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22193 Multi-Sustainable Digital Loading and Delivery Zones for City Logistics
DEL-03 S+LOADZ Final report

EIT Urban Mobility - Mobility for more liveable urban spaces

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List of abbreviations

AI	Artificial intelligence
B2B	Business to business
B2C	Business to client
KPI	Key Performance Indicator/s
LOADZ	Loading and/or Delivery Zone/s
LEZ	Low Emissions Zone
MDSD	Most Similar Systems Design
MGP	Métropole du Grand Paris
MSDD	Most similar system design
PRM	Partner relationship management
SaaS	Software as a Service
S+LOADZ	Sustainable / Smart Loading and Delivery Zones
TBC	To Be Confirmed
TBD	To Be Defined
TRL	Technology readiness level
OCR	Optical character recognition
WHO	World Health Organisation
Z-DUMA	Zone for Distribution of Urban Goods and Authorised vehicles

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1 Executive Summary

The third deliverable (DEL03) of the S+LOADZ project, the final report, presents a summary of the results achieved by the project during its implementation in 2022. This deliverable is elaborated with input from all consortium partners and includes both the deployment process and the results of the project. This document begins with the objectives of S+LOADZ, summarising the initial goals of the project in terms of product deployment and innovation. This is followed by an overview of the technological solution developed by Parkunload, including new product features, product usability and acceptance analysis. The next chapter presents an overview of the design of the 4th living labs, including Paris, Argenteuil, Vic and Ankara. The living labs chapter includes the conceptual design, the deployment process, the evaluation framework, and the results of the deployment process. At the end of the chapter, a comparison of the living labs and results is presented. Also, an analysis of the potential of micro-incentives for sustainable logistics is made. The key learning from the deployment process, as outcomes of that chapter, is the main input for the development of the S+LOADZ' handbook for cities (deliverable 4). Chapter 6 summarises the communication activities developed during the project, including both the general dissemination activities of the project and the communication of the living labs with the main stakeholders. The last two chapters present the project key results and the main conclusions of the product deployment and development process. The main lessons from the one-year project S+LOADZ, are summarized as follows:

- Kerbside management poses a serious challenge for European cities. Digitisation of loading/delivery zones implies a new behaviour among drivers, traffic officers and policy makers, so adoption rates vary according to the effort already made, the regulatory framework and the ability of the local authority to organise stakeholders and resources. Notwithstanding these challenges, the S+LOADZ approach has achieved significant results within the project – results that are expected to become more visible in the medium term.
- The deployment of 130 new smart loading/parking zones in collaboration with the solution provider and other experts means that four EU cities are managing almost 300 zones to involve almost 2,600 drivers in realising over 12,000 kerbside registrations (data for 6-week period, October / November 2022).
- The S+LOADZ pilots demonstrate that the Parkunload solution can support different configurations of use-cases – extending the range of users who can be managed at kerbsides and even controlling parking spaces at wholesales markets.
- A common success factor among the pilot cities is political will, strong support from traffic officers and a comprehensive communication campaign, which spreads the word about the project and educates end-users in the use of digital tools.
- Digitising loading and delivery activities and collecting this data, which was previously not available to cities, is of great value for urban planning and project monitoring.
- The toolset has been extended. The Big Data tool has been utilised to present data in new, effective ways to practitioners (including the zone-use breakdown by vehicle emissions categories). Integration facilitates management of environmentally-friendly vehicles such as electric cargo-bikes
- Each living laboratory is unique, so when implementing S+LOADZ, each city must consider its own local characteristics, regulations, administrative procedures and culture.
- Modifying a regulatory framework, where the driver's APP is mandatory to use the zones, and the traffic agents' APP enforces it, has proven to be a very effective measure to facilitate the implementation of S+LOADZ. In the current project, only Vic was able to do this, and the results (highest levels of APP usage and zone registrations) reflect this. Enforcement is identified as a key

factor; the Vic pilot shows how this task is simplified; only 3% of penalty notices are for overstays, the majority are for non-use of the APP.

- The 12-month timeframe was a major challenge (to coordinate the stakeholder engagement, design and agree rules, order and install equipment, design, and execute the communication plan…). The French cities faced additional administrative challenges, selecting the city of Argenteuil and selecting District X in the cases of Metropole du Paris and Mairie de Paris, respectively.

2 Objectives of the project

S+LOADZ adapts, deploys, and pilots a mature TRL 7/8 digital platform to control, regulate, monitor, and analyse “Multi-Sustainable Digital Loading and Delivery Zones”. The pilots were held during 2022 in urban areas in the European capitals Paris and Ankara, also a middle-sized city from the Métropole du Grand Paris, Argenteuil, and the Catalan middle-sized city of Vic. The overall objective of the project was to develop a sound methodology towards market launch of the Parkunload product, and a general analysis of key factors of successful deployments aimed at replication in many more cities. The cities of Ankara, Vic, Paris and Argenteuil act as a living environment in which the solution is tested, providing a sufficiently diverse view to offer a global vision of the solution's potential, applicability and scalability.

The project aims to provide operational, environmental, and holistic KPI to accelerate the shift to sustainable and digital city logistics, with the following project objectives:

- Demonstrate state-of-the-art innovation and impacts of digital loading and delivery zones (LDZ) including novel features aimed at increasing sustainability and decarbonisation, advancing an already high TRL product with a strong go-to-market mindset.
- Design, deploy and pilot different types of LDZ in diverse countries, cities, and areas, which are subject to different legislation, operational scenarios, and on-street culture.
- Integrate vehicle emissions databases to develop advanced, data-driven policies to optimise urban freight aligned with air quality strategies in cities, which also include electric vehicle fleets, cargo bike hubs, and night-time deliveries.
- Collect and analyse Big Data from real logistics activity in each type of loading zone per city.
- Evaluate impacts and measure KPI per scenario, including the assessment of possible tax strategies to align city logistics with climate objectives.
- Publish recommendations to adapt parking bylaws at local, national, and European level to enable the digital transformation of sustainable LDZ at large scale in Europe.

3 Parkunload solution and innovations

Parkunload, founded in 2017, is an innovative platform to control, regulate and monitor digital loading and delivery zones (LDZ), which has been designed, developed, and evolved since initial deployments started in June 2018, which is already operational in several European cities, and it is also being piloted in the United States. As an industrial partner, Parkunload leverages and operates its Smart Loading Zones platform, based on mobile apps and Bluetooth, incorporating additional features to align with sustainable urban mobility plans of cities in Europe.

In the framework of S+LOADZ, the ***new add-on package of multi-sustainability features*** and ***Big Data analytics platform*** for Parkunload platform were design and developed. Additionally, these innovations were tested in the European capitals (Paris, Ankara), two large cities within Métropole du Grand Paris and the middle-sized Catalan city of Vic, aiming to develop a sound methodology towards market launch and analysis of key factors aimed at replication in many more cities.

The innovations developed during S+LOADZ project are explained in detail bellow:

1. Parkunload's new Big Data analytics platform is a web-based platform to analyse Big Data collected from smart LDZ, as an add-on feature to Parkunload platform for both urban mobility planners and mobility consulting services of cities. Parkunload's platform is using state-of-the-art cloud-based Big Data services to analyse and share anonymised parking data per smart zone.

Figure 1. Parkunload product. Big data analytics

2. Parkunload's new multi-sustainability pack is at TRL 8/9 and is partially being commercialised by Parkunload as features to enhance variable and dynamic parking rules of smart LDZ within LEZ or during pollution episodes, according to a software as a service (SaaS) business model based on

monthly or annual fees. Parkunload's add-on multi-sustainability package includes the following features:

- Parkunload's Big Data analytics platform.
- Enhanced parking rules based on vehicle emissions and environmental rules.
- Enhanced management of low emissions zones (LEZ).
- Enhanced management of pollution episodes.
- Minor platform upgrades, like new zone types, vehicle types, and languages.

Figure 2. Parkunload platform. Multi-sustainability pack

Parkunload aims to commercialise as SaaS these two new add-on products that have been designed, developed, and piloted during the S+LOADZ project in four cities, considering additional modules or tiers above Parkunload standard pricing policy.

Parkunload will align its marketing strategy to include these new add-on products in the portfolio of features for digital LDZ, across the sales department and business development partners, that will first target current cities and countries (Spain, France, Germany, and Ireland), secondly cities in other countries of the European Union, and finally cities in the United States.

3.1 Product Use Cases

Table 1. Product use cases

Case No.	Use Cases
Big Data Analytics	Cities that need to further analyse Big Data gathered from digital LDZ managed with Parkunload platform, by using state-of-the-art cloud-based Big Data services, that stands out from competitor's Big Data tools. Parkunload's Big Data platform complements standard parking charts available in web based Parkunload's BackOffice (backend/dashboard/etc.) for city administrators and urban mobility planners.
Multi-Sustainability features	Set of add-on features to regulate and control parking rules of smart loading and delivery zones (SLDZ) as follows: 1. Variable parking conditions of SLDZ, such as parking permit and time limit, based on vehicle's emissions according to legislation in some European countries. 2. Variable and dynamic parking rules within LEZ based on both vehicle's emissions badge and city context. 3. Variable and dynamic parking rules during pollution episodes based on both vehicle's emissions badges and city context. 4. New vehicle types, such as cargo-bikes in loading zones. Parkunload is a unique Bluetooth-based platform that enables accurate micro-location services to successfully implement LEZ and pollution episodes in some areas of the city.

3.2 Commercial Readiness Level Identification

The Commercial Readiness Level for each product line developed in the S+LOADZ project is as follows:

- **New Big Data analytics platform** is at TRL 9, which is already being commercialised by Parkunload as an add-on feature according to a Software as a Service business model based on monthly or annual fees.
- **New multi-sustainability pack** is at TRL 8/9 and is partially being commercialised by Parkunload as features to enhance variable and dynamic parking rules of SLDZ within LEZ or during pollution episodes, according to a SaaS business model based on monthly or annual fees.

Parkunload is a SaaS platform including several commercial tiers or packages to manage several types of smart loading and delivery zones towards sustainable city logistics.

3.3 Base requirements

Parkunload is an existent digital platform to regulate, control, monitor and analyse LDZ, that has been complemented with two add-on features in the S+LOADZ project, as explained in previous chapters. Therefore, Parkunload's platform baseline components, applications, and services are required to access the new additional features such as the Big Data analytics platform and multi-sustainability pack.

Parkunload platform is composed by the next components, applications, and services:

Table 2. Parkunload platform: components, applications, and services

Resources	Description
On-street components	Road sign delimiting each smart loading and delivery zone, including a Bluetooth low energy proximity sensor according to the patented principle of operation used by Parkunload.
Mobile App for drivers	Mobile application for both Android and iOS to manage parking sessions by end-users: • Parkunload App at Google Play. • Parkunload App at App Store. Parkunload platform has already registered +100,000 users.
Mobile App for parking agents	Mobile application for Android to control parking sessions by parking enforcement agents: • PKUN Control App at Google Play. Parkunload control app is already being used in several European cities.
Web-based BackOffice	Advanced BackOffice application (=backend, dahsboard, or…?) to manage parking rules and data by city planner and parking authorities.
Cloud-based central services	Parkunload's platform central services which are hosted in cloud services such as Microsoft's Azure and Google Cloud, among others.
Customer and User support services	Parkunload's customers and user support services to assist them in operational or pilot deployments.

3.4 Product functionality, usability, and scalability analysis

The S+LOADZ' consortium partner Ferrovial have deep technological knowledge as well as constantly upgrading the product offering and adapting to customers' needs, based on their experience in the carsharing business both in the cities of Madrid and Paris. In this chapter their review of the different platforms developed by Parkunload by analysing the various touch points with public users, fleet companies and cities is presented.

The **scope of the analysis** includes an intensive review for the main components of **Parkunload'** technological solution, in terms of functionality, usability, innovation and scalability of the product:

- Parkunload APP review
- Parkunload App Control review
- Backoffice Access
- Parkunload Big Data Analytics (developed during SLOADZ)

3.4.1 Parkunload user App

In general terms the app allows to "Digitalize" the curb space by providing a booking mechanism to users by "making a reservation" of the loading/unloading system in cities; something very much needed as e-commerce and low emissions zones are becoming more popular and in an upward trend.

As mentioned in previous chapters, the system covers all aspects of potential users from transportation carriers to regular users and helps incentivise local commerce in city centres, it also takes into account future development by digitalizing PRM & carsharing parking spaces and providing city officials a tool to plan / review / control city logistics.

3.4.1.1 Usability and functionality analysis

Mobile App Parkuload

- **User Onboarding:** the onboarding process is secure and functional, and it is considered positive to have an authenticator factor via SMS in place.
- **Home screen:** automatically shows and detects the area and you can even browse the map or input an area code indicated within the sign.
- **Main menu:**
    - **Adding vehicle registration,** it's very easy, it even has an OCR recognition software for ease.
    - **Park vehicle screen:** automatic push notification provided Bluetooth recognition works should be very easy for users especially if they are in a rush providing all information for check-in and check-out.
    - **History:** it is a valuable feature for checking past trips and very much needed. Potentially in the future, if charges apply the team could provide an invoicing /payment solution.
    - **Help/support:** a very needed feature that contains a wealth of information. An addition that could work nicely is to set up a live chat or direct phone number to speak to an agent.

- **Config:** Additional functionalities like Siri or google assistant **"are nice to have"** but we would advise to divert efforts in automation development (i.e. auto check-in/check-out).

Road Signs with Bluetooth

Signs just work fine, the low power **Bluetooth beacons** do the job, they are low power and have a low maintenance cycle too. These technologies would need to be consistent and re-evaluated with technology evolution (i.e. 5G, GPS etc).

It is advisable that the technology providers make sure that **connected car** technology could also coop and communicate with this Bluetooth beacon or have a roadmap for future enhancements.

Other tech solutions such as **video analytics** and **ground proximity sensors**, in the form of a low-cost radar sensor connected via access point, are advised to be looked into or have in the product development roadmap.

Contact and Support

The contact and support features are a key element to ensure adoption and enhance user experience. It would be ideal at the beginning for users to have quick access to instant chat for support or even a direct phone support line.

3.4.1.2 Innovation

From an innovation standpoint, it is considered that the future will be in the **connected car** space, we acknowledge that the Parkunload team already has this in mind (including apple **car play** and **android auto** in their product roadmap).

Something that would be great from an innovation perspective is that delivery or commercial vehicles and "regular users" vehicles could "check-in" or "check-out" automatically once the vehicle identifies the Bluetooth beacons without manually having to touch the phone screen.

Also, having **live feeds of information on available parking spots** would be very necessary for the future, as more and more delivery vehicles appear on the streets the greater the need to "order" and orchestrate "the kerbside", for this we propose three main technologies to be looked into:

- Live video feeds to identify free parking bays with AI technology
- Ground sensors low power/low cost to provide vehicle occupancy data
- Orchestration software platform to "control/manage" the various players that "occupy" the curb. This element in the form of a "central road platform for cities" could allow the live visualisation of vehicles movements "connected vehicle features" in order to automatically (through an algorithm) manage and divert traffic or to enforce deliveries at certain times and to ease congestion.

3.4.1.3 Scalability

The scope of the platform is wide and covers a variety of potential use cases, not only logistics. Parkunload parking product includes **Urban Logistics** (DUM, Loading and Unloading), **Local Trade** (Click & Collect), **Authorised Only** (Green, Residents, Owners) **Accessibility** (PRM, Assistance), T**ransport**, **Tourism and Business** and Industry.

Technology and other use cases such as **carsharing** environments are going to be very necessary for the future of "managing / re-ordering" smart cities, not just the logistics elements of it.

In terms of technology scalability, it is clear that key factors to replicate the S+LOADZ model from the technical and functional perspective are already in place.

On the other hand, it is foreseen that in the future there will have to be a form of payment to reserve these spaces, so a marketing plan and a pricing strategy for the different models of collaboration is advised.

3.4.2 Parkunload control App

Figure 3. Parkunload control App

As part of general duties, the parking enforcement agents can have the tools to enforce and manage loading /unloading areas. This is a key function to ensure user adoption and quality of data. The app allows the team to know exactly check-in/ check-out times, vehicle registrations and allows them to manage enforcement. Adding an integration with existing controller apps would be necessary to make their job easier and guarantee adoption rates.

3.4.2.1 Functionality & usability

Mobile App for Agents

The mobile application for controllers allows parking operator supervision in parking areas by using the Bluetooth traffic signs from Parkunload technology platform.

- User Onboarding: at the moment registration must be requested to Parkuload platform administrator. This functionality perhaps should also take into account City Admin team or the "parking" control concessionaire to manage the onboard process. From the usability perspective the process could be highly reviewed/improved.

- Parking control: The app allows users to monitor the status of the vehicles in a regulated parking area by standing less than 10 metres from the vertical traffic signal. It also allows users to have a displayed list of parked vehicles and provides their parking times. Vehicle list allows access parking tickets details including vehicles status by colour codes (i.e. red time meaning exceeded allowed parking time).

- Occupation: the apps allows the "controller" to know the occupancy status of all parking areas by displaying them on a map with a colour code:

    - Free zone(-): A green circle with a hyphen (-) indicates that there are free parking spaces in the area and therefore all spaces may be free.

    - Correctly Occupied Area: A green circle indicates time minutes remaining for parked vehicles; that is, the time of the vehicle that has less to go before its time limit expires.

    - Incorrect Occupied Area: A red circle indicates the excess time of improperly parked vehicles; that is, the time of the vehicle that has been incorrectly parked.

Road signs with Bluetooth

Signs just work fine, the low power Bluetooth beacons allows the agent to login and check history logs as well as provides easy maintenance.

Technical Support

This is a key element to ensure adoption and user experience. The team has already implemented a ticketing system to raise issues and queries but having a direct line to an agent would be necessary for scalability of the solution.

3.4.2.2 Innovation

In terms of innovation, it is considered positive that OCR technology has been implemented for officers to simply take a photo of the vehicle's number plate and automatically check the vehicle's status and history. In addition, integration with existing city or dealer platforms woul d be advisable to facilitate adoption.

3.4.2.3 Scalability

There is one functionality that has room for improvement, which is occupancy, as there are several factors that could affect the veracity of the data; improper use, vehicle dimensions, lack of control, excessive time, vehicle parked without permission, etc. this would have to be addressed in order to make the tool work and be reliable. Additional sensors could help manage these situations that can be a real pain for users.

In addition, integration of the system with the vehicle emissions database by integrating the number plates would be much needed to extend and improve the functionalities of the product.

3.4.3 Backoffice Access

The Parkunload platform presents an easy way to manage the various parking bays in the city and to amend and set up the different parameters depending on type of vehicles and users. Very versatile and configurable tool that would ensure adoption and scalability of the solution.

Figure 4. Parkunload platform: backoffice access

3.4.3.1 Functionality & usability

Backoffice Administration

The platform main menu includes 7 components:

- **Dashboard** with key aggregated metrics of the use of SLOADZ
- **Parking bays** where it is possible to see vehicle parking history
- **Enforcement** were there is a list of main offenders

- **Statistics** with information of current parking being used and average parking times as well as parking areas most used
- **Zones** this is a list of parking bays areas available with location can capacity
- **Configuration** allows city officials to add city parameters including regulation conditions, bank holidays, contamination restriction days, etc.
- **Users** provide a function that allows adding/removing controlling agents and administrators.

From the UX perspective, a map with the parking availability and regulation per zone could help from a smoother and more visual user perspective.

Advanced Data Analytics

In general terms these functionalities just tick all the boxes, things that could be improved are around getting richer statistics such as KPI definition, real-time & historic information and dynamic charts.

Customer Support

An area of improvement is related to an additional functionality to the users. It would be ideal that they could add comments or open tickets in case something doesn't work properly , and also an inclusion of a FAQ area and/or support by telephone or chat.

3.4.3.2 Innovation

Other technology solutions that would be advised to be developed in parallel are Big Data and Business Intelligence services for cities and Logistic operators. This tool can enhance operations and provide cities with the right framework to cope with future logistics growth. Also having a central road information platform would allow to organise various suppliers and plan for deliveries to ease congestion and improve operations.

Data driven dynamic parking conditions per area of the city, based on air pollution, traffic and parking occupancy information in real time would be needed too.

Mixing with other data sources or data fusion from (streetlight data, here and or wejo) could enhance cities data and make Parkunload a more compelling offering.

3.4.3.3 Scalability

The back office solution seems ready to add and onboard different cities as the number of cities grows, presumably there would be specific needs /requirements which would require adding development cost to any business plan.

3.4.4 Parkunload Big Data Analytics

Big data is a fundamental part for the project, this could allow the team to reach richer findings and have an impact as well as an easy way into new products, services and enhancements. It would also be a key

piece of information for city officials to take into consideration for making policy and be prepared for the future developments.

Figure 5. Parkunload Big Data Analytics

3.4.4.1 Functionality & usability

The Web based tool is from a well-known provider (google), this allows users to check data in a visual manner via graphs and tables, including filters, with export functions and provides a very easy way to download data.

Advanced analytics include parking sessions and average times, vehicle and user types, rotation and occupancy index including distribution per day/hour, we think this is a wealth of information that the team can already expand and make good use of.

Parking Areas function – just works it would have been nice to see something similar in the back office system.

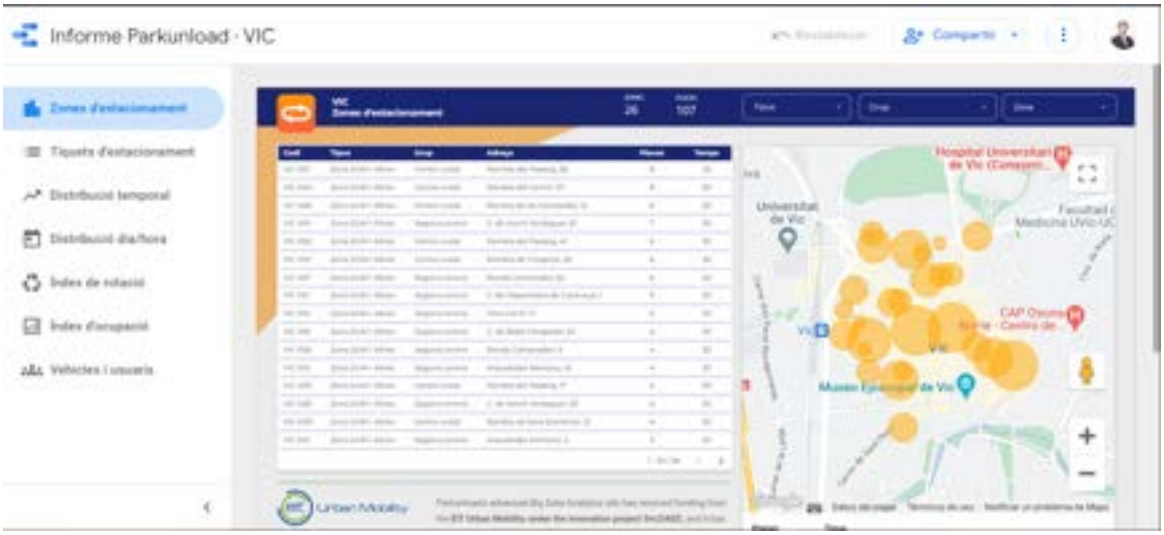


Figure 6. Parkunload: Parking areas function

Parking Tickets – this allows to check busy areas, great for placing "controllers".

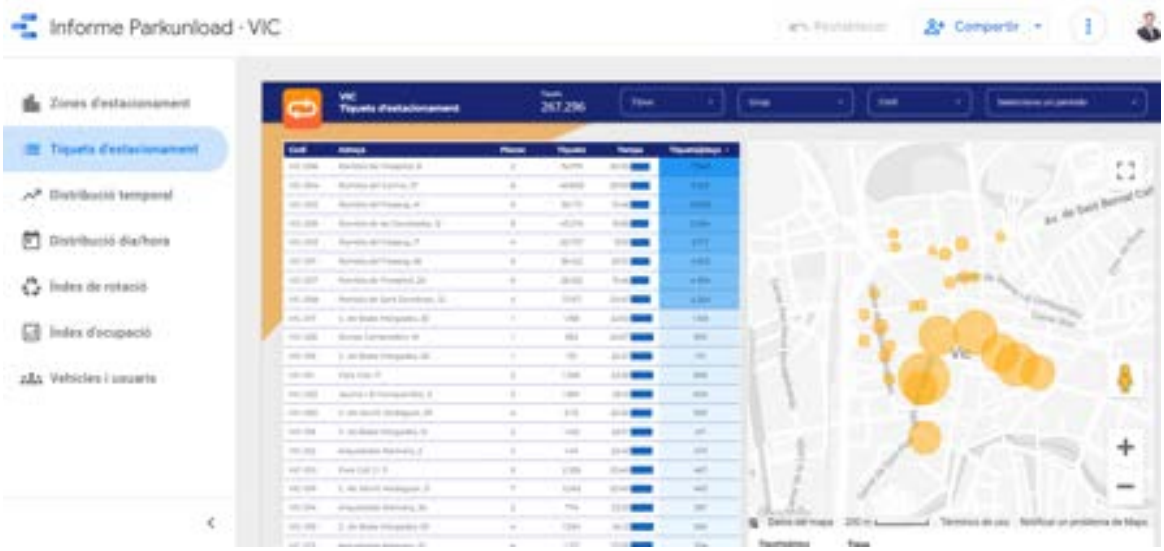


Figure 7. Parkunload: Parking tickets function

Time distribution – aggregated time /date distribution per parking tickets, great to plan for resources and enhance delivery operations.

Figure 8. Parkunload: Time distribution

Date/Time distribution – this allows to see time and day of the week availability, again great for planning in cities.

Figure 9. Parkunload: Time distribution

Rotation index – Day of the week / Rotation rate: Real tickets with respect to capacity in tickets at maximum time. Also good to have insights of key users and explore future "cost charging".

Figure 10. Parkunload: Rotation index

Occupancy index: Weekday / Occupation Index: Real occupancy times vs Total regular times.

