover, a number of other actions extending the pilot promotion have been planned.

Visual identification

Development and unification of a standard cover letter for entrepreneurs and local governments, the content of press and internet information.

Internet - Social media:

- Facebook – developing posts that will help build commitment on the fanpage and get your likes, comments and sharing. Promotion on profiles:
  - Kalisz Business Incubator (min. 1 x per month)
  - City Centre course (min. 1 x per month)
  - Kalisz – (min. 1 x per month)
- Instagram – create a list of key hashtags to better promote the project
- E-mail marketing – using FreshMail[8]. Frequency of newsletters: once a month and depending on project needs

Editorial activity

The use of modern publishing forms in the form of multimedia presentations, combining them with traditional printed forms:

[8] https://freshmail.com/

- Information materials
- Public relations activities - the purpose of Public Relation activities is to contact a group of journalists from the press and other local media, including a number of media relations activities:
    - contact with journalists: preparation of materials for articles,
    - after taking into account the range and number of recipients, recommendation of cooperation with: Radio Centrum, Calisia.pl and others
- Used Kalisz Business Incubator's own customer database - a database of e-mail addresses of potential and current customers, which will be used for information and promotion purposes.
- Cooperation with local institutions acting for the benefit of business development:
- Food Cluster of Southern Wielkopolska
- Regional Chamber of Commerce
- Wielkopolska Aviation Cluster
- Ostrowskie Entrepreneurship Support Centre
- The Kalisz Country Council
- Visits to companies and direct contact - information on the SPROUT project - promotion of pilot
- The others: On the occasion of events organized or co-organized by FKIP before the beginning of the event, a standard presentation of the project together with current events.

The schedule of activities will be established on an ongoing basis in agreement with the Municipality of Kalisz and ILIM.

6 Conclusion

At the current stage of the project, it is not a pandemic that seems to be the greatest threat, but formal procedures related to obtaining permits and preparing projects. Perhaps it is related to the location of the base station on the monument building. But also, the internal procedures of project partners are extensive and lengthy.

The small scale of this pilot also poses a threat to its comparability - the cargo traffic load of the centre of Kalisz, which, on the basis of the current pandemic situation, seems decreasing.

It is also worth noting the relatively short 3-month testing period, which may be too short to obtain reliable results, also due to the need for stakeholders to "learn" of the system. The option of prolonging this period is worth to consider.

Regardless the threats and the short time available for testing the pilot, the work was a good exercise to learn and have a better understanding for running and assessing the impacts of this mobility solution. From the short period for testing, we do not only expect to find responses that help to define policies to increase new mobility solution successfully adoption and user acceptance, but also to set a methodology to guide the process.

Annex 1: IoT-enabled freight vehicle loading/unloading space management

The main parts of the system will be:

- Android application – interface for users,
- base station – communication with bays' sensors,
- bays' sensors – continuous monitoring of occupancy,
- database – information about archived, actual and future booking,
- IT system – coordination of all others parts.

The technical details of base station are:

- the radio band: EU863-870MHz,
- number of channels: 8,
- sensitive reception: -140dBm,
- transmission power: 27dBm,
- antenna: IP65 500mm (19.68 inches) antenna @ 4.15dBi.

Figure 11. The Bosch Parking Lot Sensor[9]

After test with some different kind of sensor for installation was chosen Bosch Parking Lot Sensor (**Figure 11**), with specification (main features):

- weight 191 g,
- power supply Lithium battery (Li-SOCI2, 3.6V, 1200 mAh),
- battery lifetime up to 5 years,
- IP class IP67/IPx9K.

[9] Source: https://www.bosch-connectivity.com/products/connected-mobility/parking-lot-sensor/

The IT system (see example configuration at Figure 12) is responsible for online data exchange between the application and the database, data archiving and sharing of archival data with authorized users.

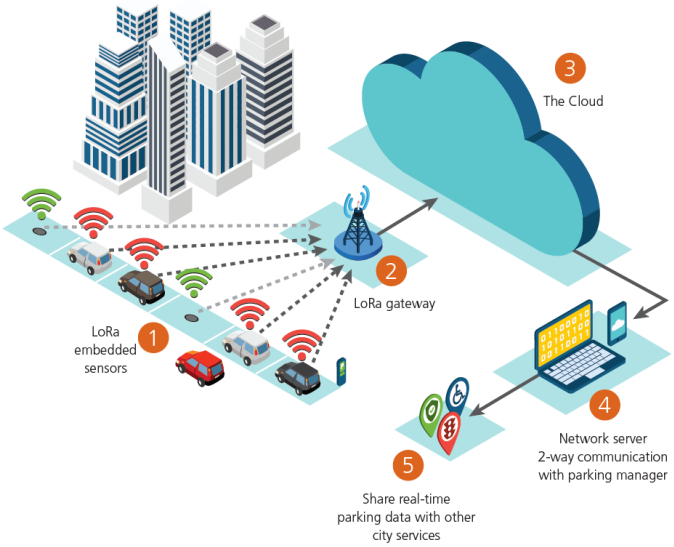


Figure 12. Passenger cars' example of system configuration

From a technical point of view, the sensor periodically checks the occupancy of the space and transfers the detected status change via the base station to the IT system. Based on information from the sensors and data from the booking database, information about the current status of individual bays is directed to the application and thus disseminated.