Figure 11. Parkunload: Occupancy index

Vehicles /usage: vehicle (van, light commercial, trucks, heavy trucks), users (professional, reduced mobility, residents, commerce owners, regular users. Great to explore future “cost charging” opportunities.

Figure 12. Parkunload: Vehicle usage

3.4.4.2 Innovation

Off the shelf tool from google “data studio” is good and error free. Integration with other data sources like Streetlight data, here, Wejo, Otonomo, could provide richer insights to cities. Parkuload could become an “city planner”/advisor to lead this change in cities traffic management.

Dashboards should be enhanced with sustainability indicators and real-time charts and inclusion of KPIs with additional indicators, statistics, and charts. Parkunload's BackOffice should also be enhanced by providing a way to improve sustainable city Logistics insights, such as parking patterns, parking time, parking occupancy, rewards, etc.

3.4.4.3 Scalability

Off the shelf tool from google “data studio” is good and scalable. Data can be extrapolated for other cities easily.

4 Living Labs

In the following chapter, the evaluation framework's methodology will be explained, next more details will be given on each of the four living labs. Each of the living labs will be evaluated separately before the labs are compared collectively.

4.1 Evaluation Framework

An evaluation framework was developed in order to understand how successful it was the implementation of sustainable digital loading/delivery zones (S+LOADZ) with Parkunload in four distinct cities/regions, (i.e. four living labs, helps them reach their objectives), two methodologies are employed. The two methodologies build on each other to first evaluate each living lab separately, before comparing them collectively. In order to do so, the living labs are evaluated separately with factors that directly relate to Parkunload, before the cities/regions are compared to each other by framing them with factors unrelated to Parkunload.

(**1.**) Firstly, the factors that show the outcome of the technology implementation are related to Parkunload, and are measured as **holistic key performance indicators (H-KPI)**. To derive KPI relevant to the project and the four living labs, a survey has been conducted in the beginning of the project to identify KPI priorities and pilot objectives. The methodology is explained further in → *Chapter 4.1.1: KPI and H-KPI*.

(**2.**) Secondly, the four living labs are compared to each other in measurable facts unrelated to Parkunload, such as city or population size, to find out the **most different systems**. This comparison is a categorisation according to the most different systems design. The categorisation offers the possibility for the four living labs to be compared in factors showing the **most similar outcome**. The methodology is explained further in → *Chapter 4.1.2: MDSD*.

At the end of the project, the KPI are revisited, and their values compared among the living labs. The goal of these methodologies is to find out how Parkunload, the technological implementation that is similar to all the four living labs, led to similar outcomes. As an outlook to the future, it would be most effective to **revisit the set-up H-KPI after a longer period of time, which the cities/regions are advised to do after the project is concluded**. Such a long-term evaluation could be interpreted as a part of the city's/region's quality management (Panitz, Sauer & Waschkowitz, 2010, p. 534).

4.1.1 KPI and H-KPI

Understanding how a new technology, such as sustainable and smart LOADZ with the help of the application Parkunload, influences the area of implementation, was one of the main objectives of the living labs. Such outcomes can be measured in key performance indicators (KPI), especially when they are set up and compared at different points in time. For the project, each of the living labs' KPIs were derived with a survey on current challenges and objectives in the project in general. However, not every KPI can be measured in hard facts or numbers. Especially KPI in relation to smart cities or sustainable approaches are

often measured in qualitative manners. For S+LOADZ, operational, processual and social KPI were considered, which can be defined as holistic key performance indicators (H-KPI).[1] The whole process of how these H-KPI were derived and measured will be explained in more depth in the following paragraphs.

In order to establish measurable KPIs, it is less crucial to define as many KPIs as possible, but instead the right ones (Panitz, Sauer & Waschkowitz, 2010, p. 534). Only the right KPIs will in turn lead to monitoring and ensuring quality for the related object (ibid.). In the case of S+LOADZ, this is the implementation of Parkunload as a new technology to help the establishment of digital LDZs in the four living labs. KPIs are performance indicators that can, in this case, assess the characteristics of a technological solution, as well as its impact on the area of implementation (Pramangioulis et al., 2019). In case of a careful consideration and in-depth analysis, the KPIs can also assess the technology's economic viability, or social acceptance (ibid.).

Relevant for further analysis and comparisons is the scope of such KPIs. Output-oriented KPIs are specific indicators for tracking progress and success with a particular implementation. Some common examples are the number of smart meters, charging stations, and users of apps (Serrano et al., 2022). Impact- (or outcome-) oriented KPIs assess both short-term goals and contributions. For example, KPIs that measure the benefits of an energy transition project can be compared to more dramatic long-term benefits like decreased greenhouse gas emissions, improved air quality, and more replicable developments (Serrano et al., 2022). To visualise the comparison of KPIs in smart cities, see Figure 13.

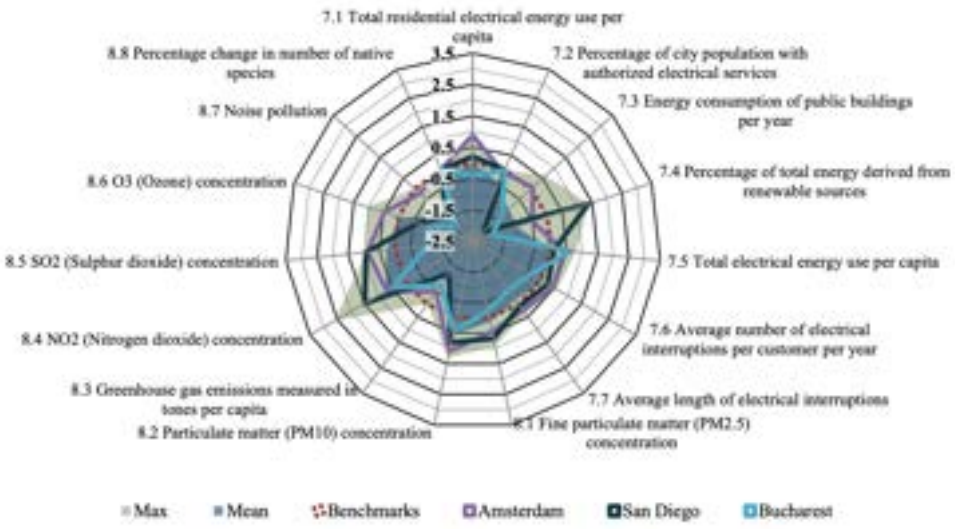


Figure 13. Example of a comparison of KPIs of three cities (Picioroagă et al., 2018)

In the case of S+LOADZ, first, general KPIs were derived in an online survey for the development of the Living Lab Model Plan for each pilot city in WP2. Next to general statements concerning challenges on sustainable city logistics, previous loading zone management and regulation requirements, each city was asked to rank the initially declared KPIs that were supposed to be achieved by implementing S+LOADZ. Within the given choices, the different KPIs were classified according to their respective dimension of

[1] For the Living Lab in Ankara, the social KPI and KPI were not measurable.

sustainability. By changing the sustainability dimension from economical to operational, the practical aspect of bringing digital loading zones to the model cities was emphasised. The operational KPIs that were selected most often by all city stakeholders were the goals of *reducing illegal parking*, *optimising parking spaces* based on *big data insights* and creating a *higher productivity of parking enforcement* (Figure 14). These among other first results emphasised the main project goal of focusing on operational advantages by testing the Parkunload app in the respective pilot areas.

Figure 14. Prioritised operational KPI within the project S+LOADZ

After the initial identification of possible pilot KPIs, all project partners met up in Vic for a face-to-face workshop which was designed to motivate successful pilots, to discuss achievable KPIs to monitor and how these are to be measured ex ante (baseline evaluation) and ex post (project evaluation) the implementation of the digital loading zones.

Thereby, operational, procedural and social KPIs were defined in order to move on to the topic of KPI measurement. Initially, the top goals and motivational aspects of a successful pilot and sustainable continuation of the digital loading zones were gathered. This was followed by a discussion of the current pilot status and clustering of KPIs by value creation for the city stakeholders. Lastly, all participants went into city-specific groups and discussed questions of data collection methods and how the information can be retrieved in the case of no baseline data being available within the project scope, keeping in mind that the framework within the project assesses technology and associated community benefits in smart cities in a more holistic manner as each city has its own unique characteristics and the solution cannot be an "one size fits all" option that works across all different application fields and municipalities.

The results repeatedly showed that across all cities', operational goals tend to be of highest interest. In particular, *decreasing illegal parking* while *increasing parking rotations* and therefore *reducing traffic congestion* stood out as goals, motivated by the creation of *controllable parking zones* and an *increase of inner-city environmental health* respectively. Goals following up were *regaining public space* and using it more efficiently through *better and more regulated policing*, and an overall better overview of local parking space usage and city planning through the collection of better and *more reliable data*.

All in all, the city-specific results reflected the initially accumulated goals and motives. Naturally, a common KPI was the increase of available loading zones, even though the underlying project goals differed. Generally, operational KPIs, with a high focus on availability of parking spaces and increase of parking

rotation, share a higher priority. The social KPIs were the second-most important to observe across all cities, though perceived liveability was on average more important than stakeholder satisfaction. Whereas perceived liveability could also imply a higher environmental health in the city, environmental KPIs tended to be less of interest on average. Moreover, the city-specific results showed similarities in the frequency of measurement and the data source, and associated stakeholders. The following paragraphs will outline the (holistic) KPIs for the four cities.

Paris and Argenteuil:

The results of Paris and Argenteuil show a focus on KPIs across all types, with a reduction of pollutants emissions, a higher turnover and wider availability of parking spaces, and a high satisfaction rate from stakeholders sharing the same level of priority. These are followed by the reduction of illegal parking, an increase of perceived liveability, and a reduction of noise emissions. Ranking the lowest on their priorities are the number of vehicle types over time, and a reduction of travel time overall. Additionally, the city emphasised the need for a baseline to measure an overall reduction of pollutant emissions, indicating the need for a set-up to collect different types of data. To measure the reduction of illegal parking, the city aimed at the number of fines measured every or every second month, the number of over time tickets measured daily, and the percentage of parking discs in relation to app usage measured at the beginning, in the middle and at the end of the project. As data sources, stakeholders and data collection methods, the city aimed at using police records, aggregated information through Parkunload, and field surveys. Paris's and Argenteuil's top five KPIs to measure successful pilots, the respective units of measurement and data sources are summarised in the following Table 3:

Table 3. Top five KPI from the pilots Paris and Argenteuil

KPI	Goals	Units of measurement	Data source
Average parking rotation in area over time	Public space optimization	Occupancy rate	Parkunload app
Availability of loading spaces over time	Public space optimization	Occupancy rate	Parkunload app
Reduction of illegal parking	Reduction of illegal use of zones for logistic processes	- Number of fines measured every (second) month - Number of overtime parking - % of parking disc usage vs app usage	Police reports, parkunload app & field surveys (ex ante & ex post)
Perceived liveability	Habit change	- Number of users over time (measured daily) - Qualitative feedback	Parkunload app & user surveys and feedback (ex ante & ex post)
Number of vehicle types with focus on emission classification	Characterise activity types/user groups and vehicle emissions	Total vehicles per vehicle type and emission classification	Parkunload app

Vic:

With Vic's previous experience with digital loading zones, the city chose a new pilot area including new stakeholders (local chemists) and vehicles (cargo-bikes) and therefore mainly focused on operational and social KPIs. Due to the short time period of the project, these seemed the most feasible to measure. Health aspects play a crucial part in the city's urban planning, however direct effects on the air quality have to be

measured in the long run - which was done for the already existing Z-DUMA digital loading zones in Vic (environmental trends in chapter 4.4.6), however cannot be monitored in the new pilot area. The availability of parking spaces, reduction of illegal parking, higher turnover rate for parking spaces and an increase of vehicle types shared the highest priority, next to a higher perceived liveability in the affected pilot area and the acceptance of the app within new customer groups. Next to following Paris and Argenteuil in mainly focusing on operational KPIs, the city emphasised the inclusion of feedback and user requirements from local chemists as well as drivers using the app in their everyday work processes. Therefore, online surveys and interview guides were set up to measure typical (un-)loading processes in the new pilot area for the baseline evaluation, as well as to measure the social KPI of user acceptance. Vic's top five pilot KPIs are summarised in the following Table 4.

Table 4. Vic's top five pilot KPI

KPI	Goals	Units of measurement	Data source
Reduction of illegal parking	Reduction of illegal use of zones for logistic processes	Fines	Parkunload warden app
Availability of loading zones	Use registration of vehicle, zone type and zone occupancy for initial overview of the new pilot area	Number of registrations and zone usage	Parkunload app
User acceptance	Identify if the app is a viable solution for new customer groups such as chemists and cargo bike logistics operators; understand user requirements	Changes in rating of the pilot concept and app	Field user surveys and interviews (ex ante & ex post)
Vehicle types over time	Advances data acquisition on vehicles and new user groups entering and leaving the pilot area	Total vehicles per vehicle type	Parkunload app
Average parking rotation in area over time	Space optimization	Occupancy rate	Parkunload app

Ankara:

The pilot KPIs of Ankara showed a clear prioritisation of operational over social and environmental KPIs due to the project scope of implementing a completely new digital system to the city. An increase in available parking spaces is the highest priority, followed by a high satisfaction rate of the stakeholders included in the management concept. These were followed by an increase of vehicle turnover on parking spaces and a higher perceived liveability in the area. The lowest priority lay on environmental aspects, with a reduction of noise and pollutants emissions, and a reduction of travel distance for logistic operators sharing the same level of importance. Thereby, the city especially prioritised two KPIs: availability of loading zones, and the acceptance of the users. The availability of loading zones, however, was aimed to apply across all loading zone types and time slots. To achieve that, officials wanted to require their users to register their vehicles and type zones, and to measure the percentage of overall zone use across all app users. Therefore, the unit of measurement was zone use registrations, and the frequency of measurement is all-day long. As mentioned, the data was meant to be measured and aggregated through automatization in their back office with additional data sources coming from field observations. The second KPI, acceptance by different groups - market trade union and transport operations - was to be achieved through a positive impression of the improved regulation. While the city wanted to measure the positive response through a change in

rating values, the exact frequency was yet to be determined. However, the data was set to be aggregated through surveys, apps, and app ratings. Ankara's top five pilot KPIs are summarised in the following Table 5.

Table 5. Ankara's top five pilot KPI

KPI	Goals	Units of measurement	Data source
Availability of loading zones	Use registration of vehicle, zone type, and zone occupancy for initial overview of the pilot area	Number of registrations and zone usage	Parkunload app
User acceptance	Identify if the app is a viable solution; understand user requirements	Changes in rating of the pilot concept and app	Field user surveys (ex ante & ex post)
Reduction of cross parking	Establish a structural environment for (un-)loading processes	Spatial use of zones	Field observations
Vehicle types over time	First time data acquisition on vehicles entering and leaving the pilot area	Total vehicles per vehicle type	Parkunload app
Average parking rotation in area over time	Space optimization	Occupancy rate	Parkunload app

4.1.2 MDSD

While the (H-)KPIs of the pilot cities were derived as factors related to Parkunload, a way of comparing the technology's implementation in the four labs is to first categorise them with factors unrelated to Parkunload, to then find out where the technology's implementation led to similar outcomes. Such a method can be aligned to the "Most Different Systems Design" (MDSD). Related to the MSDS is the "Most Similar Systems Design" (MSSD). While MDSD looks for the most similar outcomes in the most different systems, MSSD looks for the most different outcomes in the most similar systems (Steinmetz, 2021).

As Parkunload is the factor (or 'treatment', if considered in scientific experiments) that stays consistent in all of the four living labs, and the approach is to find out which comparable outcomes and impacts are achieved, we decided on a comparison in the MDSD (as opposed to a comparison in the MSSD). The merit of this approach is backed up by the definition of MDSD, where "the relationship between variables that are different to one another" is analysed (Steinmetz, 2021). For this case, we will later show that the four labs are rather different to each other in their 'variables' (→ *Chapter 4.6: Comparison of the Living Labs*), while a 'relationship' between the four labs becomes apparent in similar outcomes. Likewise, the MDSD is characterised by the fact that from a corridor of case studies or study regions that are as different as possible, precisely those are selected in which the object of study shows results that are as similar as possible (Köhler et al., 2018). One advantage of the MDSD method is that, alike the derivation of KPI (s. a.), it is not the goal to analyse as many variables as possible, but instead the researcher just needs to identify the same variables that are present in all the different cases (Steinmetz, 2021). To give an example, variables chosen can be the population size, economic characterisation, and development (Brombach et al., 2014). The chosen variables will be explained further in → *Chapter 4.6: Comparison of the Living Labs*.

As a final remark, research on the MDSD shows that similar variables can also be seen as 'control variables' (Steinmetz, 2021). Therefore, for future analyses, it might be fruitful to compare cities where Parkunload was implemented with a control case where the application has not been used. As this has not been the case in the S+LOADZ project, it is yet another reason to apply the MDSD instead of the MSSD.

In the following chapters, each of the living labs will be observed as a standalone lab, before the four labs are compared with each other with the MDSD approach.

4.2 Living Lab Métropole du Grand Paris, city of Argenteuil

The Métropole du Grand Paris is a dense, urban inter-municipality that includes the city of Paris, 123 municipalities in the three departments of Hauts-de-Seine, Seine-Saint-Denis and Val-de-Marne and 7 municipalities in Essonne and Val d'Oise (Métropole du Grand Paris (ed.), 2022).

Since its creation, the Métropole du Grand Paris has taken concrete steps to benefit its 7.2M residents. The particular role of the Metropolis has become undeniable, as it takes up the challenges of economic, social and cultural development, working to protect the environment and enhancing its international attractiveness. Its action is focused on employment, investment, and innovation.

As a public body of intermunicipal cooperation with its own taxation revenue and specific status, the Greater Paris Metropolis exercises powers in five mandatory areas, as defined in the metropolitan program:

- Economic, social, and cultural development and planning.
- Environmental protection and enhancement and living environment policy.
- Development of the metropolitan space.
- Local housing policy.
- Management of aquatic environments and flood prevention.

Initiatives by Métropole du Grand Paris aim to improve the living environment for residents, reduce inequalities between territories, and develop a sustainable social and economic urban model that ensures attractiveness and greater competitiveness for the benefit of the entire country.

In addition to this, the municipalities manage the roads network and have the power to enforce the law on their territory.

4.2.1 City logistics overview

Urban logistics is a major axis of metropolitan action and must contribute to the emergence of an innovative and resilient metropolis. The Métropole du Grand Paris has therefore drawn up a **Pact for Metropolitan Logistics** adopted in June 2018. Comprising twelve actions to be implemented progressively, the Pact currently has nearly 80 signatories, municipalities, territories, and urban logistics operators (Métropole du Grand Paris (ed.), 2018).

In 2020 the Covid-19 pandemic has shaken up habits and transformed societies. The need to reconsider urban logistics was already identified from the critical angle of pollution, congestion, safety, etc. But during lockdowns, logistics and transportation became much more visible as a strategic infrastructure for cities. Urban logistics must now take up several challenges: acceleration of its development, environmental transition, and integration into the metropolis of tomorrow.

To take into account these changes leading to new distribution models, and based on the Metropolitan Recovery Plan of May 2020, the Metropole du Grand Paris has built a new roadmap for metropolitan logistics and refocused on five more operational pillars for the Act 2 of the Pact: accelerating the transition of freight vehicle fleets, experimenting and implementing innovative logistics solutions within metropolitan area, developing waterway freight transport, relocating logistics real estate in dense urban areas, steering public policy through data.

The Sustainable Urban Logistics project carries out the actions defined in the *Act 2* of the **Pact for Metropolitan Logistics**.

Every week, the flow of goods by road generates 4.4 million movements in Ile-de-France (deliveries and/or collections), 62% of which are within the Greater Paris area. Manufactured goods constitute most movements, since 54.4 % of these are generated by trade (retail, wholesale, mass distribution) and the pure tertiary sector. It is in the heart of the conurbation that the movement of goods is most intense. It is in this area that both the economic activities and the regional population that generate movements are concentrated. In addition, it is in the dense area that movements linked to last-mile deliveries are concentrated, which more frequently take the form of rounds than direct traces and therefore generate more movements. LCVs (< 3.5 t) account for more than half of delivery movements in Paris and more than 45 % in the suburbs. In 2012, most deliveries were made in the morning, between 9 and 11 am.

This new stage in the evolution of logistics is driven in particular by digital technologies, intelligent transport systems, changing consumption patterns and locations. A series of innovations concern:

- Real estate and furniture with increasing modularity. New concepts are appearing on several levels or vertical. New concepts are emerging multi-level or vertical.
- Data to anticipate the supply chain: real-time traceability to optimise and pool vehicles, barges and trains vehicles, barges and trains, logistics spaces, roads, delivery areas, etc.
- Movement: autonomous/semi-autonomous solutions, collaborative platforms. Digital tools are simplified to optimise routes, vehicle filling, etc., or to develop collaborative solutions, which can have a positive impact on the collaborative solutions, which can have a positive environmental impact.

- The indoor process of logistics locations, in order to meet ever shorter deadlines, the multiplication of references and distribution references and distribution methods (omnichannel).

Contributing to the optimisation of deliveries involves 5 measures in connection with road, waterway, rail and space sharing:

- Harmonise road and delivery regulations in the city.
- Optimise the use of public spaces (traffic lanes, bus lanes, delivery areas, etc.) by improving access and sharing uses.
- Integrate freight transport into station and public transport line projects.
- Contribute to the development of river transport and to the improvement of access conditions to it.
- Test mixed solutions that share the use of space.

The 131 municipalities in the Greater Paris region account for 62 % of the region's freight movements and each has its own traffic and freight delivery regulations. The goods regulations vary from one municipality to another in terms of timetables, size and even authorised engines.

The City of Paris, which alone handles 26 % of the region's goods movements, has had goods regulations in place since 2007, based in particular on differentiated access times according to the size of the vehicles (surface area less than or greater than 29 m²) and their environmental performance. This last condition has been reinforced by the implementation in 2015 for Paris intra-muros area, of the first low emission zone, which has been extended in 2019 to the entire area inside the A86 highway covering 77 cities of the metropolitan area. Since 1 June 2021 , the most polluting vehicles (beyond Crit'air 4 stickers - included) are banned from 8am to 8pm.

Many professionals whose fleets transport goods within the Greater Paris territory would like these provisions to be clarified, both in terms of the authorised size (for Paris, this is a floor area, a criterion that has been (for Paris it is a floor area, a criterion that has been the subject of a consensus with the professionals, for other communes it is criteria of GVW) and environmental standards.

Harmonisation of road and delivery regulations should aim at better sharing of the road, considering road safety aspects (cohabitation of soft modes), optimisation of the use of delivery areas (sanctuary/sharing with other functions, etc.) and their accessibility. Harmonisation would make it possible to clarify the rules of access for vehicles to the municipalities located within the Greater Paris Metropolis perimeter according to their size (floor area vs. gross vehicle weight), their environmental standards in terms of GHG emissions, atmospheric pollutants (CRIT'AIR stickers) and noise pollution (Piek standards).

Apart from the road aspect, the question of the use of delivery areas is a source of strategic optimisation. Indeed, their use is not optimal insofar as supply and demand do not meet or do not meet well (at the right place/at the right time: delivery area absent, unsuitable, and/or occupied...). Facilities can be very costly and counterproductive as some can reduce the possibility of delivering the economic fabric. This is one of the reasons why some actors proposed to start by This is one of the reasons why some actors proposed to start by testing innovative solutions, evaluating them, and then progressively extending the solutions according to the needs.

The evolution of the economic and commercial fabric influences delivery practices and consequently the use and need for delivery areas. Mobile delivery areas could respond to these changes. All this requires the ability to control their use, which raises the question of resources (human, technological and financial) This raises the question of resources (human, technological and financial) and certain rules (data protection law and remote surveillance).

At the beginning of the year 2022, the Metropole du Grand Paris launched a call for applicants, among its member cities, to participate in this experiment, and the city of Argenteuil has volunteered to host this experiment. Argenteuil is located in the northwestern part of the city of Paris and is part of the Métropole du Grand Paris. The city hosts approximately 110 000 residents across 17 km² and is the fourth most populated city in the province of Île-de-France.

Argenteuil is not included in the metropolitan low emission zone. Currently due to the lack of loading zones and to the pressure on parking slots in general, the deliveries are realised in non-dedicated spaces (mainly on the road) with an impact on the congestion, and generate dissatisfaction, pollution, etc.

4.2.2 Scope and objectives of the pilot

The S+LOADZ pilot has been implemented in the city centre of Argenteuil, in the paid parking zone which has a high commercial density and a high pressure on loading and delivering, a zone that concentrates more than 400 shops from diverse services. The perimeter includes 20 loading and delivery zones and 36 parking slots.

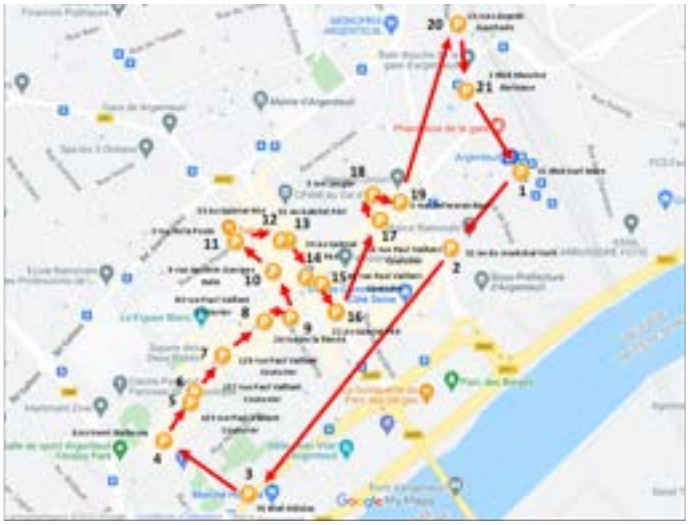


Figure 15. Pilot area. Argentueil

This experiment, coordinated by the Metropole du Grand Paris aims to meet a double objective:

- To optimise the occupation of loading zones, to improve the level of rotation on the areas and guarantee their availability for the vehicles concerned.
- To improve the enforcement of the loading/delivery zones

The current parking rules of the city:

- All vehicles authorised for loading and delivering
- 24h/7
- Time limit is 30 min, the drivers set the arrival time through a parking disk

Use case of the pilot will rely on current parking rules

4.2.3 Baseline of the pilot

Methodology for pilot evaluation

The Metropole du Grand Paris performed an ex-ante assessment in June 2022 of the 20 loading zones included in the scope of the pilot.

In the area of the city centre, there are approximately 3 000 goods movements per day, coming from B2B and B2C and 77% of the movements are operated by light commercial vehicles and 23% by trucks, with a peak of deliveries between 9 AM and 11 AM. (Source: Freturb)

The assessment has included the following studies and took place on June 13, 16, 21 and 24 of 2022:

- A characterization of the loading zones through their dimensions, signage (road marks and signage), accessibility (presence of a lowered curb, …), and location in regards with proximity to the shops or the area they need to deliver. Those data have been compared to the Cerema's[2] recommendations to have a statement regarding the compliance of the loading zones identified for the pilot.
- A field survey regarding illegal parking for deliveries
- A quantitative analysis based on a field survey during 4 half days of 4 hours to collect data on occupancy, type of vehicle on the loading zone.
- A qualitative analysis through interviews of 18 drivers, 5 shop owners and 1 control agent which have been conducted to characterize their way of working, use of loading zones, the main issues they are facing and their expectations.

Results :

A. The characterization has shown that among the 20 loading zones which have been investigated, 80% are compliant with the official recommendations. The main reasons for non-compliance are the poor accessibility to the curb to unload the goods (no lowered curb, presence of a pole) or the lack of signage (road mark partially erased).

B. Use of the loading zones

a) Quantitative survey:

- The loading zones are occupied in 80% of the observations, but in 64% of the findings it is by a private car.

[2] Cerema (which stands for Centre for Studies and Expertise on Risks, the Environment, Mobility and Urban Planning) is the major French public agency for developing public expertise in the fields of urban planning, regional cohesion and ecological and energy transition for resilient and climate-neutral cities and regions.

- The parking turnover is quite low and variable from one loading zone to another: an average of 6 rotations for a maximum which could reach 16 for one rotation every 30 minutes.
- 69% of the deliveries in the city centre are realized outside the loading zones, including 52% in double-line parking.

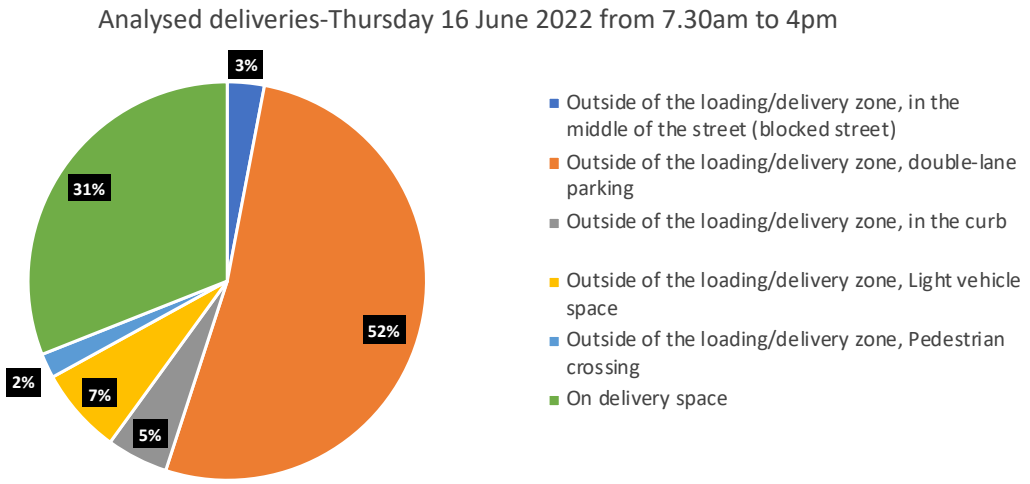


Figure 16. Use of current loading/delivery zones

Table 6. Use of the loading zones

	NOMBRE DE MOUVEMENTS constatés sur l'aire sur 8 fois une demi-heure	*Nombre de place sur l'aire*	*Nombre de rotation maximum possible*
Aire n°1. 31 boulevard Karl Marx	3	1-2	8-16
Aire n°2. 32 avenue du maréchal Foch	4	2	16
Aire n°3. 70 Bld Héloise	4	1	8
Aire n°4. 9 rue Henri Barbusse	4	1	8
Aire n°5. 163 rue Paul Vaillant Couturier	4	2	16
Aire n°6. 157 rue Paul Vaillant Couturier	12	2-3	16-24
Aire n°7. 129 rue Paul Vaillant Couturier	5	2	16
Aire n°8. 83 rue Paul Vaillant Couturier	1	1	8
Aire n°9. 26 rue de la Liberté *	9	3	24
Aire n°10. 9 rue Antonin Georges Belin			
Aire n°11. 2 rue de la Poste	7	3	24
Aire n°12. 53 avenue Gabriel Péri	7	2	16
Aire n°13. 52 avenue Gabriel Péri	3	1	8
Aire n°14. 35 avenue Gabriel Péri	10	3	24
Aire n°15. 69 avenue Paul Vaillant Couturier	7	2	16
Aire n°16. 22 avenue Gabriel Péri	14	3	24
Aire n°17. 16 rue Paul Vaillant Couturier	7	2	16
Aire n°18. 3 rue Laugier	7	2	16
Aire n°19. 5 rue Defresne-Bast	10	2-3	16-24
Aire n°20. 15 rue Léopold Gautherin	1	1	8
Aire n°21. 2 boulevard Maurice Berteaux	2	1	8
Moyenne	6	2	16

* aire occupée en permanence par une benne à gravat, prenant une place

b) Qualitative survey:

Interviews of drivers

- The average duration of a delivery is from 16 to 20 minutes.
  It can last from 1 to 3 minutes for express delivery, till up to about 1h for a department store.
- 88% of the drivers do not use any parking disc (no time, no disc or don't know that a disc is needed), and a large majority of them park illegally for deliveries (double-line, or on the curb, or on residential parking…).
- For 55% of them, loading zones are illegally occupied or too far from the delivery point.

Some proposals for improvement have been raised by the drivers:
- Having more loading zones
- Avoid the illegal parking of private cars

The interest of the drivers in the solution is mitigated: for 1/3 of them it's perceived as a constraint without any clear impact on the improvement of their conditions, whereas for approximately 1/4 it could help to improve the situation

Interviews of shop owners

- The average duration of a delivery is approximately 60 minutes. 2 of them are large stores: department store or fruit and vegetables shop.
- All the shop owners meet difficulties for their deliveries: 80% of them do not use the loading zones.
  - The main reasons are the location (no loading zone close to their shops, or not enough loading zones in the area), a low accessibility, and an illegal occupation by private cars.
- Regarding their interest in the solution, 2 out of 5 are favourable and 2 others are less favourable. But for all of them, control the use of the loading zones is mandatory to make it works

Interview of control agent

The main roadblocks for a better control of the use are the lack of clear indication of city bylaw, especially the mention of the parking disc on the signs, and a lack of human resources for the control.

Additionally, to the previous communication campaigns, an awareness campaign took place on November 30 during the experiment, with a distribution of flyers and/or in-situ explanations to drivers/shop owners/inhabitants when the misuse of delivery areas was observed.

4.2.4 Deployment process

The key moments of the implementation of S+LOADZ in Argenteuil are explained following:

January – March 2022:

-Organization of a “call for application” webinar addressed to the metropolitan cities to identify and engage a city volunteer to be a pilot

March 2022:
-Express of interest from Argenteuil / approbation of city executive management
-Definition of scope and use-case to be tested.

May 2022:
-Kick off meeting with the internal stakeholders in Argenteuil (communication department, commerce, road maintenance and public spaces, IS/IT, sustainable development, …)
-In situ visit to validate location of S+LOADZ and urban context

June 2022:
-Presentation to members of city council
-Ex-ante survey
-Design of communication plan

August 2022:
-Road signs and devices installation

September 2022:
-Training sessions for control agents
-Communication to professional users and inhabitants: flyers, website, city newspaper, specific channel from the city to shop owners.

October 2022:
-Official launch of the project / communication campaign
-EIT demonstration visit

November 2022:
-New awareness campaign to users

4.2.5 Challenges

Following the main challenges identified for the project implementation:

- Timeframe of the project: 12 months period is too short and does not allow to have enough time for living pilot and change of mindset
- Heavy administrative and legal workload
- The project implementation was intense in human resources needed
- National regulation, regarding the loading zones, is a roadblock
- Strong communication and commitment are key

4.2.6 Results and evaluation of the pilot project

Argenteuil has successfully deployed a system covering 20 loading zones in the central part of the city. This is a notable achievement given that there was a selection process at the start of the project such that Argenteuil had even less time than the other S+LOADZ cities.

The following graphics from the Big Data Tool - developed in this project – and the Platform Back Office show the driver APP registrations and other KPIs from September 12th to December 14th. A total of 83 tickets (or check-ins) were issued to drivers (See Figure 17)

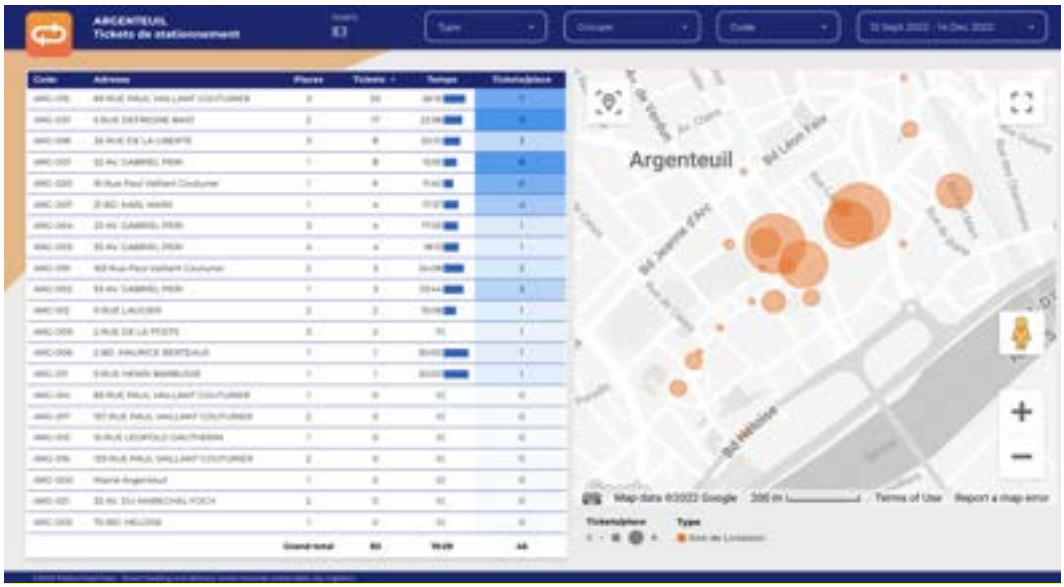


Figure 17. Driver APP registrations per zones in Argenteuil in September/ December 2022

Regarding the tickets per period of time, it is possible to observe the gradual increase in use of the APP in the last month of the pilot, December (See Figure 18). In the case of Argenteuil, the App is used similarly

both on weekdays and on weekends, with a marked peak at 11AM. The Big Data Tool allows us to identify the zones having the most tickets, zone ARG=015, 69 RUE PAUL VAILLANT COUTURIER - with 20 tickets in only three spaces.

Figure 18. Driver APP registrations per period of time in Argenteuil in September/ December 2022

The Big Data Tool also facilitates quantification of the numbers of users and the numbers of vehicles they use (See Figure 19). In the Argenteuil pilot, during 10 weeks until 14 December 2022, 24 drivers used 28 vehicles generating the 83 tickets. 75% of the vehicles were cars, 18% Vans/trucks and 7% light/commercial vehicles. From those vehicles, around 50% belong to the very high, high or medium emission category.

Figure 19. Vehicles and drivers in Argenteuil in September/ December 2022

Data analysis reveals that the average staying time is 25,7 minutes, with a standard deviation of 17 minutes, and that 34 of the 83 tickets (41%) overstayed the 30-minute limit or did not check-out with the App. On 20 occasions of the 34 (59%) the overstay was less than the 15-minute time-out.

Figure 20. Average parking time in Argenteuil in September/ December 2022

The data collected by the system is still preliminary – but the trends are already interesting; increased use in December compared to previous month, an increasing number of zones being used. Arguably of greatest interest is the recording of over half the kerbside use as overstays, and clearly the unregistered use is likely to indicate an even greater problem. This lack of rotation is the problem the solution is aiming to solve.

Results of ex-post survey :

Quantitative survey

21 loading/unloading areas (not in the S+LOADZ instrumentation) were surveyed during 6 days over the period 5-16 December 2022. As seen on **Error! Reference source not found.**, with an average rate of o ccupation of 70% (70% of the time surveyed demonstrated a use of the area by a vehicle), of which less than half was an actual loading or unloading activity. More than half was for a private car parking (illegal) or a commercial vehicle long-term parking (illegal).

The use of the loading/unloading areas (their productivity in a way) is low, with an average of 6 individual delivery activities over four hours of observation.

Table 7. Quantitative indicators collected on loading/unloading areas

	TAUX D'OCCUPATION					NOMBRE DE MOUVEMENTS constatés sur l'aire sur 8 fois une demi-heure	Nombre de place sur l'aire
	PLACE			AIRE			
	Taux d'occupation de la place (tout type véhicule)	Taux d'occupation marchandises de la place	Taux d'occupation VL de la place	Taux d'occupation de l'aire (tout type véhicule)	Taux d'occupation marchandises de l'aire		
Aire n°1. 31 boulevard Karl Marx	100%	32%	68%	100%	42%	3	1-2
Aire n°2. 32 avenue du maréchal Foch	71%	8%	63%	100%	17%	4	2
Aire n°3. 70 Bld Héloise	67%	8%	58%	67%	8%	4	1
Aire n°4. 9 rue Henri Barbusse	75%	25%	50%	75%	25%	4	1
Aire n°5. 163 rue Paul Vaillant Couturier	71%	4%	67%	83%	8%	4	2
Aire n°6. 157 rue Paul Vaillant Couturier	53%	14%	39%	83%	42%	12	2-3
Aire n°7. 129 rue Paul Vaillant Couturier	38%	4%	38%	58%	8%	5	2
Aire n°8. 83 rue Paul Vaillant Couturier	75%	67%	8%	75%	67%	1	1
Aire n°9. 26 rue de la Liberté *	36%	31%	6%	67%	67%	5	3
Aire n°10. 9 rue Antonin Georges Belin							
Aire n°11. 2 rue de la Poste	64%	33%	31%	100%	83%	7	3
Aire n°12. 53 avenue Gabriel Péri	75%	8%	75%	100%	17%	7	2
Aire n°13. 52 avenue Gabriel Péri	50%	42%	8%	50%	42%	3	1
Aire n°14. 35 avenue Gabriel Péri	82%	16%	66%	92%	50%	10	3
Aire n°15. 69 avenue Paul Vaillant Couturier	79%	50%	29%	92%	75%	7	2
Aire n°16. 22 avenue Gabriel Péri	69%	25%	44%	100%	92%	14	3
Aire n°17. 16 rue Paul Vaillant Couturier	83%	13%	71%	100%	25%	7	2
Aire n°18. 3 rue Laugier	88%	25%	63%	100%	50%	7	2
Aire n°19. 5 rue Defresne-Bast	96%	42%	54%	100%	83%	10	2-3
Aire n°20. 15 rue Léopold Gautherin	92%	92%	0%	92%	92%	1	1
Aire n°21. 2 boulevard Maurice Berteaux	33%	33%	0%	33%	33%	2	1
Total	70%	29%	42%	83%	46%	6	

* aire occupée en permanence par une benne à gravat, prenant une place

- The global average occupancy rate of the 20 loading zones is 61% (including private cars and commercial vehicles), versus 70% during ex ante survey.
- The proportion of commercial vehicles (24%) is stable compared to ex ante survey (26%), whereas available loading slots have increased (39 % versus 29%) and proportion of private cars has decreased (37% versus 45%).
- Overstay vehicles represent 29% of the vehicles, but with an occupation of 55% of the slots. 58% of the overstay vehicles are private cars.
- Over the 2 days of survey, the investigators have noted very few usage of the app : one ticket was recorded in the app in 2% of the occupancies. Parking disc was used in 3% of the occupancies.

Qualitative survey / interviews

6 shopkeepers and 13 drivers were interviewed:

- The investigators noticed a poor knowledge of the new system: 50% (3) of the shopkeepers and 92% (12) of the drivers were not aware of it and then do not use it.
- The respondents did not notice any improvement in the delivery conditions since the implementation of the app in October 2022.

City of Argenteuil:

- The SLOADZ project has highlighted the issues related to deliveries and loading zones in the city and it is an opportunity to continue the reflection regarding control, layout, location of loading/delivery zones.

4.3 Living Lab City of Paris

The City of Paris is the capital of France and home to about 2.2M residents across an area of 105.35km², whereas the urban region hosts around 12.5M residents across 17,174 km² as of 2015. As such, Paris is the most densely populated city in the European Union (Institute national de la statistique et des études économiques (ed.), 2018).

Figure 21. Photo by Vincent Rivaud from Pexels.

The City of Paris is the centre and seat of government of the region and province of Île-de-France with about 18 % of the population of France (Préfecture de la région d'Île-de-France, préfecture de Paris (ed.), 2018).

The City of Paris aims to offer its users efficient structures and networks that allow the movement of people and goods. The dynamism and economic prosperity of the city are closely linked to the exchange of goods that meet the needs of the population and businesses.

Paris currently receives the logistics services it needs (households and establishments are supplied). However, the inhabitants and users of these territories aspire to a healthy and peaceful living environment which is difficult to live with the nuisances and inconveniences generated today by the transport and delivery of goods.

4.3.1 City logistics overview

In the city of Paris, deliveries are increasingly frequent and demanding (tight flows, new ways of consuming, etc.), and take place at unusual times in residential neighbourhoods where they were not previously known. Logistics therefore has a huge impact on the road network (congestion, air pollution, noise, occupation of public space, etc.), although updated data is not available to identify precisely the scale and volumes of the delivery trends involved.

On-street delivery areas represent, in fact, one of the only few urban logistics and distribution tool on public space in Paris. The delivery areas are part of the fine scale of the street and have a real impact on maintaining commercial dynamism. Their primary function is to allow a vehicle to stop to load or unload goods, for a maximum of 30 minutes in Paris.

However, there is a lot of abuse of delivery areas, involving parking of private individuals and tradesmen for several hours at a time. Deliveries are then made in double file parking. The French Urban Goods Transport Surveys, including the last one in the Paris region (2010-2012, have shown that in the City of Paris, 75% of deliveries are made outside delivery areas. Delivery areas are generally not available, as they are occupied (legally or illegally), poorly sized, poorly positioned, or non-existent. The fact that many delivery operations are carried out in the middle of the road is both a factor of urban congestion and an accident hazard.

According to city officials, the city is facing several problems regarding on-street loading/unloading areas:

- Low parking rotation in the zones.
- Misuse of loading/unloading areas: overtime, lack of permit, etc.
- Traffic congestion due to double parking.
- Inefficient parking control methods and poor enforcement of rules related to loading/unloading areas.
- Road safety concerns and incidents that reduce the quality of life of residents.
- Lack of mobility data related to urban freight vehicles.
- Delivery vans/trucks occupying bicycle paths or sidewalks

Approximately 6,000 delivery areas (representing 9,700 individual delivery parking spaces) are marked in Paris, one third of which are allowed exclusively for delivery vehicles 24 hours/7 days, and two-thirds of which are “shared”, i.e.; open to private car parking at night. The markings on the ground are differentiated: a solid double line for exclusive areas, dotted lines for shared areas (see Figure 22).

Figure 22. Information about different parking zones for non-commercial usage

A loading/unloading area is a stopping zone and not a parking area. It is intended for the loading and unloading of goods or people, with the driver remaining close to their vehicle to move it if necessary, according to article R. 110-2 of the Code de la Route (national Street Code)

Since 2007 a regulation on the transport and delivery of goods has been in force in Paris. Traffic and delivery rules have been simplified to limit the circulation of the most cumbersome and polluting vehicles. Stops in delivery areas are limited to 30 minutes, a period controlled with a goods delivery disc, or the European parking disc.

Within France, it is mandatory for vehicle owners to display the Euro emission category by use of an environmental badge (Euro standards are converted into Crit'Air standards, Ministère de la Transition Écologique, 2022). The Paris Low Emission Zone since 2015 has introduced de facto parking restrictions based on vehicle emissions and for instance, the most polluting vehicles are not authorised from driving or parking in the capital.

In June 2020, the Ville of Paris and the Île de France Region together launched an innovative city logistics project targeting the loading/unloading areas in the fourth district of Paris, which also belongs to Paris Centre (see Figure 23).

The experimental project aimed to evaluate several components and technologies to improve the regulation, control, and monitoring of the delivery zones, based on both a declarative mobile application, like Parkunload with Bluetooth technology, and two types of parking availability sensors, like magnetometers and camera-based sensors.

Figure 23. Map of digitized delivery zones in Paris 4th district (experimented since 2020)

The scope of this project called "Aires de Livraison connectées" has been as follows:

- All the delivery zones (138) are regulated and controlled with the mobile app Parkunload, which is not mandatory to be used by drivers, just optional.
- 22 delivery zones are also equipped with a camera-based parking sensor to detect parking availability per zone, managed by ParkingMap.
- 33 delivery zones are also equipped with a magnetometer parking sensor to detect parking availability per space (5 metres), managed by ParkingMap.

ParkingMap centralised data collected from Parkunload and parking sensors in real-time to display parking availability information to the police officers, who are the parking control agents in the delivery areas of Paris.

Since there is only a small amount of loading zones, no direct positive effects considering operational measures such as an increase in parking rotation or the reduction of illegal parking can be concluded.

The same accounts for KPIs related to the environment such as the reduction in traffic congestion or the reduction in total vehicle emissions. Although there is no obligation, many logistics vehicles do use the Parkunload platform for loading/unloading activities, making the solution highly accepted among this group of stakeholders.

The solution does also support the workflow of parking enforcement agents, which can be seen in their high acceptance of the system. Local businesses and nearby residents have expressed a neutral opinion regarding digital loading zones.

Scope and objectives of the S+LOADZ pilot

The S+LOADZ solution implemented in the tenth District of Paris has the following objectives:

- Reduce the amount of illegal parking in loading zones
- Improve the efficiency of the control of loading zones by municipal police officers

- Increase the turnover and availability of delivery areas
- Demonstrate the interest in adapting parking regulations in Paris and the Metropolis, regarding the contribution of digital technology
- Use data to optimise loading zones: analysis of the number and time of stops, types of vehicles.

In order to achieve those objectives a total of 80 loading/delivery zones were equipped with Bluetooth technologies connected to the Parkunload solution in the 10th district of the city of Paris, so logistics operators can declare their arrival and departure on the Parkunload application, and the traffic enforcement agents can improve the efficiency of the zones' enforcement efforts.

The pilot is located in the south of the 10th arrondissement of Paris, characterised by its high density of both residents and commercial uses, and located close to two main train stations: Gare du Nord and Gare de l'Est. It is therefore an area of great attraction and travel for production and logistics.

Figure 24. District X, Paris. S+LOADZ pilot area

4.3.2 Baseline of the pilot

Methodology for pilot evaluation

The University Gustave Eiffel has been involved in **three studies** since mid-2022 regarding the Paris baseline:

1. Ex-ante survey of the delivery situation in the pilot area, including a qualitative (see Figure 1: KPI 8 'Change of perceived liveability') as well as a quantitative survey (see Figure 1: KPIs 1 to 7).
2. Communication and awareness campaign during the experiment.
3. Ex-post survey (during and after experiment), February 2023.

The first and second studies have taken place during 2022. The first one took place during five full days of field survey over the period October 6-20, 2022, as well as during 12 full days over the period of the second study). The second study (communication and distribution of flyers) took place during 12 full days over the

period 18 November 2022 to 16 December 2022, at the same time as the quantitative data collection. These two studies have yielded preliminary results. The third study has taken place during three days within the period 6-11 February 2023. Nota Bene: A complementary survey will take place over five days during the period from 13-28 February 2023. The third study took place during three days within the period 6-10 February 2023. Nota Bene: A complementary survey will take place over five days during the period from 13-28 February 2023.

4.3.3 Deployment process

The key activities and dates of the implementation process of the pilot are the following ones :

January - April 2022:
Exploration of how and where to implement the experimentation
Search for funding in the City of Paris budget

May 2022:
Presentation of the project to the city hall of the 10th district
Presentation of the project to the cabinet of the elected official in charge of public space

June 2022:
Presentation of the project to the internal stakeholders: communication mission, municipal police, territorial road section of the 10th district

July 2022:
Validation of the sector of the experimentation with the city hall of the 10th district
Preparation of the documents to be submitted to the Paris Council
Validation of the agreement by the legal department

August 2022:
Ordering of the traffic signs
Design and validation of the flyers for the delivery drivers

September 2022:
Diagnostic visit on the ground with local actors: 10th district town hall, municipal police
Installation of the PARKUNLOAD application on the phones of the municipal police officers
Coordination of work interventions on the roadway

October 2022:
Installation of traffic signs
Training of municipal police officers
Publication of flyers for delivery drivers
Evaluation at T0 by the Junior Enterprise of the UGE (ex-ante survey)
Launch of the project at the end of October

November 2022:
Approval and signature of the deliberation at the Paris Council, authorizing the signature of the agreement with the EIT and the collection of the grant.

November-December 2022:

Communication campaign from the Junior Enterprise of the UGE

February 2023:
Ex-post survey (survey during experimentation)
First phase: three-day survey done between 6-10 February
Second phase: five days planned between 13-28 February

24 April 2023: planned meeting with Tenth arrondissement's deputy mayor of transport and other municipal stakeholders. Presentation of the experiment and its evaluation, discussion with policy-makers and enforcement authority.