From the Internet of things point of view, the reloading will inform the IT system about actual status, which will influence disseminated information and the possibility to book and further on using the reloading bays.

Annex 2: Pilot location finding acitivities

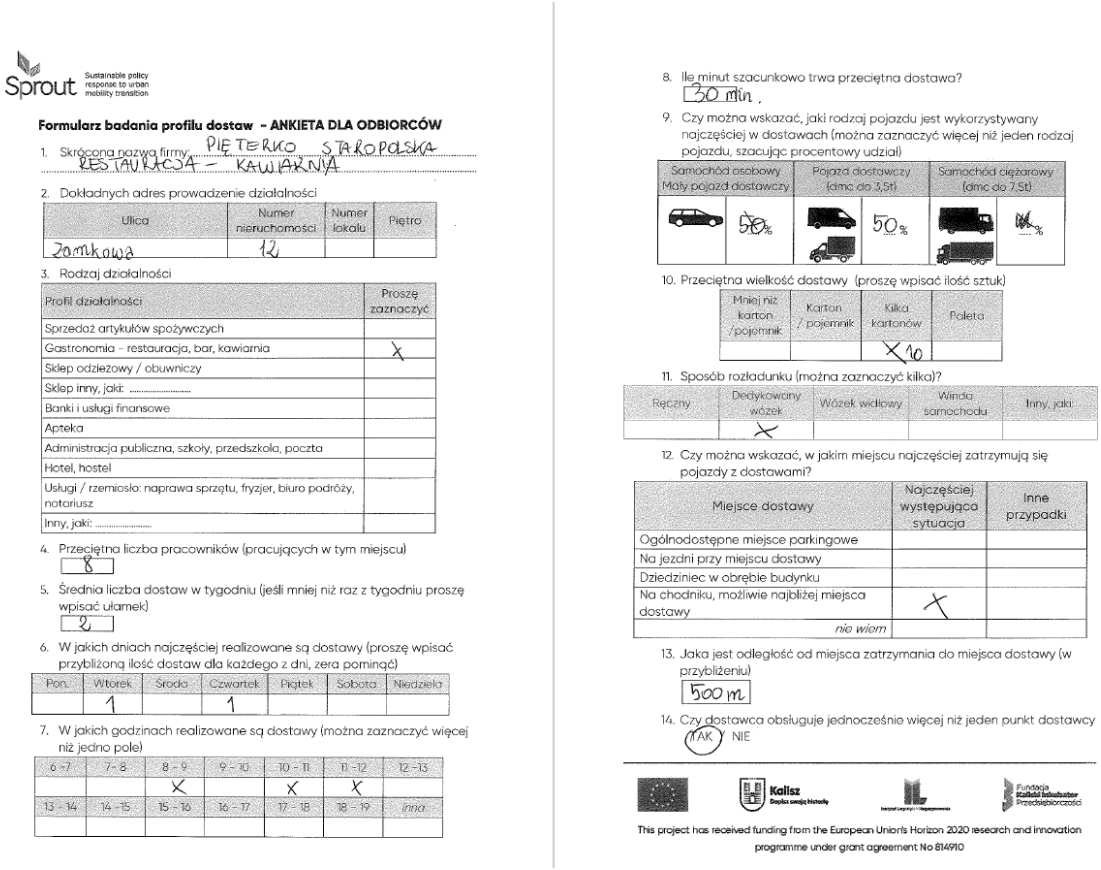
There are two main components of Kalisz pilot:

- identification of optimal loading space locations & pilot setup,
- IoT-enabled freight vehicle loading/unloading space management.

The pilot arena includes the centre of the Kalisz city (see Figure 10). The preliminary arrangement was connected with location of the base station in the city hall building, located in the geometrical centre of the city. The 400 m radius is minimum expected reach range of the base station in the highly urbanized area.

Figure 13. City centre of Kalisz with potential location of base station and its expected range (Source: City Hall Kalisz)

The first step of the project was a research realized by Kalisz Incubator providing estimation of potential, optimal location of sensorized reloading bays. The survey was made by direct (face-to-face interview) or indirect (left and collected questionnaires) contact with the representatives of enterprises located in the pilot area of the project. The main respondent companies were shops and restaurants, which were expected to generate traffic of bigger trucks and vans. The example filled in questionnaire can be seen on Figure 14