4.3.4 Challenges of the deployment process

Main challenges and lessons learnt from the deployment process are the following ones:

- Prepare the deployment of the project in short period of 6 months (April – October 2022)
- Find a budget for the installation of traffic signs and the production of flyers
- Get all the stakeholders to join the project
- Find solutions to administrative and legal constraints. The French Code of the Street is quite restrictive in terms of decentralized policymaking for parking and traffic. Municipalities cannot decide freely on the way they manage on-street delivery areas, especially when technology potentially invasive regarding privacy is involved.
- Ensure a continuous involvement of the enforcement team. As shown by ex-ante and ex-post surveys (see below), the number of parking enforcement agents is lower than would be necessary

4.3.5 Evaluation of the pilot project

80 zones (180 spaces) have been deployed in Paris tenth district becoming operational in early October 2022. The following graphics from the Big Data Tool - developed in this project – and the Platform Back Office show the driver APP registrations and other KPIs for the ten weeks period from Wednesday October 12th to December 14th. A total of 283 tickets (or check-ins) were issued to drivers (See Figure 25).

Figure 25. Driver APP registrations per zones in Paris District X over 10 weeks in October / December 2022

Regarding the tickets per period of time, it is possible to observe that the gradual increase in use of the APP is most noticeable in the weekdays as portrayed in the right-middle figure (See Figure 26), with a specific peak at 8:30 am in the morning, 12:30 pm at noon, 3:30 pm in the afternoon and 6:30pm at noon. Another improvement with the Big Data Tool is the identification of the zones having the most tickets (upper figure); zone PR-=014 Rue du Faubourg, Saint Martin - with 32 tickets - is the most used.

Figure 26. Driver APP registrations per period in Paris District X over 10 weeks in October / December 2022

The Big Data Tool also facilitates quantification of the numbers of users and the numbers of vehicles they use (See Figure 27) – see second figure below. In the case of the 10-week period in Oct/Dec 126 drivers used 131 vehicles generating the 283 tickets. Also, it is possible to compare the vehicle emissions categories of the two Big Data Tools developed for Paris; the figure shows that a higher percentage of the vehicles in District X are in the “very high” or “high” emissions categories compared to District IV.

Figure 27. Vehicles and drivers in Paris District X over 10 weeks in October / December 2022

The graph of average duration of stay per day shows considerable variation. Data analysis reveals that the average staying time is 30,4 minutes, with a standard deviation of 16 minutes, and that 158 of the 283 tickets i.e. 55% overstayed the 30-minute limit or did not check-out with the App. On 166 occasions of the 283 (59%) the overstay was less than the 15-minute time-out. The proportion of a half that checked-out on red is similar to the result for Argenteuil.

Figure 28. Average parking time in Paris District X over 10 weeks in October / December 2022

Looking at the registrations made in the analysed period, some 126 drivers used the APP; the driver making the most registrations made 12 (4%) of them. Given that the scheme is voluntary – and with reference to an approach used in trials in the USA, it is worth considering awarding a monthly prize to the frequent-user as a means of promoting uptake of the APP. These users can become ambassadors of the project – providing feedback and insights via individual contact.

The City of Paris has successfully deployed a system covering 80 loading zones in a central part of District X. Already, the number of transactions is sufficient to require use of the Big Data tool – especially, to analyse which of the 80 zones are being used (see Baseline report for District IV).

Results of first evaluation study: 'Ex-ante survey of the delivery situation in the pilot area'

a) Qualitative survey (see detailed questionnaire in Appendix)

Number of respondents: 68, including two police agents, 17 delivery workers, and 39 retailers.

Qualitative feedbacks

On the availability of respondents

- It was difficult to survey large retailers (supermarkets).
- Delivery drivers, on the contrary, were easy to interview, happy to be considered worthy of a study. Because of a high delivery staff turnover, many questions related to the past (eg "Has the delivery situation improved or deteriorated in Paris?) were not answered. As a consequence, there is very little historic feedback from delivery drivers.
- There were not many police staff interviewed (only two) because the team did not meet many of them on the streets.

On the responses to the questions.

- Very few retailers are concerned with deliveries, except when from the neighbourhood.
- Delivery drivers' rule #1: delivery stop will happen as close as possible to receivers.
- Large vehicles do not bother trying to park in a delivery area (too long to manoeuvre).
- A huge misuse of delivery areas with long-term parking (of other vehicles or commercial vehicles) a common feature.
- Deliveries are chaotic and people are used to it ("fatalism").
- Fines are low in France and delivery staff consider fines as a normal operational expense
- Retailers wish to have more information in advance on building works on the roadway.
- Boulevard Bonne Nouvelle: many shops but no on-street delivery area
- Increasing volume of packaging for pick-up.
- Many delivery vehicles stop in bus lanes.

Responses to survey questions

As displayed by **Error! Reference source not found.**, **Error! Reference source not found.**, and **Error! Reference source not found.**, delivery drivers are more severe towards their evaluation of the organization of deliveries in the 10th arrondissement of Paris than retailers are. 35% of delivery drivers think that the organization of deliveries is sub-optimal today (1 to 5 out of 10), while 27% of retailers think so. 14% of delivery drivers think the situation is at its best or near best (8 to 10 out of 10) while 34% of shopkeepers think so. The two enforcement agents interrogated have a negative view of the situation (with a 2 and a 5 out of 10).

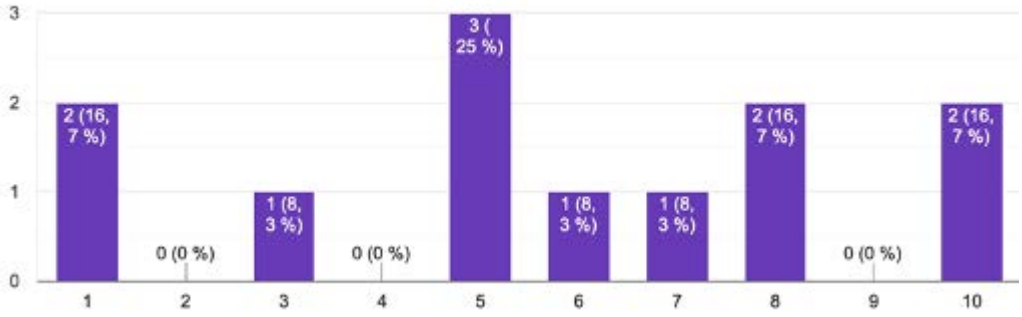


Figure 29. Delivery staff answers to "From 1 to 10, how do you evaluate the organization of deliveries in the neighbourhood?"

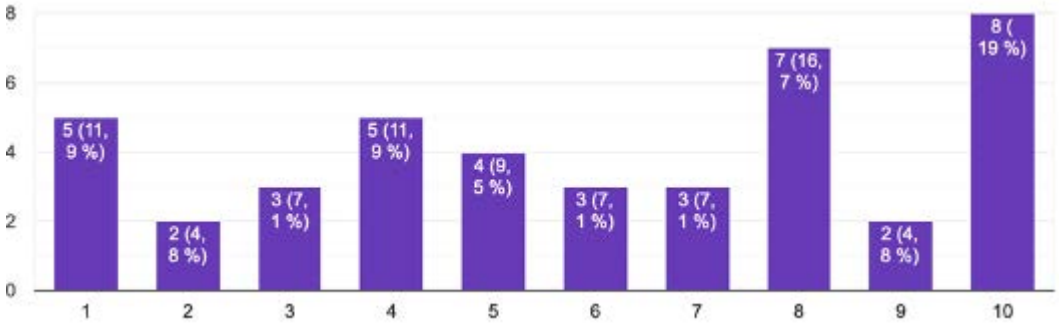


Figure 30. Shopkeepers' answers to "From 1 to 10, how do you evaluate the organization of deliveries in the neighbourhood?"

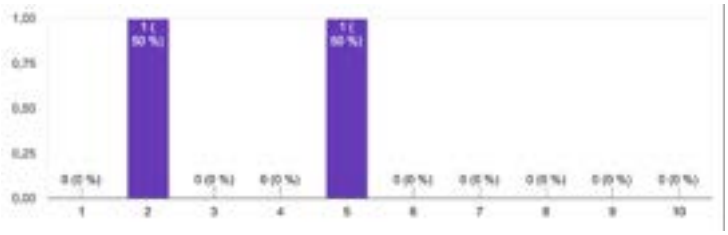


Figure 31. Police agents' (NB only 2 were surveyed) answers to "From 1 to 10, how do you evaluate the organization of deliveries in the neighbourhood?"

Overwhelmingly, delivery drivers need little time to make their deliveries: 37.5% estimate it takes them less than 5 minutes in general, and nearly 87% deliver in less than twenty minutes (**Error! Reference source not found.**).

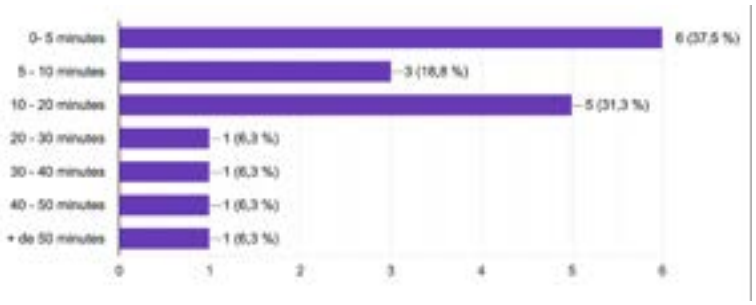


Figure 32. Average time of deliveries as estimated by delivery drivers

When asked what best could make deliveries better organized, respondents provide the following answers (**Error! Reference source not found.**): overwhelmingly, they suggest the creation of new loading/unloading a reas on the street. Then they suggest tougher enforcement so that loading/unloading areas are better protected from illegal use. The third preferred option is to make available an app that informs delivery drivers about the availability of loading/unloading areas. This is an interesting and encouraging answer, as this option looks very much like the pilot currently experimented.

Only 7% of respondents believe the system should not be changed.

To be noted, 17% of respondents agree that off-hour deliveries could be a good option.

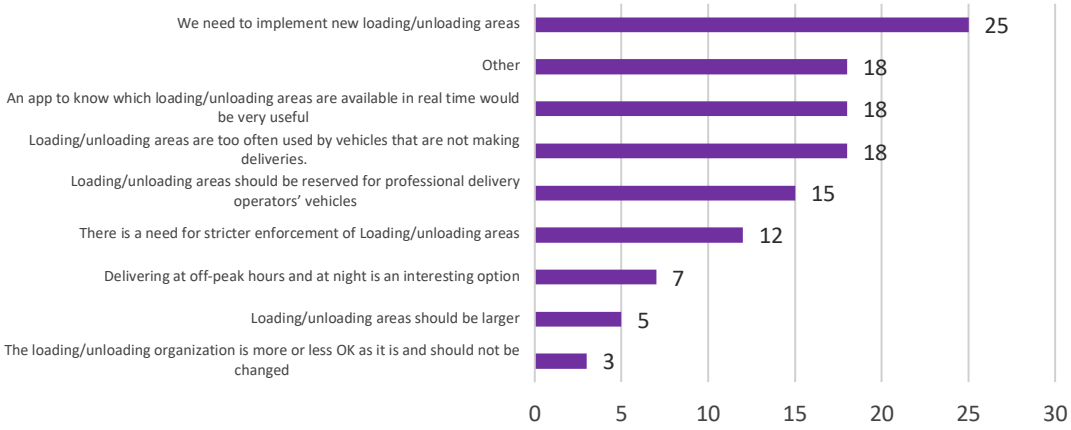


Figure 33. Answers to 'How could deliveries be made better?'

Results of ex-post survey (first phase)

As a general comment, **the system is too little known to fully report on the effectiveness of the application**. Delivery drivers have been reluctant to take the survey, because of a lack of time. 11 delivery drivers accepted to take the survey.

- 9 out of 11 respondents (82%) acknowledged they did not know of the new system. Several drivers mentioned that the S+LOADZ signs and QR codes are rather high and difficult to notice.
- 10 out of 11 respondents (91%) described the delivery situation as "bad" or "very bad", due to 1. unavailability of delivery areas 2. Congestion in the street.

- One respondent was using a cargo-bike and mentioned that delivery was much easier when using a cargo-bike.

20 shopkeepers were interviewed, of which 75% were not aware of the new system. 15 did not identify a better delivery situation than before October 2022, and five had no opinion on the subject.

For those who did not know of the system, when asked about the *potential* effectiveness of the system, delivery drivers and shopkeepers emphasized that the system may create more complications than solutions.

No enforcement agent was interviewed during the three full days of the first phase of ex-post survey because none was seen in the street. There is an apparent lack of enforcement personnel on the streets.

4.3.6 Summary of results and propositions for Paris

There has been a successful implementation of 180 connected delivery spaces (over 80 on-street delivery zones) in Paris' tenth district. The system's tool shows that there was a gradual increase in the use of the app. This use has been most at 8:30 in the morning, 12:30 pm at noon, 3:30 in the afternoon and 6:30 in the evening. From October to December 2022, 126 drivers used the app with one driver who made the most registrations making 4% of them.

⇨ One recommendation is that frequent users are rewarded (in one way or another, to be defined) as a means of promoting an uptake of the app. These users can become ambassadors of the project providing feedback and insights via individual contact.

Technically, the implementation of the system has been very adequate. The app is working properly. One technical issue has been identified which is that the QR code is physically quite high and somewhat difficult to see and reach.

⇨ One recommendation is that an additional replication of the QR code and basic information be placed closer to the ground.

The municipal team in Paris has spent a lot of time and energy to prepare for the implementation of the system in a short period. It has accomplished this thanks to a very good commitment of the key stakeholders: internal stakeholders (local elected officials, enforcement agents) as well as external stakeholders especially retailers' association. However, several obstacles were identified related to administrative and legal constraints. The French Code of the Street is quite restrictive in terms of decentralized policy-making for parking and traffic. Municipalities cannot decide freely on the way they manage on-street delivery areas, especially when technology potentially invasive regarding privacy is involved.

⇨ One recommendation related to this issue is that there should be a more decentralized process for traffic and parking policies in France. This would require a change in the national legislative framework.

Two evaluation studies were carried out in the streets where the system has been deployed. Awareness from delivery drivers and retailers has been a challenge, despite an active communication campaign (900

flyers distributed by UGE team and by enforcement agents). As the system is voluntary and not mandatory, delivery drivers do not wish in their vast majority to commit. The main reaction as identified by our field survey has been : 'this system seems to generate more lost time than actual benefits' Delivery drivers perceive the network character of such a system: benefits (such as better information on the availability of on-street delivery spaces or better enforcement of short term parking on delivery spaces) are seen as effective if and only when many delivery drivers use the app, which doesn't seem realistic to delivery drivers because the use of the app is not mandatory.

- ⇨ The same recommendation as above applies: in order for the system to be perceived as beneficial, the use of the app should be made mandatory, which would require a change in the national legislative framework.

Retailers have expressed a relative interest towards the system. Many retailers are not directly involved in decisions related to their deliveries, and they trust delivery drivers to get by and make deliveries possible even when the local situation is complicated (congestion, lack of delivery spaces). Despite their relative indifference to the way deliveries are carried out, they are generally supportive of a change in the system that would generate more efficient deliveries. Some retailers want to make sure that their specific authorisations to park long term in the street are maintained, even if there are more connected delivery spaces. This may be a problem, as these long term parking authorizations have been estimated to be a conflict for an efficient turnover of delivery spaces.

- ⇨ A more efficient way forward to be the reduction in long-term parking authorizations to retailers. In the longer term, retailers should not be authorized anymore to park on on-street delivery spaces in Paris, unless they are loading/unloading goods or passengers.

Enforcement agents think that the S+LOADZ system is generally user-friendly and easy to use. More generally, enforcement agents believe that the delivery situation in Paris is complicated and complex to enforce (especially because all types of vehicles can stop and unload, so the right vehicles are difficult to identify if the delivery driver is not close to their vehicle). They believe that the system would help make deliveries easier to enforce. However, they think that this means it should be made mandatory.

- ⇨ This relates to a recommendation made before the municipality of Paris should be able to decide on making the S+LOADZ system mandatory for all delivery drivers.

Another conclusion from the evaluation field surveys is that it has been difficult to interview enforcement agents because they were not many in the streets. The number of parking enforcement agents and/or parking enforcement tickets is lower than would be necessary. This goes well with one of the results from the delivery drivers' surveys. Delivery drivers think there should be more delivery spaces on the street, and they suggest tougher enforcement so that loading/unloading areas are better protected from illegal use.

- ⇨ A recommendation is that there should be more agents in the streets to ensure a better enforcement of delivery spaces, which at the moment are not available enough to deliveries.

Finally, delivery drivers and retailers, nearly four months after the implementation of the new system and more than 900 flyers distributed by UGE team and by enforcement agents, were not sufficiently aware of the existence of 180 connected delivery areas.

- ⇨ A recommendation is that there should be continuous awareness campaigns. Transport organizations and retailers' association should be associated to awareness campaigns so that they can send the information to their members operating in Paris.

4.4 Living Labs City of Vic

Figure 34. Vic. Source: Photo by JackF from Istockphoto

The city of Vic (Figure 34) is located in the NE of Spain, 70 km north of Barcelona, in the Catalan region with a population over 50.000 inhabitants in a total urban surface of 31 km^2 in a zone outside the metropolitan area of Barcelona. Its long history, present in the neighbourhoods and places of the historic centre, coexists with the new urban growth, which shows the dynamism of a cosmopolitan city, expressed through the resurgence of markets, the consolidation of the University of Vic and the growth of industrial areas. The numerous businesses established in the city centre of Vic are highly attractive, including a number of bars and restaurants. In addition, the industrial sector is diversifying, and the traditional leather industry has left behind metallurgy and agri-food, which is now the dominant industry.

The city's strategy to consolidate itself as a benchmark has been based on the commitment to become a city tailored to human needs. It places the quality of life and the health of its inhabitants at the centre of every municipal policy and of the action plans that have been implemented in recent years, such as the Municipal Urban Master Plan, the SUMP, the Accessibility Plan, aiming to create more safe and sustainable mobility.

Sustainable city logistics play a crucial role in making cities more liveable and attractive. A thorough and integrated understanding of the objectives of the different actors concerning city logistics, the distribution network, the planning and control of that network, the planning processes, information and communications technology, and organisational structure is necessary to develop city logistics solutions. Thereby the regulations set out by the municipal and supralocal authorities are the crucial component of city logistics. They must support the consolidation of freight movements and waterways to deliver commodities to and from the city, and contribute to creating more liveable cities with zero-emission vehicles.

The city of Vic aims to accelerate the shift towards more sustainable and innovative city logistics based on the complete digital transformation of parking spaces for urban delivery, covering different use case scenarios adapted to the needs of the city, the commerce, and its citizens. Its objective is to manage the high demand for logistics parking spaces by achieving a 30 % increase in parking rotation and availability, a 100 % reduction in illegal parking and an improved economic situation as kerbside spaces are used more effectively. In addition to testing other types of use cases, inspired by best practices in other cities or the current challenges of cities, always adapted to the needs of Vic.

4.4.1 City logistics overview

According to city officials, the city of Vic has faced several challenges in the most centrally located loading and delivery zones of the city, which are surrounding the city centre and main commercial streets. The most crucial problems that need to be solved range from an increase in parking demand for deliveries, low parking rotation in loading and delivery zones, inefficient parking control methods, to the constant misuse of parking spaces. Moreover, the city registers traffic congestions due to double parking which also leads to road safety issues that reduce the liveability of the city's residents. Lastly, the city has noted that due to the lack of mobility data related to urban freight vehicles, there are rarely regulatory decisions made based on big data insights. As a measure to face these problems, in June 2018, the city of Vic started the deployment of the digital loading and delivery zones called Z-DUMA[3] that stands for "Parking zone for distribution of goods and other vehicles"[4]. These zones are regulated, controlled, and monitored with traffic signs and a mobile application provided by Parkunload, which is mandatory to use for drivers (Figure 35). These are free-of-charge loading zones with time limits for vans, trucks, commercial vehicles, shop owners vehicles used for loading/delivery activities (30 min.) and for vehicles of nearby residents (10 min.) Reduced mobility is unlimited and other private vehicles are completely prohibited from using these zones.

Figure 35. Parkunload sign example in Vic

To implement digital loading zones, the city council amended and approved new parking bylaws, which includes a new name for the "Zona DUMA" with particular parking rules. According to this, the local parking agents have been trained to enforce parking control on the digital loading zones and they are able to issue penalty notices in case any vehicle either overstays or parks without starting a parking session with the Parkunload app.

[3] Zona de Distribució Urbana de Mercaderies i Altres Vehicles Autoritzats
[4] Ajuntament de Vic (ed.), 2021

To give an idea of the data that the city has been able to collect for all vehicles parked in the original eight loading zones, the results from data modelling research *"Joint modeling of arrivals and parking durations for freight loading zones: Potential applications to improving urban logistics"* undertaken by Kumar Kalahasthi et al (2022) should be considered: for the six months in 2018 from July to December (pilot) and the whole year of 2019 (first year of full system operation), the full (uncleaned) data comprises of 103,967 records (31,026 in 2018 and 72,941 in 2019) of vehicle parking including start time, end time, professional activity, and vehicle type. There are 6,412 vehicles with unique registration numbers parked in these 18 months (2,956 in 2018 and 5,233 in 2019). As a result of the implementation of digital loading zones started in June 2018, the city has already achieved measurable positive operational effects such as a higher parking rotation and available free parking spaces, a clear reduction in illegal parking (overstay, lack of permit, double line, etc.), a higher productivity in parking enforcement tasks, based on digital means and lastly, a higher optimization of scarce public spaces. These positive impacts motivated the city to expand the system - adding 61 additional loading spaces in 2021 (Ajuntament de Vic (ed.), 2021). The city council of Vic has thus already digitised 25% (Zona-DUMA) i.e. 107 loading spaces of the total.

Figure 36. Map of digitised Z-DUMA parking zones

Environmental effects can mainly be seen within the reduction of traffic congestion, as well as the reduction of km per delivery. Digital loading zones also obtain a high level of acceptance among stakeholders such as City Council, residents, or logistics operators. Local business or parking enforcement agents have a neutral opinion on the topic. Nonetheless, even if the current loading areas are positive for the local mobility, there is room to improve regarding the sustainability objectives and the full potential of Bluetooth-based kerbside management.

In July 2019, the City Council of Vic approved the revised text of the POUM (Urban Development Plan) of Vic, which has been created considering the health determinants on which a plan of this nature can have

an impact, in order to reduce or eliminate the negative impacts and increase the positive ones. From this moment on, the government team establishes health as a transversal axis in all its policies and works with the will to consider the impact of health in the municipal budget. The urban environment, in which people develop their daily lives, plays a very important role in the health of the city's citizen from different factors that a summarised in the following Table 8:

Table 8. Urban environmental factors on citizen's health

Factor	Description
Atmospheric pollution[5]	51 % of atmospheric emissions come from land transport
Noise pollution	80% of the noise in cities comes from motor vehicle traffic. Being exposed to higher levels than those recommended by the WHO throughout the day and night, is associated with risk factors for discomfort and alterations of sound, stress, hypertension, cardiovascular diseases, diabetes, etc.
The "heat island" effect	Inside the cities there are higher temperatures than in the peripheral areas of the cities. This is caused by the energy, in the form of heat that is released from energy consumption, the functioning of activities and transport itself, as well as by the type of materials used in construction and the lack of green (vegetation) and clear (water) spaces. This "heat island" effect is also associated with risk factors for premature mortality, cardiovascular and respiratory diseases, fatigue and injuries due to accidents
Traffic accidents	accidents are the leading cause of premature death in young adults aged 15 to 24 years. It also leads to loss of quality of life for all those who have been involved in a traffic accident. In Vic there is a high number of road traffic accidents and collisions between vehicles attributed to distractions of drivers (and the parking search is one of the circumstances where the driver is more distracted).

[5] This pollution has an important impact on the environment, but it is also associated with health problems such as respiratory, cardiac and arterial diseases and cognitive development problems in children, among others.

Factor	Description
Physical activity	The WHO considers that it is necessary to do 150 minutes of moderate physical activity or 75 minutes of vigorous physical activity per week, however, there are studies that indicate that many citizens do not achieve this recommendation. The health effects of not having good levels of physical activity are many, and most of them are widely known, such as cardiovascular problems, respiratory problems, diabetes, obesity, but others may not be so well known such as increased risk of breast or colon cancer, dementia, mental health problems, among others
Lack of green and public spaces	According to the WHO, each person should be able to have a green space or an open space at a maximum distance of 300 linear metres from their home. Having this type of space is associated with an increase in physical activity index, reduction of stress, improvement of mental health, social interaction and cohesion, increase of biodiversity and reduction of pollution and noise levels.

The mobility model of a city has a direct or indirect impact on all these factors, and therefore, the mobility model for the distribution of goods is also a contributing element. The fact of being able to regulate and control efficiently the parking for urban distribution of goods allows to reduce the number of vehicles that circulate looking for a parking space (eliminating or reducing indiscipline and increasing rotation) and this implies:

- Less atmospheric pollution derived from the extra kilometres of circulation that a vehicle must make to find a free parking space to park and make the loading and unloading.
- Less noise from the vehicles, and less honking horns when vehicles park in double files or in other unauthorised places.
- Less risk of accidents because the vehicles must spend less time moving to find a parking space, but also because the driver can work in a less tense environment to manage to deliver all the day's goods.
- The optimization of parking spaces can allocate road space to urban green or other road users who may need it at certain times.
    - The shopkeepers of the premises that must receive the merchandise can also better assure the moment of delivery and the relationship with the delivery person can be calmer (more civilised).

4.4.2 Scope and objectives of the pilot

Considering that the city of Vic has been experimenting with digital loading and delivery zones for almost four years, it can be considered that this is an advanced city lab regarding urban logistics with 107 loading spaces distributed among 30 digital loading zones (Z-DUMA).

The S+LOADZ pilot in the city of Vic focused on the following new subjects:

- Urban Logistics and short-term parking in pedestrian areas of the city: create new digital loading and delivery zones in large pedestrian areas of the city, for deliveries and authorised visitors to complement the existing access control system based on cameras.

- Short-term parking zones near primary services of the city: implement restricted short-stay zones near primary services such as pharmacies.

- Cargo-bikes and non-motorized vehicles parking in digital loading zones: test which requirements must be met to offer efficient (un-)loading processes for more sustainable vehicles and therefore more sustainable city logistics.

- Data-driven optimization of scarce public parking spaces based on both operational and environmental KPIs: Further analyse parking data considering several scenarios to optimise and promote sustainable city logistics, considering a shared-use of the public parking spaces.

- Communication channels with end-users throughout the mobile app: create a communication channel between the city and frequent end-users to send notifications regarding the city context, such as during pollution episodes, within low emissions zones or due to the update of parking regulations.

By developing innovative digital solutions in these areas, the city aimed to facilitate sustainability with features supporting improved air quality and reduction of mileage per delivery.

According to this, the S+LOADZ project scope planned for the city of Vic was as follows (Table 9):

Table 9. Planned project scopes for Vic's S+LOADZ deployment

	Covered area	Local infrastructure	Admin & Legal
Digital loading zones in pedestrian areas	Pedestrian areas in city centre (3)	Additional signs. 28 Bluetooth sensors	Current city parking bylaws
Cargo-bikes parking in Z-DUMA	Current Z-DUMA	As it is	Local licence plates for cargo-bikes, inc. GDPR amendment
Pollution Episodes in Z-DUMA	Current Z-DUMA	As it is	As it is
Low Emission Zones in Z-DUMA	Current Z-DUMA	As it is	National legislation
Short-term parking near primary services	Pharmacies in the city (12)	Additional signs with 12 Bluetooth sensors	Current city parking bylaws

	Covered area	Local infrastructure	Admin & Legal
Advanced Big Data analytics reports	City	N/A	GDPR. Anonymized and aggregated data
Addition comms channel for cities	City	N/A	Probably GDPR amendment

In order to accomplish the goals set for the city of Vic, the following technical features were developed during the S+LOADZ project:

- Integrate cargo-bikes (Electric Pedal-Assisted Cycles: EPACs) in the delivery zone solution
    - Requires a revision of the Driver APP (new type of vehicle) and development of a municipal EPAC registration system.
- Administration of parking conditions during pollution episodes, as well as in Low Emissions Zones (LEZ) at Parkunload platform.
    - Requires gathering vehicles' environmental badge data from official vehicles' database in Spain from DGT (Dirección General de Tráfico).
    - Requires managing communication channels to end-users such as SMS or similar.
- Design and develop variable and dynamic parking conditions based on vehicles emissions category at Parkunload platform.
    - Define emission-based parking rules per zone, group of zones and cities.
- Create a new type of Loading and Delivery Zones in pedestrian areas at Parkunload platform.
    - Requires new zone types, vehicle types and additional authorised vehicles.
    - Requires integration with camera-based systems located at the entries of the pedestrian areas in the city of Vic.
- Create a new type of short-stay zone for primary services at Parkunload platform.
    - Requires new zone types, signage and additional communication features.
- Create advanced Big Data Analytics reports for the city to further analyse sustainable city logistics strategies based on historical parking data before, during and after the pilot.
    - Requires transference of large amounts of data between the two cloud-based platforms used by Parkunload.
- Integrate big data sources from Parkunload to KEITA's micro-subsidies platform.
    - Requires transference of large amounts of data between cloud-based platforms.

4.4.3 Baseline of the pilot

Various actions were realised to establish a baseline, whereas the overriding idea was to measure the usage of the scheme for a period that coincides as much as possible with the other pilots (i.e. facilitating comparative analysis wherever possible). In Vic the pilot period took place from October 10th to November 24th of 2022, whereby a baseline for driver registrations that uses data from the same six weeks was defined (for those zone groups implemented previously).

In the light of Vic's most relevant KPIs (reduction of illegal parking, availability of parking spaces for loading processes and an increased average parking rotation), data on traffic violations were collected for the baseline analysis. One source of data were penalty fines issued by the warden app to vehicles incorrectly using the Z-DUMA zones. For the other areas of the city where zones were being considered – inside the pedestrianised centre and beyond the Z-DUMA implementation – registrations using a camera-equipped police patrol car were made available. For both datasets, the data was collected and analysed for the 5-month period from March to July of 2022.

The camera enforcement covers various infractions, but the ones presented in Table 10relate to overstays of parking time. Although the camera enforcement varies in intensity and location from one month to another, we can highlight a problem of overstays of 20+ cases per month in the pedestrianised centre, some 16 % of the sanctionable actions registered by the system.

Table 10. Penalty Fine Notices (overstays) issued using camera-based enforcement in Vic. Source: City of Vic

Month	Registered actions	Sanction (Y=1)	Sanctions as % of actions	Actions registered in Central Ped Area? (Y=1)	% actions in Ped Centre	Sanction in Ped Centre	% sanctions in Ped Centre	% actions in Ped Centre sanctioned
March	164	66	40%	5	3%	0	0%	0%
April	184	63	34%	34	18%	5	8%	15%
May	242	42	17%	138	57%	22	52%	16%
June	608	317	52%	124	20%	22	7%	18%
July	108	108	100%	0	0%	0	0%	
Total	1306	596	46%	301	23%	49	8%	16%

The sanctions realised using the ParkUnload warden app during March, in the Z-DUMA zones, to July of 2202 are shown below in Figure 37. With an average exceeding 200 sanctions per month it can be said that the regulations (mandatory use of the driver app) sets up a highly efficient enforcement action. The impact of this is commented upon in chapter 4.4.6. Overstay sanctions account for just 3 % of tickets: 97 % of sanctions are for non-use of the (driver) app. The original central eight zones account for 15 to 20 % of the sanctions with the remaining 80 % occurring in more-recently implemented zones (in late 2022).

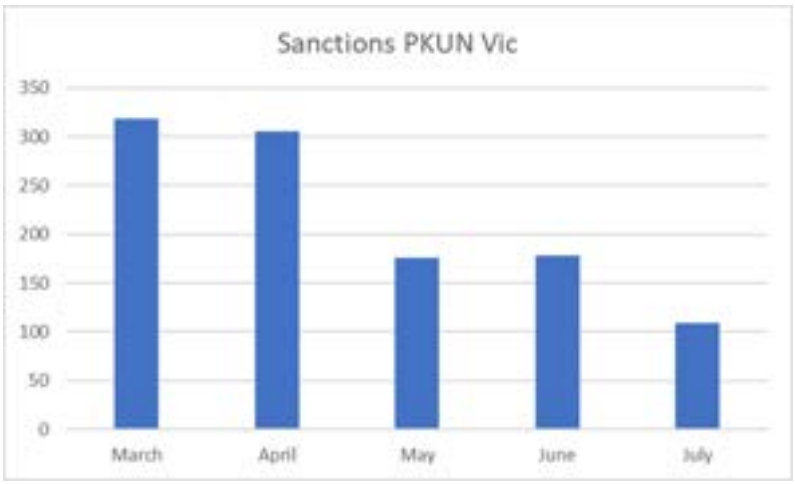


Figure 37. Penalty Fine Notices issued by ParkUnload Warden APP in Vic. Source: ParkUnload, City of Vic.

Furthermore, it was clear from the extension realised in 2021 that a big data tool was required to manage the amount of information being generated from a system of more than 20 zones. This tool – developed in S+LOADZ - not only enabled a better spatial understanding of those locations where a lot of registrations ("hot-spots") or where few registrations were made (possible low demand for unloading – or low use of the APP), but it also improved the way a planner can access trends in usage over time. Of particular interest – given the relative longevity of this scheme – is the evolution in the types of vehicles making deliveries – especially the trends in high-polluting and low-polluting vehicles. ParkUnload categorised registered vehicles using the Spanish vehicle emission classification used to implement low emission zones in various cities including Barcelona (See Figure 38).

Figure 38. Spanish vehicle emissions classification

The Spanish vehicle emissions classification establishes four categories for which label certificates are issued; high-polluting vehicles have no label. Using the big data tool, vehicle registrations by pollutant category were compared. For example, the following Figure 39 compares the overall trend by vehicle emission category for the months of October and November for 2018, 2021 and 2022. It is possible to see how the percentage of high-polluting vehicles has reduced from 17 % in 2018 to 12 % in 2021 and 10 % in 2022. Especially for environmental indicators a longer baseline is often beneficial – as the figure shows.

Figure 39. Trend in percentage of registrations by vehicle emission category
Source: ParkUnload S+LOADZ big data tool

The city of Vic commits to being a healthy city and this work includes a collaboration with the *Diputació de Barcelona* in realising periodic air quality surveys related to vehicle-based emissions. The data from surveys conducted in 2021 was made available, analysed and taken into consideration in establishing the plan of zones and regulations. As Figure 40 summarises, the air quality in the centre of Vic is relatively good – both in absolute terms and, in comparison with the peripheral areas. Furthermore, no traffic-related pollution episodes have been registered, to date.

Figure 40. Average NO2 concentrations measured in Vic during March 2021.
Source: Diputació de Barcelona[6]

Lastly, in order to measure the acceptance of the regulatory concept as well as the app and its functionalities, online surveys and interview guides were set up to be conducted before, during and after the pilot phase. The goals thereby were on the one hand to gather logistical information on the pilot area and local delivery processes, on the other hand to receive direct feedback from local pharmacies, logistic operators and city wardens that were automatically affected by the structural and regulatory changes

[6] Authority for the Province of Barcelona

through the pilot project. For the local trade and commerce, especially targeted at pharmacies with short-term digital loading zones and logistics drivers, an online survey was conducted, whereas logistic operators as well as the wardens were supposed to be interviewed.

Unfortunately, the response rate was too low to be able to draw statistically relevant conclusions and to conduct the planned interviews. This can be attributed to the fact that the processes of implementation were drawn out due to the complex structural, regulatory and organisational implications in the expansion of the digital management system. It impacted the pilot phase and accompanying research, and therefore led to a much delayed survey and evaluation. These challenges are addressed in chapter 4.4.5.

Nevertheless, there were some survey responses acquired through the online survey for the local trade and pharmacies in the pilot area, giving valuable input for the city council on the current local delivery situation in order to potentially adjust features within the digital system, especially the regulatory aspect of the zones and the functionalities within the app. Taken from the responses, most deliveries to pharmacies are made conventionally with 3,5 - 7,5 t vehicles. Furthermore, the responses indicated that delivering one pharmacy takes up to ten minutes on average. Traditionally, delivery drivers do not solely deliver packages from a loading zone to one single customer. However, with pharmacies, which only have a certain frequency in the city, the feedback was a good indicator in adjusting the time settings for the digital loading zones near them in order to guarantee the just-in-time health services the city promises to its citizens. In the long term of Vic's traffic planning, survey participants especially expressed the wish of improving the delivery situation based on environmental aspects such as zero pollution policies during any kind of delivery processes. In this context, it was also stressed that under such conditions, access to loading zones should no longer be limited.

With Vic being the city in the project consortium with previous implementation and experience with Parkunload's technology and management back office, the evaluation holds the key advantage of being able to track the development of the city's operational and environmental KPIs with the big data they have been collecting since their initial implementation of digital loading zones in 2018. The results drawn from the big data tool are discussed in chapter 4.4.6.

4.4.4 Deployment process

A S+LOADZ checklist was used to design, plan and then deploy the Vic S+LOADZ pilot. With relation to the requirements for the city of Vic, the following tasks were realised:

- **Legal requirements in parking bylaws**. Amendment of the current city parking bylaws according to the legal advice services on public policies. In addition, a legal framework for municipal registration of EPACs / cargo-bikes has been identified.

- **Design, development, test, homologation and launch** of the upgraded version of Parkunload platform including the "multi-sustainable pack" (up to 4 months).

- **Design, manufacturing and installation of road signs** per digital loading and delivery zone (up to 3 weeks).

- **Execution of the communication plan** before, during and after launching the pilot.

- **Execution of the training plan** before, during and after launching the pilot.
- **Execution of the quality assessment plan** before, during and after launching the pilot.
- **Execution of the operational stage of the pilot**, including SaaS, customer support and parking control tasks.

The Mobility Department of Vic developed the project in close collaboration with other departments of the municipality (Environment, Commerce, Communications and Urban Security) and with participation of the Association of City Centre Commerce, and Trade Association of Pharmacy Outlets and the local cargo-bike operators (Figure 41).

Figure 41. The stakeholder working group facilitated the definition of the regulations and the communication plan.

The following Table 11 shows how the parking restrictions for S+LOADZ zones in Vic have extended the system; the types of zones deployed have been expanded to cover primary services and pedestrian areas. Regulations have also been extended to cover a greater number of vehicle types. Given the analyses of emissions data priority in developing sustainability policies was given to integrating cargo-bikes (zero-emission vehicles with no number plate) in the ParkUnload solution.

Table 11. City of Vic Regulations for S+LOADZ pilot extending Z-DUMA system

Inclusion of vehicles with no licence plate, Adaptation to Sustainability policies

	Z-DUMA Loading zones	Primary Services Short-stay zones	Pedestrian Areas Delivery zones
Trucks, vans and light commercial vehicles	30′	10′	10′ (pre-authorized)
Vehicles of nearby residents per area	10′	10′	10′ (pre-authorized)
Vehicles of people with reduced mobility	Unlimited (due to national legislation)	TBD	TBD
Cargo-bikes / non-motorized vehicles	30′	10′	10′
High polluting vehicles during pollution episode	Prohibited	N/A	Prohibited
High polluting vehicles in Low Emissions Zone	Prohibited	N/A	Prohibited
Other private vehicles	Prohibited	10′	10′ (pre-authorized)
Regulation hours	Mo-Fri 8am to 8pm Sat 8am to 2pm	Mon – Sun 24h	Mon – Sun 24h

New zones types -> city-wide rules

The mobility department of the municipality has engaged with local cargo-bike operators via *Osonament I ADFO*, a NGO that facilitates work opportunities for people with disabilities, and which operates Arete, the

last-mile operator that delivers parcels for SEUR (DPD group) as well as serving local clients. This is commented further in the following chapter 4.4.5 on challenges during the pilot project.

The other steps of the procedure were relatively straightforward given the city's experience in having already deployed the first pilot in 2018 and then extending it in 2022. The following Figure 42 and Figure 43 show how the S+LOADZ deployment in 2022 has expanded Vic's digitally-managed curbsides. The previous Z-DUMA zones were extended inwards to include the pedestrianised centre and outwards to cover primary service zones.

Figure 42. Vic's 56 digitally managed zones

Figure 43. Vic's 13 Primary Service zones

In total, the city of Vic now has 56 controlled zones, configured into seven groups (see Table 12). In S+LOADZ project framework 13 pharmacies service zones and four groups of pedestrianised areas (15 zones) were added to the previous 28 loading zones (Z-DUMA).

Table 12. Overview of Vic's digital loading zones

Name	Deployment date	Zones
DUMA city center	2018	9
DUMA second ring	2021	19
Pharmacies	2022 (S+LOADZ)	13
Pedestrian area – Historic centre	2022 (S+LOADZ)	9
Pedestrian area- Eixample Morató	2022 (S+LOADZ)	3
Pedestrian area- El portalet	2022 (S+LOADZ)	1

Name	Deployment date	Zones
Pedestrian area – Carrer de Gurb	2022 (S+LOADZ)	2
Total sum of digital loading zones		**56**

4.4.5 Challenges

During the project a checklist was devised covering various aspects that pose challenges to deploying digital kerbside schemes. This list included regulatory aspects, the design and ordering of signs and equipment, communication plan and execution, establishing parking wardens. It was developed based largely on Vic's experiences in realising the deployments in 2018 and 2021. Although the S+LOADZ pilot in Vic was able to draw on these previous experiences to handle these challenges, it is important to mention that the (territorial) extension of the deployment, from the loading zones around the centre, both outwards primary zones and inwards to include the pedestrianised centre, proved to be challenging. Various stakeholder groups were engaged simultaneously, and different specific configurations had to be agreed on and executed taking account of the resource implications of each aspect. Next to adapting regulatory laws and establishing implementation contracts, the communication of the project to the different stakeholder groups, especially residents, proved to be time consuming due to the several communication channels and materials (e.g. physical leaflet and online appearance) that had to be drawn up. Doing this in an overall time scale of 12 months was the main overall challenge addressed.

S+LOADZ has set itself the goal of demonstrating state-of-the art innovation by implementing digital loading and delivery zones including novel features aimed at increasing sustainability and decarbonisation, advancing an already high technology readiness level product with a strong go-to-market mindset. Next to procedural processes to advance Vic's management system being more time consuming than expected, one minor but essential, environmentally-related challenge needs to be addressed. Increasing the percentage of zone use by electric vehicles is a long-term objective of the city, and with S+LOADZ, a first important step was taken by integrating cargo bike deliveries on digital zones. This however presented a technical challenge in that cargo-bikes do not require or rather are not issued with a vehicle plate number, which is a requirement for using the ParkUnload app. In terms of this approach, the use-case of the city of Barcelona was identified as a good practice, and whilst this was followed in terms of documentary requirements[7] for the registration of cargo-bikes by the municipality, a local adaptation was to use a seven-digit identifier rather than the five-digit identifier used in Barcelona (see **Error! Reference source not found.**). The "I" character is not used for vehicle registration. It can be used uniquely for cargo-bikes. The three-letter format serves to identify the city (VIC-XXXX) and allows up to 9999 cargo-bikes to be registered by the municipality.

[7] Manufacturer's certificate of EPAC standard compliance: EN 15194-2017 & RD 339/2014 plus 3rd party insurance documentation.

4.4.6 Results and evaluation of the pilot project

The city of Vic has successfully deployed two new types of zones – extending the 28 Z-DUMA (un-)loading zones to a city-wide deployment of 55 zones. Over the first 10 weeks of the pilot, 319 users using 339 vehicles made 679 registrations in the new zones. During this period, the usage of the original 28-zones saw an increase in tickets (app Check-ins) – 2,350 more registrations than in the same period of the previous year. The baseline analysis highlights the efficiency of ParkUnload's solution when the driver app use is made mandatory. Without an efficient enforcement in the earlier half of 2022 it is doubtful that this high increase in registrations would have been recorded.

This increase in registrations and registered zone usage can also be found in the big data acquired. The following graphs were generated from the S+LOADZ big data tool and show that registrations made with the ParkUnload driver app were working correctly in the newly integrated zones. Figure 44 compares the total tickets for the six-week period from October 10th to November 16th in 2022 with the same period of 2021. The total number of tickets has increased by 3,029 from 7,139 to 10,168 registrations.

Figure 44. Total tickets for the six-week period from October 10th to November 16th in 2022 with the same period of 2021

Figure 45 compares the tickets registered in the 28 Z-DUMA zones for the two periods, and Figure 46 shows the tickets registered in the newly-deployed zones (pedestrian areas and primary zones in front of pharmacies). It is evident that, at this early stage of operation, the main increase in tickets (some 2,350 App check ins) were registered in the original 28 zones with a total of 679 tickets in the newly-deployed zones. It is worth mentioning that during the S+LOADZ pilot, the city promoted a voluntary use of the App, without the implementation of fines, so the tickets show a great achievement of a high "voluntary" adoption of the Parkunload App.

Figure 45. ParkUnload driver app tickets registered in Vic for different zone groups and time periods

Figure 46. ParkUnload driver app tickets registered in Vic for different zone groups and time periods

Next, the Figure 47 shows the numbers of users and vehicles making the registrations during the pilot period. Overall, 1,957 users used 2,178 vehicles; there were 319 users using 339 vehicles in the newly-deployed zones.

Figure 47. ParkUnload Vehicles and Users registered in Vic; total (above) and new zones (below) for Oct-Nov 2022 pilot

To complete this initial look at operational data, the following Figure 48 generated by the back office of the ParkUnload platform compares the registrations made during the first weeks of November in the primary zones and in the pedestrianised centre. It is encouraging to see average parking times for the primary zones in line with the 10-minute stay limit established in the regulation. The higher average parking times for the pedestrianised centre is also noted.

Figure 48. ParkUnload tickets and average parking times for new zones; primary service zone and pedestrianised centre during first weeks of November 2022

All in all, it can be summarised that due to the challenges described in previous chapter 4.4.5, there was not enough time within the project term to conduct a definitive assessment of the performance of the new digital zones. The performance in the pedestrianised centre however promises to be particularly interesting considering the types of vehicles entering this area.

The S+LOADZ pilot in Vic established a first city-wide deployment of (bluetooth) digitally-controlled curbsides. Initialising a city-wide dataset is an important step towards designing new regulations aimed at sustainability policies. A recent legislation by the Generalitat (Catalan government) obligates regional capital cities, having over 50,000 population, to deploy low-emission zones. Vic's population is growing, and it could pass this (50,000 threshold) in a couple of years. Such a zone would be defined based upon the city centre. By integrating the pedestrianised centre in the digital zones platform, the city can collect data that could help define a mechanism for implementing a low emission zones policy.

As the dataset grows it will be interesting to examine the zone usage by vehicle emissions categories. Already now there is a positive evolution apparent with a lower percentage of high-polluting vehicles (see chapter 4.4.3 baseline evaluation) and relatively good air quality. Assuming that the deployment in the pedestrianised centre evolves favourably, there may be opportunities to apply a regulation that accelerates a further limitation of high-polluting vehicles. This, in turn, could lead to an increase in cargo-bike registrations and circulation.

In the case of Vic, the integration with the Spanish vehicle emissions databases was realised for the 2018 pilot. In the baseline section 4.4.3, the big data tool developed in S+LOADZ was used to examine the trends in the proportions of zone use by the different vehicle emission categories. What we now see is that this overall trend changes in part due to external factors (such as improvement of the delivery van vehicle stock over time) but also upon the scale and the scope of the city's digital kerbside deployment. By piloting primary zones, the number of car driver app users is expected to further increase. By integrating the pedestrianised centre, other types of vehicles – especially larger trucks used for food deliveries – are featured in the dataset. If we are to optimise urban freight aligned with air quality strategies, then we need to define which part of the city and which vehicle group have to be targeted next (follow up activities after S+LOADZ).

Figure 49. Wider range of vehicles must be handled as the scheme extends; cargo-bikes and larger trucks

Finally, it is relevant to mention that the city of Vic has taken advantage of the knowledge exchange environment generated by this type of European projects, where cities have a space to share experiences. Inspired by the Ankara project, the department of commerce, markets and mobility is thinking that to manage the loading/unloading activities on the municipal market every Saturday and Tuesday in the Plaça Major of Vic aiming to organise more these chaotic presages of setting up and dismantling the market. In this way the city of Vic would take advantage of the fact that it already has the Parkunload technology to put it to another use. This conceptual idea can also be considered a relevant result of the S+LOADZ project.

4.5 Living Labs City of Ankara

Ankara is the capital of Türkiye - one of the few counties in the world on two continents and often seen as a “crossroad” between Europe and Asia. With 5.7 Mio. inhabitants on a surface of over 25,000 km² and an urban density of 228 citizens/km², Ankara is the second largest city in the Türkiye after Istanbul. The city of Ankara consists of 25 districts. Due to an active industry, high level bureaucracy, international institutions, non-governmental organizations of and year-long social, cultural, sport and art events the city provides an opportunity of a diverse city life to its residents [Haci Bayram Veli Üniversitesi, 2021].

Figure 50. Ankara photo. Source: Photo by Gogosvm from istockphoto

Ankara's strong economy has benefited from its geographical location, modern infrastructure and growing young population with the most skilled workforce. The proximity to markets in the EU, Middle East, North Africa, Asia and Russia is a catalyst for foreign capital. More than 2,300 international companies wanted to settle in Ankara. The high commercial volume of the Turkish capital was an opportunity for investors and entrepreneurs. With a foreign trade volume of $19.6 billion, Ankara achieved about 5% of Turkey's total foreign trade volume in 2019 [Ankara Development Agency, 2018]. In 2022 Türkiyes economy suffered from a high inflation rate as well as a collapse of the currency: In December the inflation rate climbed up to 85% whereas the currency fell from 8 Turkish Lira equivalent to one US-Dollar in 2021 to almost 19 Lira within one year. Even if the prices for the domestic market has increased drastically: Agriculture is still one of the strongest economic factors in Turkey: Turkey grows between 80 and 100 percent of the food it needs nationally [TURKSTAT].

As agriculture and trade are such crucial economic factors for the Turkish economy, as well as for the city of Ankara, it was decided to let the pilot project take place in the city's largest foodmarket, the Ankara Metropolitan Municipality Wholesale Market - or “Ankara Büyükşehir Belediyesi Toptancı Hali” in turkish. The local project is led by BELKA (BELKA Inc. (ed.), 2022), the municipal agency whose responsibilities include parking management. BELKA also manages the municipal markets, including the Metropolitan Wholesale Market of Ankara [S1] .

The current focus of the project is to develop the pilot and assess the technology at this site. Whilst following the on-street pilots at the more advanced cities; the scope for a wider deployment including on-street locations will thus be considered at a later stage in the project[S2]

4.5.1 City logistics overview

According to the city officials, a capital with this size must deal with critical problems considering city logistics such as: Low parking turnover in loading and delivery zones, the misuse of parking spaces (overtime, lack of permit, etc.), traffic congestion due to double line parking and inefficient methods of parking control. Within the city, there are delivery and loading zones with a total amount of approx. 1,600 parking slots available to logistic vehicles such as trucks, vans and light commercial vehicles. Contrary to the other model cities, there is no concept of digital loading zones yet.

However, in Türkiye there is an environmental badge in place for vehicles according to the national legislation. The city council of Ankara has recently approved the *2030 Master Development Plan* targeting the following goals (T.C. Ankara Büyükşehir Belediyesi (ed.), 2017):

- It aims to establish the balance of protection and use by providing socio-economic and cultural development, in a way that will not harm the existence and continuity of natural and human resources and potentials and allow optimum utilisation.
- It aims to create liveable, healthy, urban, semi-rural and rural living environments with increased quality of life.
- It considers the habitability principle and the bearing capacity of the city and natural structure.