Sprout Sustainable policy response to urban mobility transition

Formularz badania profilu dostaw – ANKIETA DLA ODBIORCÓW

1. Skrócona nazwa firmy: PIĘTERKO STAROPOLSKA RESTAURACJA – KAWIARNIA

2. Dokładnych adres prowadzenie działalności

Ulica	Numer nieruchomości	Numer lokalu	Piętro
Zamkowa	12		

3. Rodzaj działalności

Profil działalności	Proszę zaznaczyć
Sprzedaż artykułów spożywczych	
Gastronomia – restauracja, bar, kawiarnia	X
Sklep odzieżowy / obuwniczy	
Sklep inny, jaki:	
Banki i usługi finansowe	
Apteka	
Administracja publiczna, szkoły, przedszkola, poczta	
Hotel, hostel	
Usługi / rzemiosło: naprawa sprzętu, fryzjer, biuro podróży, notariusz	
Inny, jaki:	

4. Przeciętna liczba pracowników (pracujących w tym miejscu)
8

5. Średnia liczba dostaw w tygodniu (jeśli mniej niż raz z tygodniu proszę wpisać ułamek)
2

6. W jakich dniach najczęściej realizowane są dostawy (proszę wpisać przybliżoną ilość dostaw dla każdego z dni, zera pominąć)

Pon.	Wtorek	Środa	Czwartek	Piątek	Sobota	Niedziela
	1		1			

7. W jakich godzinach realizowane są dostawy (można zaznaczyć więcej niż jedno pole)

6 – 7	7 – 8	8 – 9	9 – 10	10 – 11	11 – 12	12 – 13
		X		X	X	
13 – 14	14 – 15	15 – 16	16 – 17	17 – 18	18 – 19	inna

8. Ile minut szacunkowo trwa przeciętna dostawa?
30 min.

9. Czy można wskazać, jaki rodzaj pojazdu jest wykorzystywany najczęściej w dostawach (można zaznaczyć więcej niż jeden rodzaj pojazdu, szacując procentowy udział)

Samochód osobowy Mały pojazd dostawczy		Pojazd dostawczy (dmc do 3,5t)		Samochód ciężarowy (dmc do 7,5t)	
	50%		50%		...%

10. Przeciętna wielkość dostawy (proszę wpisać ilość sztuk)

Mniej niż karton /pojemnik	Karton / pojemnik	Kilka kartonów	Paleta
		X 10	

11. Sposób rozładunku (można zaznaczyć kilka)?

Ręczny	Dedykowany wózek	Wózek widłowy	Winda samochodu	Inny, jaki:
	X			

12. Czy można wskazać, w jakim miejscu najczęściej zatrzymują się pojazdy z dostawami?

Miejsce dostawy	Najczęściej występująca sytuacja	Inne przypadki
Ogólnodostępne miejsce parkingowe		
Na jezdni przy miejscu dostawy		
Dziedziniec w obrębie budynku		
Na chodniku, możliwie najbliżej miejsca dostawy	X	
nie wiem		

13. Jaka jest odległość od miejsca zatrzymania do miejsca dostawy (w przybliżeniu)
500 m

14. Czy dostawca obsługuje jednocześnie więcej niż jeden punkt dostawcy
(TAK) / NIE

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 814910

Figure 14. The example of filled in questionnaire

Annex 3: Stakeholders' involvement

Table 9 gives some detailed information about the stakeholders will participate in the pilot in Kalisz.

Table 9. Pilots stakeholder's identification and involvement.

Type of stakeholder	Name of specific local stakeholder organisation	Involvement
Public administration		
Governmental bodies responsible for transport planning, public works, infrastructure, environment, public space, on local, regional and metropolitan levels.	City Hall Kalisz	Whole pilot project, especially during initiation phase
Public Services		
Police	Municipal Police: SM (Straż Miejska SM) Kalisz	(if required) verification of occupation of not booked bays
Conventional public transport operators		
Operators of freight transport	Suppliers to the local enterprises, especially local drivers of the trucks	Main stakeholders of the project. Operators in the region of the bay are invited to test the solution, participate in surveys and review the application, they will be notified via delivered shops about the pilot.
Data/Tech companies		
Wayfinding and route planning providers (e.g. Google Maps, Waze, TomTom, JoynJoyn)	Supplier of map for application	Used during application preparation

Type of stakeholder	Name of specific local stakeholder organisation	Involvement
Mobility as a Service provider (e.g. Citymapper)	(if any)	Adding the reloading bays after their full implementation to the local maps
Providers of smart technology for traffic management	ILiM as developer of application and technological integrator	Support in case of required application / technology modifications
Potential Stakeholders		
Drivers' associations	(if any)	Feedback during project conduction
Potential Users – Residents		
Civil society organisations representing residents (e.g. neighbourhood committees)	(if any)	Potential feedback during project conduction
Potential Users - Local businesses		
Federations of business owners (e.g. chamber of commerce)	Regionalna Izba Gospodarcza (Chamber of Commerce) in Kalisz	Potential feedback during project conduction
Residents		
Beneficiaries of projects, as result of better reloading operation organisation, congestion reduction and safety improvement.		
Local businesses		
Beneficiaries of projects, as result of better reloading operation organisation, congestion reduction and safety improvement		Direct contact of companies "in a reach of reloading bays