- It determines the spatial decisions and strategies regarding the site selection, size and distribution of the uses, and the population distribution and density decisions on the macro scale, in a way that guides the sub-scale development plans and applications.
- It aims to protect natural, cultural, and environmental values, historical assets, water resources, agricultural and forest areas, to eliminate/reduce disaster risks, and to take precautions against disasters.
- It ensures that the cooperation and coordination principles between the institutions and organisations related to the implementation of the plan are revealed and the investments are carried out in a coordinated manner.

This plan is compatible with sustainable development policies based on Ankara's global structure, place and potential in the country and the region. The participation of Ankara / BELKA in this EIT project serves the purposes of the 2030 Master Development Plan. The current focus of the S+LOADZ project is to develop a pilot to assess the technology at the Metropolitan wholesale market of Ankara, which is being managed by BELKA.

4.5.2 Scope and objectives of the pilot

Regarding the city of Ankara has not had any experience in digitising parking spaces until the beginning of the project, the aim was a step by step integration of all parking lots within the Ankara Wholesale market in the app.

The S+LOADZ pilot in Ankara focused on three main subjects:

- Creating a safer place for pedestrians (in terms of traffic and social safety)
- Identify the car types coming in, duration of each car type and eventually determine and the emissions [S5]
- Creating exclusive parking sections for each vehicle type to structure the traffic flow and make parking more efficient
- Introducing a new feeing system based on vehicle type

As one of the biggest obstacles was the large number of different vehicle types parking inside the loading- and unloading zones, it was decided to make pre-trial with the spaces inside the car parking lot (capacity for up to 600 cars). In consideration of the short amount of project time, it would have been much more difficult to put up signs in appropriate height at the parking lot for trucks and paint a large number within the truck zone first, as there is almost no time when the truck section is completely empty.

For the solution provider - ParkUnload - the initial objective was to seize the opportunity that was presented in terms of working with a local team on a use case in a new country different from anything previously considered concerning product and market development. In spite of various challenges (see later sections) the collaboration between BELKA, Artech, ParkUnload, Factual, Fraunhofer - all the partners – progressed with a collective commitment of working with the Wholesale Market administration to find a feasible case-study to pilot. Particularly successful was the good cooperation of the consortium partners in translating the driver app from English into Turkish, working on the communication plan and researching the relevant variables (e.g. number of vehicles on the market). The huge scope of the market can be appreciated in the following pictures and graphics (Figure 51):

Figure 51. Aerial views of the Ankara Wholesale Market. Scale of lower picture: approx. 1:3,000 (size of one market hall: 50m x200m)

Especially for the subject of creating exclusive parking sections, BELKA communicated the scope and the issues to overcome to the rest of the team. Together they discussed what options were possible. This exchange identified which types of vehicle (see baseline below) would best be managed in which part of the market estate. It was also agreed that the solution would be applied to the parking areas rather than the entry point to the estate or to the loading bays themselves. This preliminary work led to an overall design of the circulation whereby land in the buffer area would be incorporated. A scheme of four zones – each assigned to one vehicle type (Figure 51Figure 52 and Figure 53)– was agreed and formed the basis for the subsequent work.

Figure 52. Scheme of the circular park zone management

Figure 53. Example of preliminary scoping discussion

4.5.3 Baseline of the pilot

Due to the absence of any digitalisation at the Ankara Wholesale Market - apart from scanning the licence plates for the vehicles to track their duration - the description of the baseline consists of qualitative interviews with members of the market management, the sellers and the truck drivers. These were combined with scientific situational observations during the visit to the wholesale market in Ankara though Fraunhofer IAO.

The Wholesale Market area with fruit, vegetable and fish halls is 22 hectares in total. The fish sector was renewed in 2022. In the centre of the market there are three market halls with 66 sales areas each, a total of 194 shops in the fruit and vegetable sector and 15 shops in the fish market section. Within the market are 150 official parking spaces for market vehicles and trucks and 600 parking spaces in the car parking area outside the actual marketplace. There are three types of deliverers at the market of Ankara: Logistics companies (1), farmers who grow and sell their own food (2) and distributors (3) who pick up smaller batches of food from various smaller farmers. Depending on their loading size there are also three main vehicle types inside the market: The *tır*, a truck up to 17m in length, the *kamyon*, a smaller truck up to 14m, and the *kamyonet*, which is a regular pickup.

The biggest rush is between 00:00 p.m. and 04:00 a.m. in the morning. The transport of the goods on the last mile from the vehicles to the market hall is done with handcarts, on bicycles and simply on shoulders. This causes very dangerous situations, especially in the maintimes with only little lighting and a lot of trucks parking very close to one another. But what would be impossible in a lot of European countries works well in Ankara most of the time: With interpersonal communication drivers and pedestrians are able to share that very little space left to move around and bring the goods to the market halls.

Only a few accidents have been registered at the Ankara wholesale market in a long period of time. But based on local experience it is suspected that a lot more accidents happen but are simply not reported.

Figure 54. Different angles of the surveillance cameras on the most crowded time of the market between 03:30 and 04:30 a.m.

One of the market's biggest problems is the lack of parking space: The Wholesale Market was built in 1984 for the number of citizens at that time. Since then, not only the city's population has changed, but also the structures within the market. However, there is no possibility of expanding the market in size regarding the surface. The number of vendors has increased, the type and size of the vehicles delivering the goods as well as the type of packaging and regulations have changed. Until around 2014, trucks were allowed to carry a maximum load of 32 tons. Today they are allowed to weigh up to 16 tons maximum. Subsequently more trucks are needed for the same amount of load, therefore the number of trucks has been increased. In the past, there were between 10-15 trucks per day - today the numbers almost doubled. In addition, the dimensions of the vehicles have also increased - which finally led to the current situation. The peak times are in summer: From June to September between 10-13,000 vehicles enter the wholesale market per month. The early hours in the morning (from midnight to 5 am) are usually the most crowded time of the day at the market (see figure below).

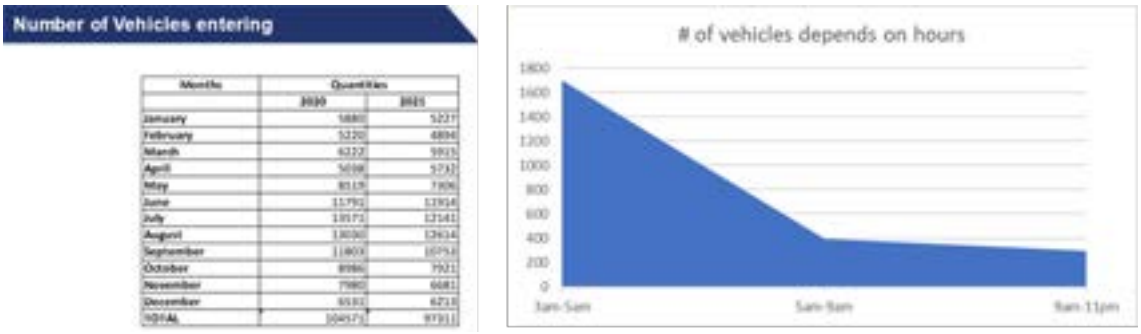


Figure 55. Table of vehicles entering Ankara's Metropolitan Market by month in 2020 and 2021, and a graph cumulating entering vehicles by hourly intervals

Today all vehicles entering the market are recorded with their number plates of the time of arrival and departure, and accordingly a charge is made to the time they stay. However, no data is stored and the recordings are not linked to other databases such as the police to determine the type of vehicles or emissions. The installation of visual systems as AI recognition software to scan truck types would not work at night or in rain/ fog, so there is still a need to find out where the tightest spots are and how the vehicles can be arranged more efficiently. One of the common situations at the market hall is the "blocking trucks": If two trucks park in front of a market hall, there is about 5-10 m of space left to pass them, thus blocking the way, which is why cars park inside the truck unloading areas.

To solve this problem, parking spaces are allocated for trucks and vendors/ businesses, but there is the "rule of the road" - not everyone parks in their allocated space and a truck driver can find it difficult to re-park his truck. Drivers have a differentiated opinion, for them everything is clear, and every truck driver knows where to park. It is almost always the new drivers, some of them without any knowledge of Turkish, who block the narrow streets with their big trucks if they don't know where their space is. In addition to that, there is also a criminal situation (parking lot mafia) in the market in which even project members have been threatened because of this project. This has a social impact on project members as well as drivers and vendors.

Besides these obstacles the Turkish culture in general is very technophile, therefore it is assumed that the implementation and acceptance will be successful.

Figure 56 Current parking distribution as defined by BELKA

4.5.4 Deployment process

<u>January - February 2022</u>

Selection of the Living lab location: Since Ankara wholesale fruit and vegetable market is a municipality-owned organization, it was able to provide solutions to the desired criteria and problems encountered more easily when any changes were requested in the market. That's why it was seen as more appropriate to choose this place during the selection.

<u>March 2022</u>

Definition of LOADZ: Following step is definition of zones and the necessary circulation of vehicles from their respective entry points to the parking zones.

<u>April - June 2022</u>

Signs design and translation of Parkunload App: Having defined the zones, Ankara team progressed with designing the signs, translating the APP into Turkish and configuring the zones in terms of key parameters such as their capacity and stay limit. The figures below show work in progress on sign design as well as the definitive signs of the 4 zones.

Figure 57. Design work on signs

Figure 58. Final design of different signs for the four parking zones in Turkish

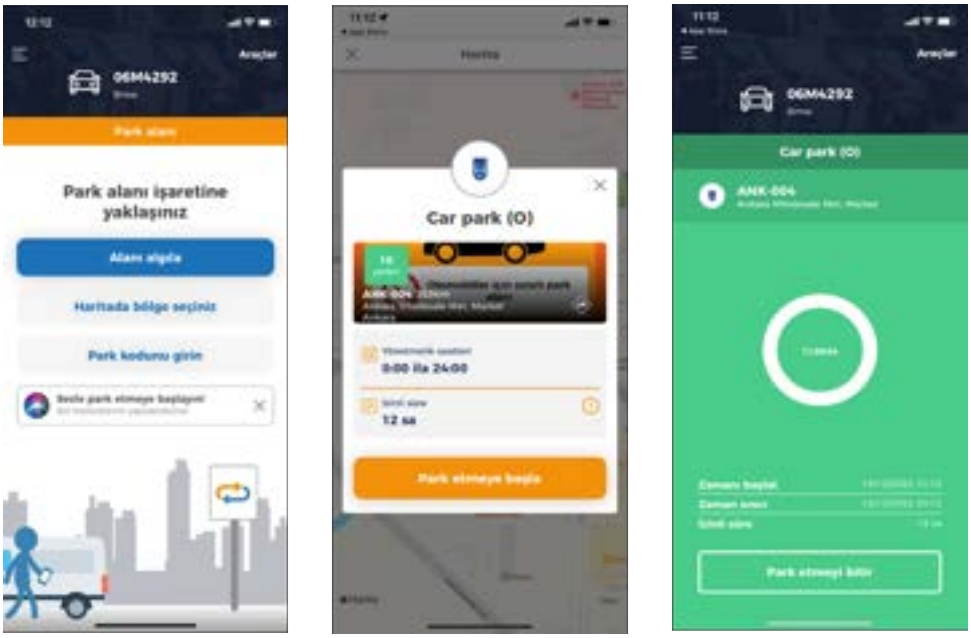


Figure 59. Screenshots of the Parkunload-App in Turkish

Bluetooth devices programming: An initial configuration plan was defined for all four zones and Bluetooth beacons were programmed for this configuration and sent to BELKA. Belka used a demo zone device to validate the translation of the Android version of the driver APP. A version for IOS in Turkish was then produced.

Communication strategy launch: In parallel to preparing the equipment a communication plan was designed and various actions and events were made. First of all, leaflets were designed to inform the drivers who will use the parking lot about the project and teach them how to use the Parkunload application step-by-step. Then, at the fast-breaking dinner held in the Ankara Wholesale market, the project was first explained to the participants with the participation of Ankara Metropolitan Municipality Mayor Mansur Yavaş and the Belka team. Afterwards, the prepared leaflets were given to the participants. In addition to

all this, both Ankara Metropolitan Municipality and Artech Consulting shared the developments of the project on their social media platforms.

Since the leaflets prepared only to inform the drivers in the pilot area were not sufficient, a 25-meter poster was made outside the Ankara Wholesale Market. Thanks to this poster, not only Ankara Wholesale Market users but also Ankara citizens were informed about the project.

July 2022

Dissemination of the Turkish S+LOADZ pilot: Suna Akbayır participated in the event prepared by EIT Innovation Hub. In this event, the S+LOADZ project and the Ankara pilot were explained to the participants.

September – November 2022

Signs and devices installation: Implementation of traffic signs with different colour codes were carried out in order to use the application.

The roads were marked with different colored stripes. These lines were used as a guide for different types of vehicles, allowing them to navigate the parking spaces where vehicles of their own type are located.

Training plan for drivers: A training plan has been created. By creating an educational brochure within this plan, it not only explained how to use the application step by step, but also served as a manual containing information about the new market order. Employees in BELKA team distributed these brochures to people in the market and provided on-site training.

Pre-trial pilot configuration definition: The following table summarises the parameter configuration for this trial (or pre-trial) phase.

VB	Ankara wholesale Met Market														
	Zone ID	User type	Area m2 (Approx)	Capacity (painted spaces)	Vehicles per day (Approx)	Peak Stay Limit	Peak Hours	Off-Peak Stay Limit (min)	Off-peak hours	Days of the week	Car	Light Com. Vehicle	Vans & Light Trucks (3,5t)	Medium Trucks (3,5t to 12t)	Heavy Trucks +12t
green	ANK-003	Trucks	12000	4	300	120'	0h to 13h	360'	13h to 24h	Mon - Sat	No	No	Yes	Yes	Yes
orange	ANK-004	Cars	11000	10	250	12h	00 to 24h	N/A		Mon - Sat	Yes	Yes	No	No	No

Figure 60. Ankara pilot system configuration

4.5.5 Challenges

By September we had registered a usage of the driver APP, and a meeting was held to discuss the initial experience. By this time we could identify three main challenges: **Cultural, technical and timing** issues.

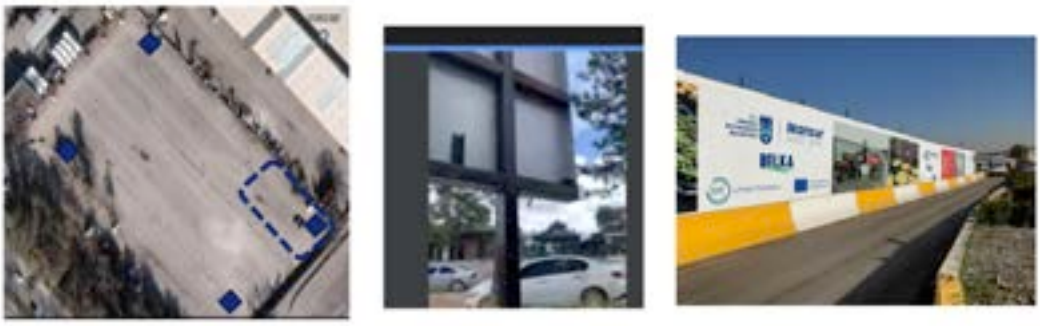


Figure 61. First attempts at equipment deployment, Ankara Wholesale Market

Cultural issues

Türkiyes current economic situation with an extremely high inflation rate (over 85% by December 2022, compared to 21% in the previous year) paired with the socio-economic structure of the people working at the market (low income jobs and sometimes illegally working foreign drivers) raised the probability of theft. The on-field testing of different variations of the sign proved this statistical assumption, as one of the Bluetooth-devices on the back of a sign has been stolen. The initial sign deployment was made in each corner of the car park, using short poles. It was demonstrated that theft of Bluetooth devices is a problem (middle picture) when the signs are located on short poles. BELKA has found a way of covering the rear of the signs (with wood) on taller poles which still allows a good signal and which has obviated the option of signs on lighting columns (this would have involved a 3rd party and caused delay).

Apart from the social-economic factors, the culture of the deployment space itself brought further challenges to light:

Divers at the Ankara Wholesale Market use no GPS-devices at all - not for tracking times, nor for tracing their routes. If available, they use their private smartphones. But research (see survey in 4.5.6.) also shows that the usage of smartphones is not as common at the Ankara Market as it would be in other sections of the Turkish society (general smartphone penetration in Türkiye for 2022 is estimated to be over 70 %). But by far the biggest challenge was the already established parking culture inside the market: The parking system that has been used in this region for years and they have a set of ethical rules that they apply within themselves - including the presence of the parking lot mafia. Many drivers have to take part in this system - either by monetizing the parking spaces they have access to or by "buying" the best parking spots. Therefore, drivers show resistance to changing these rules and applying a new system. This lead to misuse of the pilot spaces on the driver's side, and to fear of sabotage and openly expressed threats in the direction of the BELKA-Team during the implementation of the pilot.

Technical issues

Another challenge was that the beacon devices, programmed to work for a specific zone sign, got mixed up – possibly when replacing the stolen device. Work progressed with the creation of a 6-space car park zone, and with a reconfiguration of the system to assign beacons to zones having the correct stay limit parameters. The following figure shows a correct operation for the last week of October.

Figure 62. Painted areas in the car park zone of the Ankara Market vs. Dataset validating the system configuration (October 25th)

Timing issues

The infrastructure systems in the fruit and vegetable market belonging to the Ankara municipality are managed and shared by different institutions belonging to the municipality. Therefore, when any change is requested, many procedures must be followed to obtain permission. Because these procedures are time consuming, the changes that really need to be made at the Ankara Wholesale Market to make the pilot work in the initially intended way - for example painting a large, contiguous section within the truck area, did not give the desired results within the given project time.

4.5.6 Results and evaluation of the pilot project

The evaluation of the project is based on several indicators: Expert interviews on site as well as a pre-post survey of the people working at the market, data analytics, the evaluation of the KPIs and a general evaluation. The scope and high standards of the project must always be taken into account in all results.

KPI evaluation

Due to the special situation on the Ankara Wholesale Market and the challenges explained in the previous chapter, out of the five KPIs defined in the beginning (availability of loading zones (1), user acceptance (2), reduction of cross parking (3) , evaluation of vehicle types over time (4) and the average parking rotation in area over time (5) only two key performance indicators could be evaluated: Hints of the parking rotation could be seen through the analysis of the parking data, the information for user acceptance was collected via a pre-post survey.

Data analysis

The graphics from the Platform Back Office show 79 registrations for the 6 weeks from 3rd October to 18th November. The length of stay graphic shows an increase in the average time of stay after 25th October which is when the system configuration was validated (see previous section).

Figure 63. Ankara Wholesale Market Car Park zone 4 registrations 03-10 to 18-11

If we look at the 35 registrations made from 25th October, the tickets have been issued to 13 different automobiles (see figure below) The cars that have participated in the trial belong to employees at the Wholesale Market. Looking at the 35 registrations since 25th October, on 24 occasions (68%) the driver stayed for over the 12h limit, on 4 occasions (11%) the stay was for 385 minutes and on 5 occasions (14%) the driver stayed for 190 minutes. The remaining two occasions were stays of between 10 and 12 hours.

Long-term car parking is a different use-case to the ones the ParkUnload solution is typically used for. It was thoroughly discussed during the configuration process that, if we were to interest the Market in making the trial, we would have to define a 12-hour stay limit for (at least, the employee part of) the car park zone.

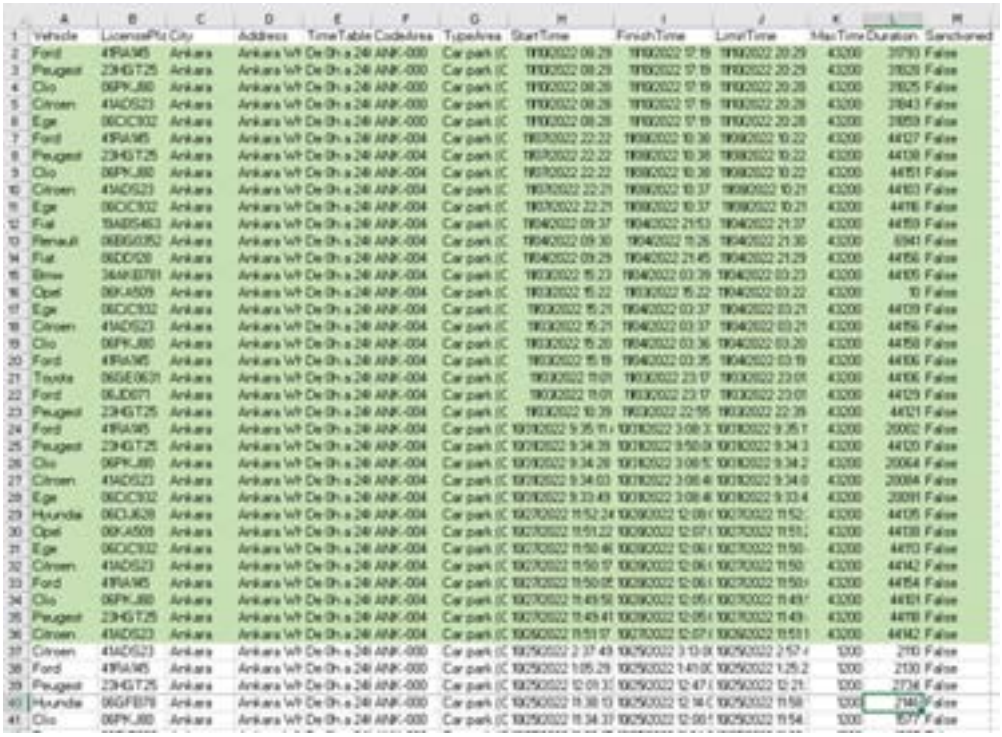


Figure 64. Ankara Wholesale Market Car Park zone 4 registrations 25-10 to 18-11

Survey analysis

Due to the special circumstances of the Ankara-pilot – from being the only pilot at a wholesale market, over to being the only project city not being located within the EU – the bare numbers of users can not be compared solely to the app usage of the other cities. Changes in the staff, cultural differences and especially the organised crime structures (parking lot mafia), which even led to direct threats to the members of the teams on the marketplace, made it very difficult for the pilot of Ankara to become established. Nevertheless, for the project partners working in the wholesale market in Ankara, piloting the S+LOADZ project seemed to have an impact on social structures: Some of the drivers reported a de-escalation of the criminal situation since the pilot testing started. To have a specific and scientifically proven evidence for these statements, the project team decided to make a pre-post survey on the perceived safety among the people working at the market [see annex].

The pre-survey took place between the 31th of October and the 6th of November 2022 (N=49). Most questions could be answered by a unipolar, numbered Likert-scale (1= min, 5= max) and led to the following results:

Over half of the drivers (55%) find the current situation for pedestrians at the wholesale market very dangerous (1) or dangerous (2) (mod. =2). For vehicles most of the respondents (42%) described the safety situation as “normal” (3). Over a third (36%) of the drivers sometimes find a space to park their vehicle. Another third of the respondents (32%) said that they have almost always (4) or always (5) the same parking spot, whereas 10 percent of the drivers never park at the same place (1). The bipolarity of the parking spot question is also recognizable within the further questions of safety: About half of the drivers feel unsafe (1 and 2) during the parking process, whereas over 40% feel rather safe (4 and 5). Only 10 Percent describe the situation as “normal”. The perceived safety within the loading and unloading process shows: Almost 45% of the drivers feel unsafe or very unsafe when moving their goods. In general, less drivers (30 %) feel safe or very safe during the (un-) loading process than in the parking process. When asked about the perceived impact that the S+LOADZ project has, over two thirds of the respondents said that the project has at least a small positive effect on the situation on the wholesale market in Ankara – less than one third (28%) perceived no impact at all.

The post-survey has been conducted four weeks later between the 28th of November and the 06th of December 2022 (N=50). The statistical comparison of the two datasets via independent samples t-test showed interesting developments:

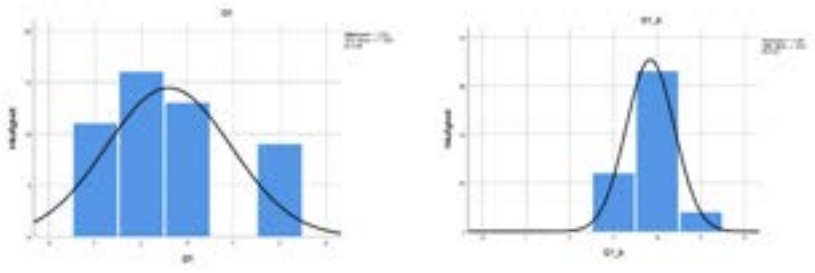


Figure A: Histograms on the question perceived safety for pedestrians (Q1) in pre-survey (left) and post-survey (right)

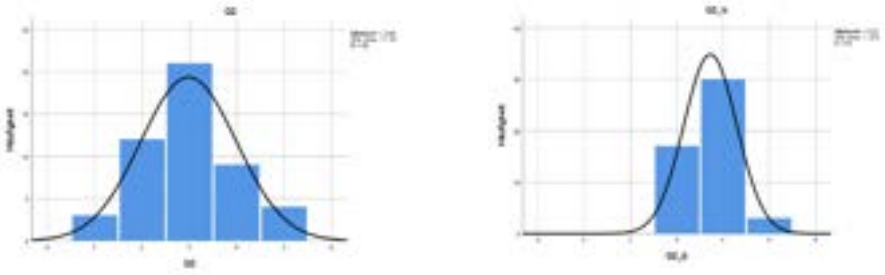


Figure B: Histograms on the question of the perceived safety for vehicles (Q2) in pre-survey (left) and post-survey (right)

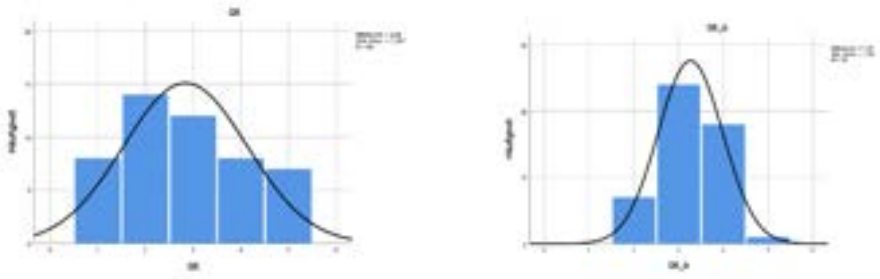


Figure C: Histograms on the question of the perceived safety during the loading and the unloading process (Q5) in pre-survey (left) and post-survey (right)

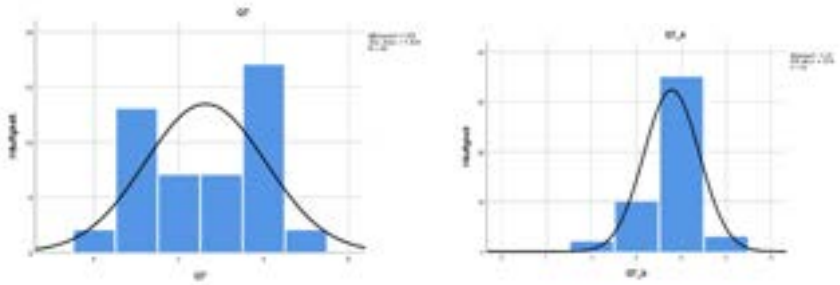


Figure D: Histograms on the question of the perceived positive influence of the project on the market situation (Q7) in pre-survey (left) and post-survey (right)

Most of the questions in the survey showed a significant difference between the pre and the post answers. Below are results of the survey measured by the magnitude of mean differences, including with the largest difference between pre- and post-surveys:

The perceived safety of the pedestrians (Q1, Figure A) raised significantly ($p < 0.00$) from an average rating of 2.59 in the pre to 3.76 scale points on the post survey. Also the perceived positive effect of the project on the market (Q7, Figure D) increased by more than one scale point from 2.63 to 3.78 and is highly significant ($p < 0.00$). The perceived safety for the vehicles increased slightly below one scale point (Q2, Figure B) from 2.89 to 3.72 points on the scale ($p < 0.00$). The drivers' sense of safety during the loading process raised significantly ($p<0.05$) from 2.84 to 3.26, but with an increase about half a scale point did not change in the same extend as the other findings.
The question of whether drivers always park in the same parking space (Q3) as well as the question of safety during the parking process (Q4) showed no significant differences between pre- and post-surveys, which – given the implementation stage of the project at the wholesale market of Ankara - speaks for the validity of the survey results.

The significance of the results indicates that the results are not random and that there was a demonstrable difference (e.g., in terms of a specific influence or event) between the first and second surveys. We interpret this influence as the progress of the project with the on-site communication campaign and associated with that the progressive recognition of the painted parking spaces and parking signs by drivers, as no other influencing factors could be identified at this time.

Analysing the open questions of the reasons for the app-usage (Q6b) and suggestions (Q8) the data gives strong hints that there is a divide within the community of drivers at the Ankara wholesale market. The answers to these questions showed a variety between mostly supporting comments, constructive critique but also some negative statements.

When it comes to the app-usage, the figures differ: In first survey more than 50 % of the respondents said that they have not heard about the app or do not know how to use it. The fact that there were more people (20 in the first and 45 persons in the second survey) answering they were using the app, at first may contradict the numbers in the back office (13 vehicles) - but the missing knowledge or wrong use - considering the people downloading it and not knowing how to use it properly - would explain the difference.

Conclusion

The figures of the pre-post-survey in combination with the interviews show that the continuation of the project at the wholesale market in Ankara has demonstrably had relevant and statistically significant positive effects on the workers' sense of security for pedestrians, vehicles, and the general situation at the wholesale market - independent from the absolute numbers of users. Since no other factors influencing the wholesale market could be identified during the study period, it is concluded that the visible elements of the project, such as the signs and floor markings in combination with the on-site presence of the BELKA-team led to these results.

Notwithstanding a rotation of technicians assigned to the project by BELKA (this, in part in response to threats received by opposers of the project), the Ankara Team and Project Partners worked together to deploy from scratch a pilot that demonstrates the potential of the solution to the key stakeholder – the Wholesale Market Management. The problem of theft of Bluetooth devices – something that had not

happened in any project prior to this - was resolved. Practical decisions were taken to downscale the pilot in line with the project duration of 12 months, and a coherent dataset has been generated.

It is clear from the initial communication actions that the project was endorsed at a high political level in the City of Ankara. It is suggested that this high-level ambition constrained the Team in proposing alternative pilot configurations more in-line with the pilots at the other S+LOADZ cities. In hindsight, a lower-profile pilot on public city space where BELKA could be accountable to the citizens and representatives of Ankara might have been more appropriate, with a more exploitable end-result.

4.6 Comparison of the Living Labs

The methodology chosen to compare the living labs with each other is the MDSD explained in → Chapter 4.1.2: MDSD. The following five factors to describe and compare the cities to each other were chosen: population (no. of residents), size (km²), number of households, the area, and the urban density (citizens/km²) (see Table 13Table 6). As Table 13shows, there was no distinction in the area (all of the cities are urban areas), which is why only four factors are considered for the compilation of the MDSD. The other four factors were chosen as they describe the four cities on a very generic, but comparable level (population, size, and urban density), or due to the fact that they have a relation to logistics yet are not influenced by Parkunload. To give an example, the variable 'number of households', acquired through the use of open data on cities' household structures, gives a good initial estimate of the average stop density in the respective area. Based on the market shares of a delivery provider, the total parcel volume can be estimated. Based on the shares of the market segments for end customers and business customers, the parcel volumes can then be estimated. Finally, based on the population figures and the sales areas, pilot-specific apportionment factors can be determined.

Table 13. Comparison of the four living labs[8]

	Argenteuil	Paris	Vic	Ankara
Population (residents)	111,038 (2)	2.1 M (3)	50,000 (1)	5.1 M (4)
Size (km²)	17,22 km² (1)	105 km² (2)	31 km² (1)	2737 km² (4)

[8] Sources for number of households: Insee (2022a); Insee (2022b); gencat (2022); TÜİK (2022)

	Argenteuil	Paris	Vic	Ankara
Number of households[6]	45,317 (2)	1,389,375 (4)	19,154 (1)	1,874,093 (4)
Area	urban	urban	urban	Urban
Urban density (citizens/km²)	6,4K(4)	20,5K (3)	1,5K (1)	1,9K (2)

After collecting the numbers for all the factors, we applied the methodology for enabling a comparison between the four living labs as shown in the example (s. a.; Picioroagă et al., 2018). The allocation of values between (1) and (4) does not strive for equal distribution, but instead is meant to put each of the living labs on a spectrum to show similarities and differences in an easy, understandable way (see Figure 65). Where the difference between one, or more cities seemed to be bigger to one, or more cities, a value in between was left out (e.g., size).

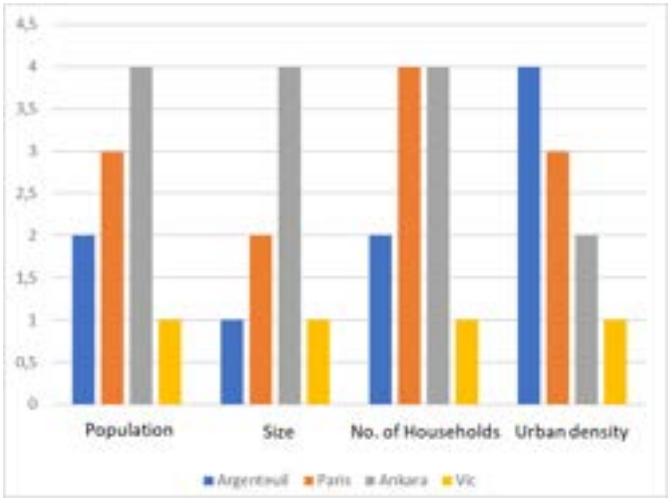


Figure 65. Comparison of the four living labs with the factors population, size, number of households, and urban density.

MDSD

Next, the MDSD is set up. As shown in the example (s. a.; Picioroagă et al., 2018), a net diagram offers one solution to characterise the cities as rather similar or rather different to each other (see Figure 66).

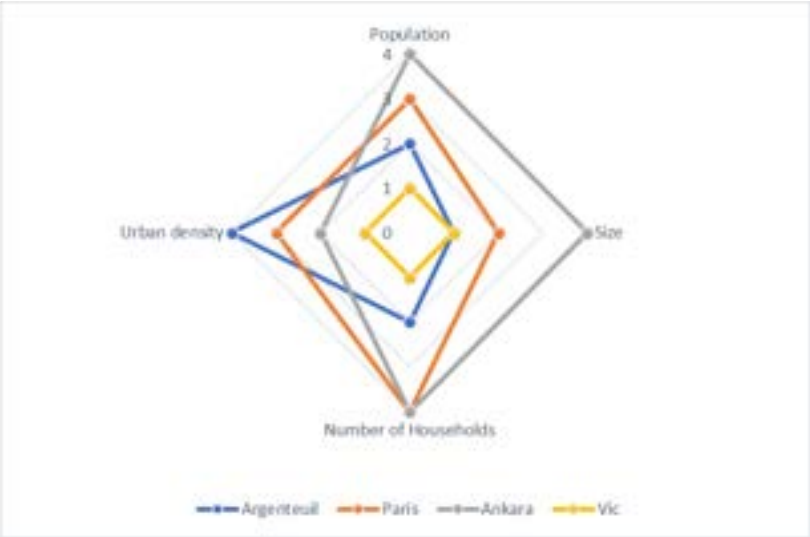


Figure 66. The four living labs in the Most Different Systems Design.

Figure 66 offers an interpretation in the MDSD set-up. Vic and Ankara appear to be most different from each other. While Vic seems best comparable to Argenteuil, Argenteuil in turn appears to be closest to Paris. Paris in turn appears to be the city closest to Ankara.

One should also keep in mind that the living lab in Ankara was set up at a wholesale market, instead of in the city/urban area with individual traffic like in the other three labs, where the lab focused on the last mile of package deliveries.

Key Findings

To summarise from → *Chapter 4.4.6*, Vic was successful in increasing the amount of LDZ, as well as the number of tickets, and registrations to the Parkunload application. During the data collection period, there was a lower percentage of high-polluting vehicles than before, improving the air quality. The increase in registrations and registered zone usage was also found in the big data acquired during the pilot project.

The French living labs (Paris and Argenteuil) share comparable results, and are very different from the Vic living lab . In Paris and Argenteuil, as in many dense urban areas in France, on-street deliveries are dysfunctional: many deliveries take place while the delivery is double-parking, creating congestion; few delivery drivers can use loading/unloading areas because these areas are very often used by non-delivery vehicles. Enforcement of the municipal rules regarding loading/unloading is insufficient. Delivery drivers complain about poorly designed, poorly enforced loading/unloading areas. In the two French pilots, the implementation of S+LOADZ has been viewed by local drivers, shopkeepers and enforcement agents, in our ex-ante survey, as a potentially good way to make progress. However, it has been difficult to implement a new system, for bureaucratic reasons that are shared by both Argenteuil and Paris, especially in relation to the national administrations. And in both cases, it has been difficult to convince delivery operators to use the S+LOADZ system and the app: this use is voluntary and delivery drivers often find it difficult to add yet another task to their busy routine. In France, municipalities cannot make this type of system compulsory to delivery drivers, nor can they dedicate loading/unloading areas to professional delivery drivers' vehicles.

Private cars can use loading/unloading areas, provided they are engaged in delivery operations, and enforcement agents have a hard time proving that a vehicle is not engaged in a delivery, therefore they hesitate in giving fines.

Lastly, Ankara applied other (H-)KPIs than the other three living labs. For this living lab, it was especially important to look for social factors, such as the security at the wholesale marketplace. The usage data of Parkunload rather focused on long-term parking, which is characteristic for a market, instead of short-term, last-mile package delivery as in the other labs.

Outlook on future evaluations

As a result, it becomes apparent that not all living labs derived the same data for the set-up (H-)KPIs. Especially Ankara presented itself as a lab where the establishment of LDZ was rather difficult and prevented by events or structures outside of the project's influence. Nevertheless, it becomes apparent that comparable results were reached for the labs Paris and Argenteuil because they share the same challenges, under a shared regulatory framework, resulting on an increase on registrations in the App, which is comparable per space among the two living labs, but relatively lower compared to the city of Vic. Meanwhile, the Vic living lab obtained a different set of results, such as a higher registration rate per parking space, possibly because a preliminary version of the App has already been implemented in the city which has generated a high adoption of the technological solution by the main actors of the project, supported also by regulatory power to make the use of the App mandatory.

Finally, it becomes clear that the evaluation of the four living labs, with a comparison of exactly these, faced complications due to a short period of data collection. In some of the labs, the set-up (H-)KPIs have not yet been observed further. To establish an ongoing observation of Parkunload's impact in the four labs, it is highly suggested that the cities, and Parkunload, should proceed in the collection of the data for a longer period of time. Then, a pre-post-treatment comparison is going to be possible, which will show impacts on a larger scale. The cities and Parkunload are therefore advised to keep up that form of quality management, possibly after the S+LOADZ project is concluded.

5 Micro-incentives for logistics

5.1 Analysis of potential use of micro-incentives for logistics

A mobility micro-incentive is a tailor-made monetary or an in-kind reward based on flexible sets of criteria to maximise financial and societal goals. Criteria could include the selection of mode of transport at specific times or days, as well as any other attribute such as origin and destination of a trip or any attribute such as certifications, or type of company.

A micro-incentive can help shifting towards more sustainable logistics by nudging behaviour. Cities and any public entity could reward sustainable logistics behaviour in order to push citizens and companies to take more sustainable decisions, for example, collecting parcels in collection hubs rather than at home for the products, which would reduce the dispersion of last mile logistics.

Nudging logistics couldd happen at two different levels: on the one hand, the end-clients opting for more sustainable choices for delivery whenever theres'a chance to choose it. On the other hand, logistics companies by improving the sustainability and optimization of their mobility needs.

It has been proven that users can be positively motivated or nudged to opt for more sustainable options. For example, when showing information related to the emissions and environmental impacts of the delivery selection, e-comerce users can be significantly motivated to select a more sustainable option when the information is clearly displayed (Thomas et al. 2022; Buldeo Rai et al. 2021).

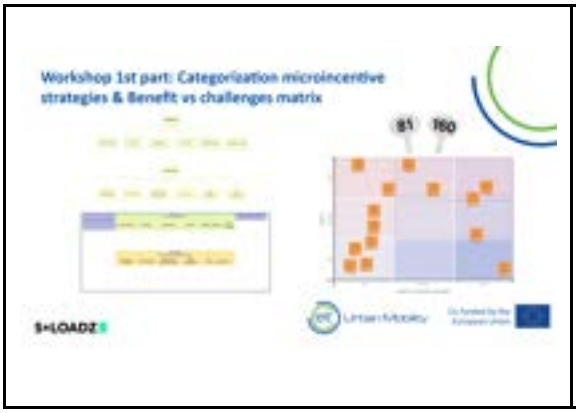
It can be understood that nudging behaviour from end-users can be made based on their will to select more sustainable options. However, on the side of logistics operators, the use of micro-incentives to nudge towards more sustainable behavior needs to be aligned with the companies' efforts within their endless battle between gaining market share and improving their operations efficiency. For example, if there were more loading and loading zones for cargo bikes than for carbon-fueled vehicles, the more sustainable vehicles would have an advantage for faster delivery than their more pollutant competition.

The example below illustrates an option where infrastratucture is differentiated to allow the micro-incentive. However, there are examples were factors such as time allowance can allow this without any major difference in infrastructure. For example, enabling times of the day when cargo bikes are the only allowed to park in any loading and unloading zone in a central area of the city.

It is important to mention that the idea of a micro-incentive is follows the theory of the carrot and the stick, where a carrot can be understood as a micro-incentive and regulation can be understood as the stick. Micro incentives have proven to be relevant in affecting behaviour in end users (Riggs, 2016). However, there is not enough data to add certainty of the efficiency from micro-incentives to nudging logistics operators behaviour. Here below some of the projects in which different logistics opportunities have been tested:

- New York – TURBLOG project – off hour delivery (OHD) with incentives for receivers if they accept deliveries between 7PM and 6AM
- Turin – NOVELOG project – sharing of PT reserved lanes, booking of load/unload docks, LTZ entrance
- Paris – CITY-LAB – assessment of the impacts of urban consolidation centres inside the city
- Milan – U-TURN – collaborative logistics, from farms to city centre
- Mechelen – NOVELOG – development of a UDC with bike couriers and parcel lockers in the inner city

As part of the SLOAD+Z scope and in order to add expertise to the opportunities of micro-incentives in logistics, there was work done with the cities and partners of the S+LOADZ consortium. In included some initial interviews and a workshop which consisted in the ideation, analysis and evaluation of microincentive ideas for logistics that can help nudging towards more sustainable logistics.



In general terms, micro incentives for logistics seem to be an opportunity to have a positive impact for sustainable logistics and improved operational efficiency. However, they need to be part of a more comprehensive framework in which sustainable logistics are part of the goal of the city (or any context) to improve mobility. Different challenges were found that should be taken into account to make logistics micro-incentives possible:

- Technical
- Partnerships
- Complexity
- Momentum
- Legal framework
- Public acceptance

The initial brainstorming and analysis was done in three different teams representing each of the three regions in the consortium: Ankara, Paris region (Paris city and Métrople du Grand Paris) and Vic. In the

second part of the workshop, the cities and other partners collaborated in selecting which ideas for micro-incentives in logistics were more beneficial and less challenging with the following conclusion:

- Issue 1: *Congested road with multiple uses such as commercial and residential.*

  Potential solution: Create minihubs where parking places exist nowadays. Only cargobikes can deliver from this minihub for the last mile.

  Key words: Cargobikes, Minihub, Short-stays, Active modes, Bicycles & Kickscooters, Scalable solution, Change in governance.

- Issue 2: *Private commercial area with high density freight delivery.*

  Potential solution:Fidelity program for correct use of the parking areas with rewards like discount in parking

  Key words: Simple implementation, Positive mobility impact, No environmental benefit.

- Issue 3: *High emission vehicles delivering goods*

  Potential solution: Delivering goods for free if providers use zero-emission vehicles

  Key words: Zero-emission deliveries, Win-win, Last-mile, Cargo bikes, Active Modes, Shop owners benefit.

  Analysis of opportunities of micro-incentives with real data of parking (digital) tickets from services in the cities of Vic (Spain) and Paris (France) from the ParkUnLoad platform.

A parking ticket is defined as the check-in done by a driver who has parked in a public delivery zone. The analysis below helped analyse potential use of micro-incentive programmes to positively affect the emissions and mobility in the cities. The analysis is focused on the emission category of the vehicles defined in the ParkUnLoad platform which differs from Spain and France.

Table 14. ParkUnLoad emissions categories and its reference to the vehicle environmental badge on each country

ParkunLoad (emissions categories)	Spain (DGT)	France (Crit' air)
Zero	0 (electric)	Electric
Low	ECO	1
Medium	C	2
High	B	3
Very High	---	4
Undefined	---	5
		6

Class	Motorcycles	cars, vans, campers ≤ 3,5 t		Bus, truck, motorhomes > 3,5 t	
0	Hydrogen, electric vehicles, plug-in hybrids with ≥ 40km electric range.				
ECO	Hybrids, plug-in hybrids with < 40km electric range, LPG, natural gas vehicles that meet at least the criteria of sticker C				
Class	Diesel/ Petrol	Diesel	Petrol	Diesel	Petrol
C	Euro 3 - 4 from 01.01.2007	Euro 6 from 01.09.2014	Euro 4 - 6 from 01.01.2006	Euro 6 from 01.01.2014	Euro 6 from 01.01.2014
B	Euro 2 from 01.07.2004	Euro 4 - 5 from 01.01.2006	Euro 3 from 01.01.2001	Euro 4 - 5 from 01.10.2006	Euro 4 - 5 from 01.10.2006

Figure 67. Vehicle environmental badges Spain

Figure 68. Vehicle environmental badges France

5.2 Analysis of parking tickets in loading and unloading zones in Paris and Vic and proposal of a micro incentive programme

General information:

As part of the project, Keita Mobility Factory developed a theoretical proposal of a micro incentive programme using real data from the Parkunload platform in the cities of Paris and Vic. The idea was to analyse the characteristics of the type of vehicles and the usage of the delivery zones. Based on this, a suggestion was made considering the type of vehicles in terms of their emissions combined with extra time allowance for parking in the delivery zones for the most efficient vehicles. In the section 'Theoretical proposal for the use of a micro incentive programme based on tickets data from Parkunload, Keita suggests an idea of a micro incentive programme in order to nudge delivery companies to a more sustainable delivery of goods.

For this exercise, there were a total of 3 088 parking tickets for the city of Paris (from August 2021 to March 2022) and 41 433 tickets for the city of Vic (from August 2018 to March 2022).

As mentioned above, the simulation was done using real data from the Parkunload platform, however, a larger universe of parking tickets plus more recent tickets can improve the accuracy of the data and the conclusions.

Table 15. Total number of collected tickets in loading and unloading zones in the Parkunload platform for the cities of Paris and Vic

Paris

EmissionDescription	Nr of tickets	%
Very high	181	5,86%
High	343	11,11%
Medium	1289	41,74%
Low	1176	38,08%
Zero	65	2,10%
No defined	34	1,10%
Total	**3088**	**100,00%**

Vic

EmissionDescription	Nr of tickets	%
Very high	32193	13,33%
High	106343	44,05%
Medium	99055	41,03%
Low	2448	1,01%
Zero	1196	0,50%
No defined	198	0,08%
Total	**241433**	**100,00%**

- **Paris:**

In Paris the majority of tickets are classified in the emission type as Medium (42%) and Low (38%). The total of High and Very High Emission tickets are almost 17% of the total, and Zero tickets are just 2,10%.

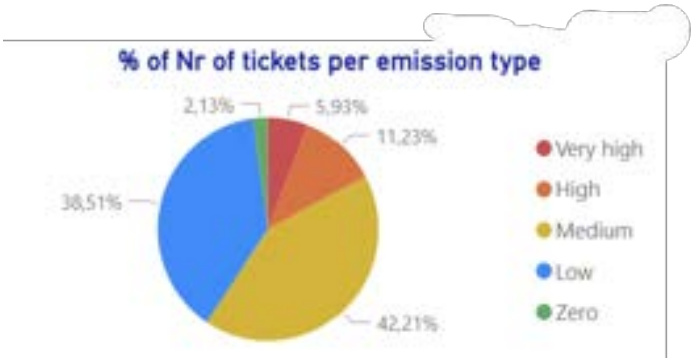


Figure 69. Paris. % of tickets per emission type.

- **Vic:**

In Vic the majority of tickets are classified in the emission type as Medium (41%) and Hight (44%). The total of High and Very High Emission tickets is around 57% of the total, and Zero tickets are just 1,01%.

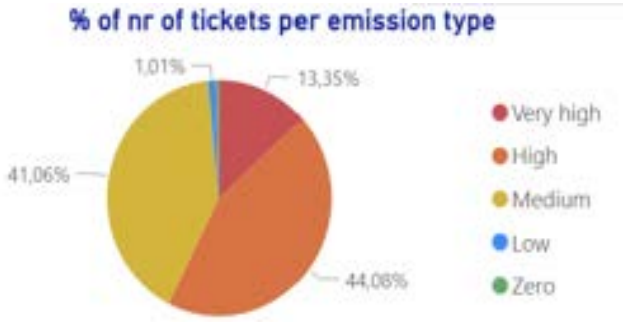


Figure 70. Vic. % of tickets per emission type.

Vehicle Type vs Emissions

- **Paris:**

1. Tickets with High and Very High Emissions vehicles are mostly found in LCV and cars Vehicles (6,38% and 5,73% of the grand total respectively)

2. 100% of the Truck with more than 12T are High Emission and around 24% of LCV are High or Very High Emissions Type.

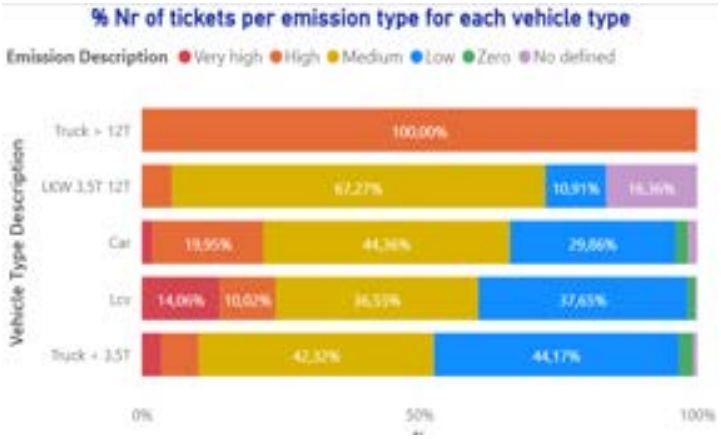


Figure 71. Paris. % of tickets per emission type for each vehicle type

- **Vic:**

1. Tickets with High and Very High Emissions vehicles are mostly found in LCV and Truck<3,5T Vehicles (14,5% and 36% of the grand total respectively)

2. However, Car has the highest percentage of high and very high tickets from the total of each vehicle, that is 69,5% of the cars are high or very high emissions type.

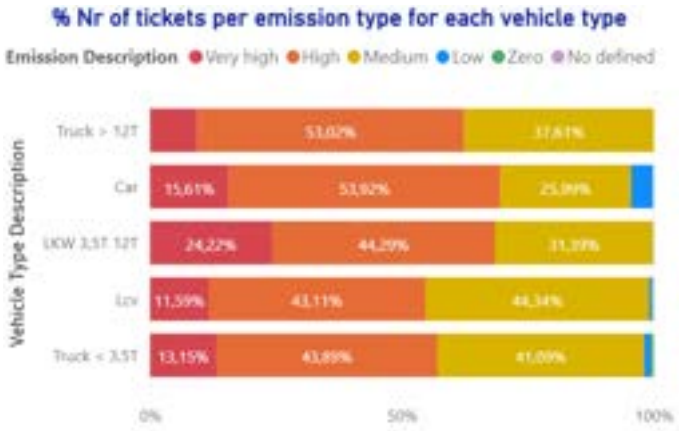


Figure 72. Vic. % of tickets per emission type for each vehicle type

Vehicle Type vs Emissions vs parking time limits

According to the data collected from parking tickets (or check-ins by drivers in loading and unloading zones), there's still a high percentage of vehicles exceeding the time limits for parking deliveries, 64% in the case of Paris and 39% for Vic.

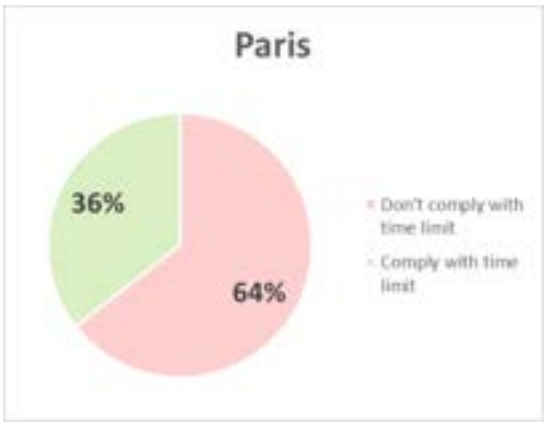


Figure 73.Paris. Current % of vehicles that comply/exceed parking time limits

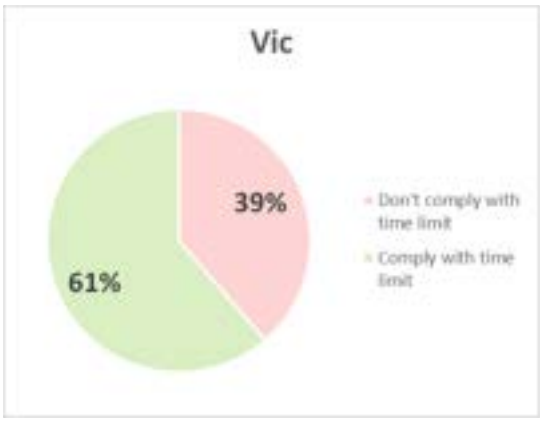


Figure 74 Vic. Current % of vehicles that comply/exceed parking time limits

- Paris:

    1. In Paris, only 35,5% of the tickets respect the time limit according to local regulations in the loading and unloading zones.

- VIC

    1. In Vic, 61,4% of the tickets respect the time limit according to local regulations in the loading and unloading zones.

In Paris, 58% out of the total available tickets which don't comply with the time limit correspond to vehicles that are not zero or low emission. On the other hand, in the city of Vic there's only 1% of the tickets which don't comply that are zero or low emission vehicles.

Figure 75. Time limit complied by type of vehicles

Theoretical proposal for the use of a micro incentive programme based on tickets data from ParkUnLoad

As part of the effort of the study, a theoretical suggestion was delivered to propose a micro incentive programme in the cities of Paris and Vic consisting in allowing extra time in the delivery zones depending on the level of emissions of the vehicles.

Based on the characteristics of the vehicles and the usage of the delivery zones, it is viewed as a theoretical improvement of the fleet if companies will be entitled of extra delivery time when the use more efficient vehicles. This analysis was done for the cities of Paris and Vic where parking tickets exceed the time limit by 64% and 39% respectively.

The case of Paris:

If the regulation time would be increase to +15 min, the percentage of tickets on time raises to 57%, being on time: 63% of zero-emission tickets and 53,8% of low emission tickets. Representing an increase of 70% and 64% respectively.

Table 16. % of tickets that respect the time limits by simulation scenario

Emission Description	% of increase with +5 min	%of increase with +10 min	%of increase with +15 min
Low	41,40 %	59,14 %	70,16 %
Zero	40,00 %	52,00 %	64,00 %
High	30,23 %	49,61 %	65,89 %
Very high	28,00 %	46,00 %	56,00 %
Medium	27,50 %	43,61 %	55,80 %
Total	**32,90 %**	**49,95 %**	**62,12 %**

The case of Vic:

1. If the regulation time would be increase to +15 min, the percentage of tickets on time raises to 77,2%, being on time: 63% of zero-emission tickets and 85,2% of low-emission tickets. Representing an increase of 38% and 26% respectively.

Table 17. % of tickets that respect the time limits by simulation scenario

Emission Description	% of increase with +5 min	%of increase with +10 min	%of increase with +15 min
Zero	19,08 %	30,64 %	38,72 %
High	12,72 %	20,85 %	26,23 %
Medium	12,38 %	20,37 %	25,83 %
Very high	12,03 %	19,96 %	25,24 %
Low	5,60 %	9,80 %	12,27 %
Total	**12,42 %**	**20,43 %**	**25,80 %**

According to the data above, if there was an incentive for delivery companies in which vehicles with lower emissions would have extra time for delivery, this could engage companies on selecting more efficient vehicles and/or utilising their most efficient vehicles in zones of the cities where air quality tends to be higher, such as city centres or commercial areas. There is an interesting factor to mention that vehicles with zero or low emissions tend to respect more the time limits, however, no conclusion could have been found as part of this study.

6 S+LOADZ communication and dissemination

Communication and dissemination is a key aspect for the S+LOADZ project in order to deliver a compelling message to the target audience during the project lifetime. The communication strategy is twofold: from one side, it is highly important to keep informed local stakeholders and potential users of loading zones, and on the other side, to promote the knowledge developed by the project and S+LOADZ solution through international city logistics events. In this chapter we have listed all the activities developed during 2022, related to the communication component of the project.

6.1 S+LOADZ visual identity and branding

A strong and coherent visual identity of the project was developed through the design of the project logo to ensure a unique identity of the project. This visual identity was used in all communication materials with applied co-branding of EIT Urban Mobility/EU (See Figure 76).

Figure 76. Project Visual Identity

Once the visual identity of the logo was designed, the branding manual (See Annex *S+LOADZ Guidebook*) was disseminated to the consortium partners, together with presentation templates and documents including the logo with the joint EU/Urban Mobility EIT branding, aiming to ensure unified communication related to the project.

6.1 S+LOADZ website

The project website (https://sloadz.com/) serves as an efficient and effective information and communication system for the S+LOADZ consortium members, other project stakeholders and for other cities interested in the project. The project website has been a dynamic channel of communication and dissemination of the S+LOADZ project. The following communication activities have been carried out in this space:

- Information about the project, pilot cities and project partners
- Dissemination of the benefits and technical details of the sustainable loading and delivery zones.
- Dissemination of S+LOADZ best practices
- News and updates on the progress of the living labs

To this end, the project website is composed of 7 sections with the following specific objectives:

1. Home: Provide an overview of the project, the main objective, the partners and the latest news/updates.
2. What we do: Explain the technological solution, the project idea, its main objectives and benefits.

3. **Who we are:** Presentation of the project partners grouped into three categories according to their role in the project; 1) Research 2) Cities and 3) Innovation , technology and business development.
4. **Use cases:** Provide an overview of the pilot cities and the main features of their living laboratories.
5. **Insights:** Dissemination of the project deliverables.
6. **News:** Give an overview of the latest updates and progress of the project
7. **Contact us:** Provide a communication channel to interested stakeholders

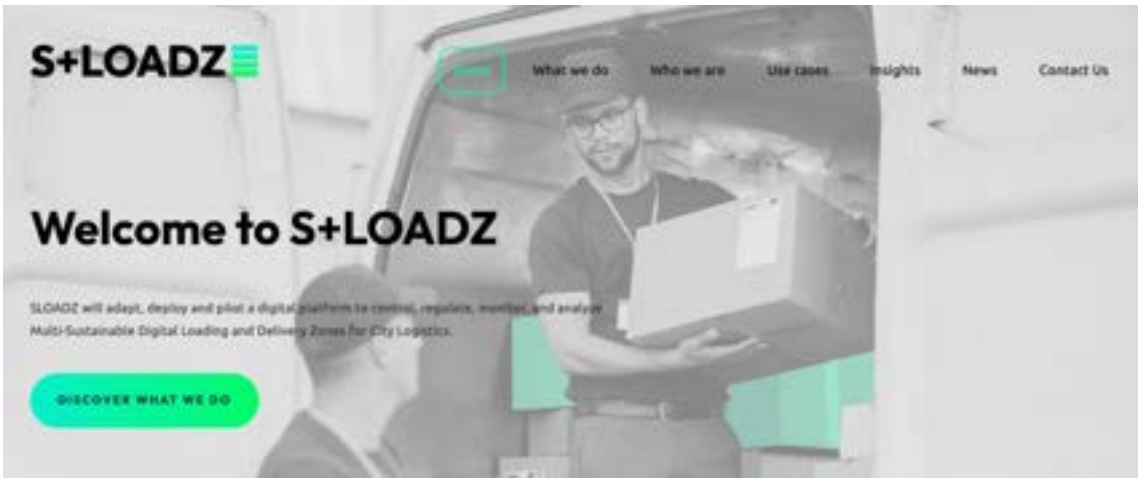


Figure 77. S+LOADZ' website

The S+LOADZ website features a modern, accessible, intuitive and responsive design that aims to ensure accessibility not only from a computer, but also from mobile devices such as tablets and smartphones. It is carefully designed, to meet the needs of multiple stakeholders: municipalities, logistic operators, researchers, media and general public among others.

According to modern aesthetics in web design, https://sloadz.com/ is a fully responsive, fast, user-friendly and SEO-optimised website.

According to Google's analytics, since the launch of the website until 28 November, the project's website shows the following statistics:

- The project website had more than 550 users during 2022, with a particular increase in users around the time the project video was launched and the project newsletters were sent out.

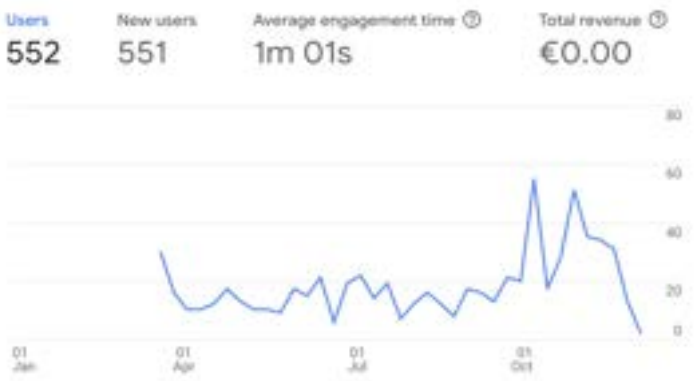


Figure 78. User of the S+LOADZ' website during the project lifetime

- 44% of the users come from the pilot countries, Spain (145), France (65) and Türkiye (32). The other 56% came from beyond the borders of the pilots, including China, the United States, Germany, the Netherlands and Australia, among others.

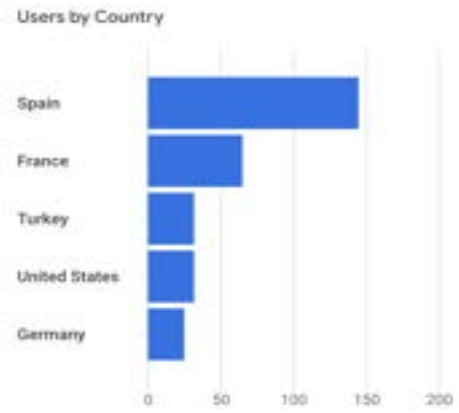


Figure 79. Users of the S+LOADZ' website by location

- In terms of user acquisition, it can be observed that most users find the website directly or by organic search, which means that they already knew about the project when they found it. This can be explained by a redirection of users through other publications on social networks.

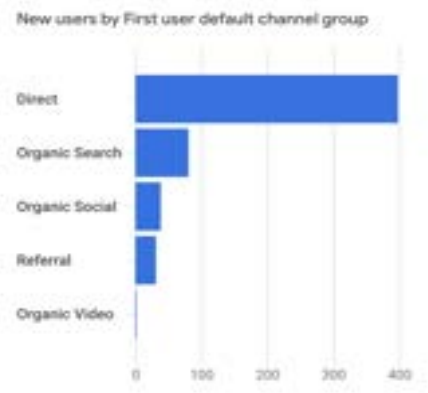


Figure 80. User acquisition of the S+LOADZ' website

6.2 Project video

The project video, available in Youtube with direct access from the project website , was published in September 2022 and includes a general explanation of the project, the technological innovation and the living labs. The project and the solution are explained by the industrial partners, the living lab landscape by the pilot cities and the evaluation efforts by the research partners.

6.3 Project newsletters

For internal and external communication, the project coordination has developed quarterly newsletter over S+LOADZ progress, to keep informed and motivated all the key stakeholders.

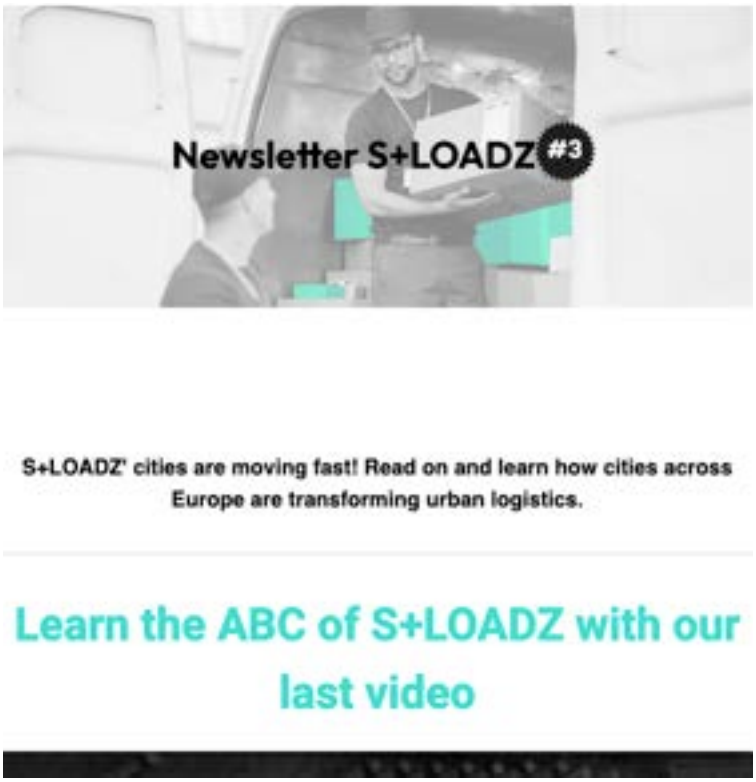


Figure 81. Quarterly S+LOADZ' newsletter sample

6.2 General project dissemination in events

The SLOADZ consortium partners have disseminated both the project's Living Labs and the Parkunload product at conferences and exhibitions. During 2022, SLOADZ partners actively participated and presented the project objectives and results at specific events and actively sought opportunities to speak. The main events where the project was disseminated are listed below.

6.2.1 Sustainable City Logistics Community Event in Copenhagen

On 30th May, the Action and Impact Group of EIT Urban Mobility, Innovation Hub North and Royal Norwegian Embassy organised the "Sustainable City Logistics Community Event" in Copenhagen. S+LOADZ project was represented by its project officer Wiebke Müller (EIT Urban Mobility) and project coordinator Marc Figuls (Factual).

During the event the S+LOADZ representatives had the chance to discuss the digitalisation of the kerbside, the promotion of low-emission logistics and the deployment of incentives to nudge user behaviour towards a more sustainable mobility, all of them aspects that are playing a key role in the S+LOADZ project. It was clear there that the main goal of the new European topics addresses similar objectives as S+LOADZ project:

to reduce the externalities of city logistics (pollution, noise, congestion, etc), to make them more efficient and to co-create new frameworks to promote citizen engagement and its participation in shaping future city logistics.

Figure 82. S+LOADZ in the Sustainable City Logistics Community Event in Copenhagen

6.2.2 Innovation Hub Central event

In July 2022 Marc Figuls Rovira and Suna Akbayir, from FACTUAL and Artech International respectively, attended the Innovation Hub Central event hosted by Istanbul Metropolitan Municipality and EIT Urban Mobility. There, they presented the S+LOADZ project, in a session that count with the participation of Metin Turkay (Koç University), Sayalee Pendharkar (Landeshaupstadt München), Ali Kutay (Delivers.AI) and Wolfgang Inninger (Fraunhofer IML).

The main objective of this session was the dissemination of the knowledge generated and the scalability of the innovative solution to other cities such as Istanbul. It was a major milestone for the S+LOADZ project to be part of the debate and to be recognised globally as a transformative solution for city logistics.

Figure 83. S+LOADZ in the Innovation Hub Central event

6.2.3 Smart city expo world congress 2022

The Parkunload team participated in the Smart city 2022 expo-congress. The business partner had a stand where it was able to exhibit and demonstrate its latest innovations and services, including the one developed during the S+LOADZ project, on a three-day event 15-17 November.

Figure 84. Exhibition of Parkunload' product at the Smart city expo congress 2022

6.2.4 POLIS annual conference 2022

The 30th of November the SLOADZ representatives from Vic Municipality, Joana Rodríguez and Fabiana Palmero, presented the deployment process, the technology and results of their pilot at POLIS conference from 2022, on the session *Urban Freight strategies and tools.*

Figure 85. Presentation of the S+LOADZ Vic pilot at POLIS 2022 conference

Furthermore, on the 30th of November 2022, representing the city of Ankara, the S+LOADZ partners of Aretch consulting international, Esra Sunker and Suna Akbayir, presented the conceptual idea of the pilot wholesale market in Ankara, in the session *Tools and strategies for modern traffic management*.

Figure 86. Presentation of the S+LOADZ Ankara pilot at POLIS 2022 conference

6.2.5 #SLOADZ in social media

The #SLOADZ hashtag appeared 12 times in Twitter and 12 times in LinkedIn professional network, for a total of 24 appearances in the social media.

6.3 Project communication and dissemination in Living Labs

6.3.1 S+LOADZ pilot: Métropole du Grand Paris, Argenteuil

In the city of Argenteuil, one of the main communication materials was the printed brochure, aimed at informing logistics operators and drivers about the pilot project and how to use the application correctly (See Figure 87).This leaflet was physically distributed to the main users of the Parkunload App, the drivers and the shop owners.

Figure 87. Leaflet for drivers and logistic operators

To facilitate dissemination, both the pilot city and the Mètropole du Grand Paris, have developed two video materials, published in multiple social media channels:

1. Video Logistique urbaine: expérimentation d'aires de livraison connectées à Argenteuil.

In this video the pilot project is explained directly by local politicians, including the mayor of Argenteuil, and other key stakeholders of the project.

Figure 88. Video Logistique urbaine: expérimentation d'aires de livraison connectées à Argenteuil. Available at: https://www.youtube.com/watch?v=W_k4m42YrnQ

2. Video Métropole du Grand Paris - Reportage Logistique urbaine Argenteuil

The Métropole du Grand Paris has produced a video report on urban logistics in Argenteuil, explaining the use of the application with a real example.

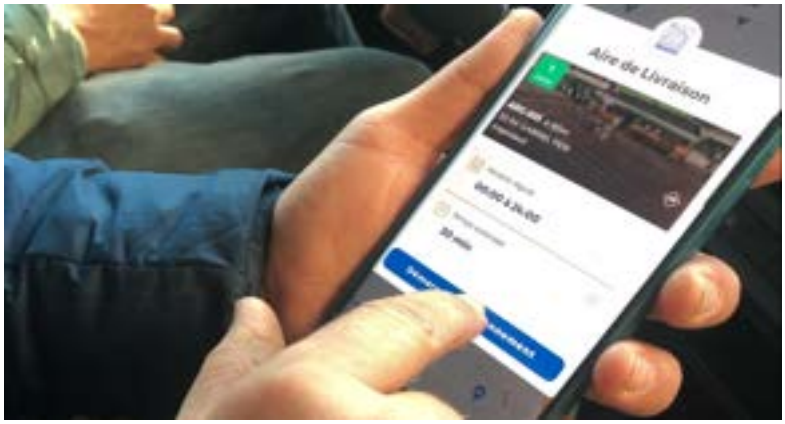


Figure 89. Video Métropole du Grand Paris - Reportage Logistique urbaine Argenteuil. Available at: https://vimeo.com/773420860/52e7169bfc

Furthermore, the Métropole du Grand Paris and Argenteuil have use multiple media channels, bit digital and printed, to disseminate and communicate the S+LOADZ pilot project:

1. Official website of Argenteuil municipality

The city municipality also used their website to disseminate the project vision, goals and objectives in their article *Places de livraison connectées* and Les aires de livraison connectées arrivent à Argenteuil | Site de la ville d'Argenteuil

*Figure 90. Article **Places de livraison connectées** available at https://www.argenteuil.fr/fr/actualites/places-de-livraison-connectees*

Figure 91. Press release ***Les aires de livraison connectées arrivent à Argenteuil*** *available at* https://www.argenteuil.fr/fr/actualites/les-aires-de-livraison-connectees-arrivent-argenteuil

2. Facebook of Argenteuil

Figure 92. Facebook post of the project available at shorturl.at/huOSY

3. ***Argenteuil en poche***

The city used other relevant communication channels, such as ***Argenteuil en poche***, a website dedicated to Argenteuil retailers, to disseminate the pilot information to a target audience.

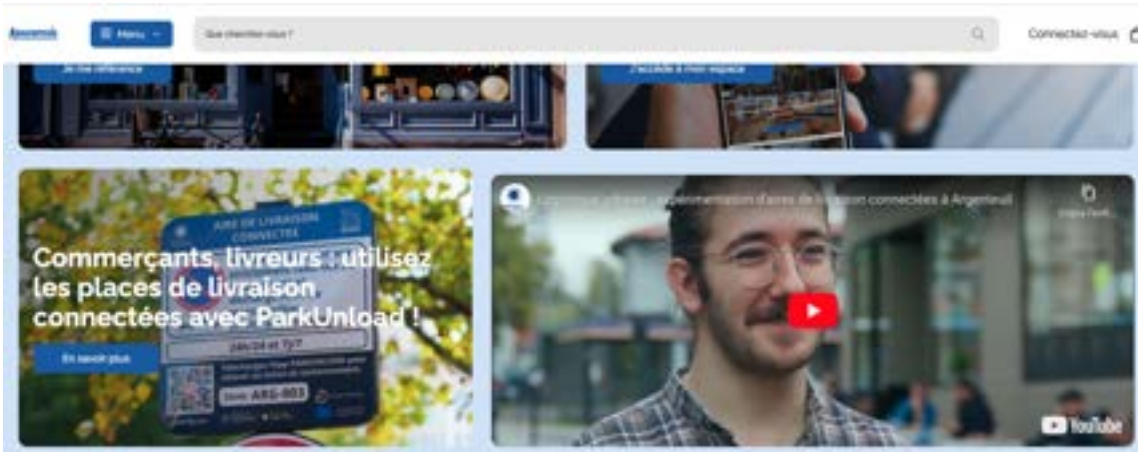


Figure 93. Pilot project publication in home page of . Available at: https://argenteuilenpoche.fr/

4. Les Echos, on-line magazine.
   Article : **Argenteuil expérimente les aires de livraison connectées pour fluidifier le stationnement | Les Echos**

   Available at: https://www.lesechos.fr/pme-regions/ile-de-france/argenteuil-experimente-les-aires-de-livraison-connectees-pour-fluidifier-le-stationnement-1875213

Figure 94. Argenteuil expérimente les aires de livraison connectées pour fluidifier le stationnement | Les Echos

5. French TV channel BFM
   News: **Des Aires de livraisons connectées à Argenteuil**
   Available at: https://www.bfmtv.com/paris/replay-emissions/bonsoir-paris/val-d-oise-des-aires-de-livraisons-connectees-a-argenteuil_VN-202211040658.html

Figure 95. Val-d'Oise: des aires de livraisons connectées à Argenteuil

6. La gazette, on-line media.

   Article: **Argenteuil veut résoudre le problème des places de livraison**

   Available at: https://actu.fr/ile-de-france/argenteuil_95018/argenteuil-veut-resoudre-le-probleme-des-places-de-livraison_55571329.html


La gazette

Argenteuil veut résoudre le problème des places de livraison

Dans l'hyper-centre, où les problèmes de stationnement et circulation sont connus, la municipalité a lancé une expérimentation via une nouvelle application numérique, Parkunload.

Figure 96. Argenteuil veut résoudre le problème des places de livraison

7. L'Itinérant, on-line media

   Article: **Argenteuil : aires de livraison connectées**

Available at: https://www.liti.fr/argenteuil-aires-de-livraison-connectees/

Figure 97. Argenteuil : aires de livraison connectées

8. **L'Officiel.** Page 38. Diffusion 827

Article: **Paris et Argenteuil testent la solution S+LOADZ**

Figure 98. Paris et Argenteuil testent la solution S+LOADZ

9. Smart city on-line magazine

Article **Logistique urbaine : Paris et Argenteuil testent le stationnement connecté**

Available at:

http://www.smartcitymag.fr/article/1150/logistique-urbaine-paris-et-argenteuil-testent-le-stationnement-connecte

Figure 99. Article Logistique urbaine : Paris et Argenteuil testent le stationnement connecté

6.3.2 S+LOADZ pilot: Paris

The city of Paris have disseminate the project in the local media in multiple journals and newspapers including the following:

1. Strategies Logistique on-line magazine

Article **Chargement et déchargement à Paris : Parkunload évolue**

Available at: https://www.strategieslogistique.com/Chargement-et-dechargement-a-Paris,12716

Figure 100. Article Chargement et déchargement à Paris : Parkunload évolue. 1. Strategies Logistique, 2022

2. Smart city on-line magazine

   Article **Logistique urbaine : Paris et Argenteuil testent le stationnement connecté**

   Available at:

   http://www.smartcitymag.fr/article/1150/logistique-urbaine-paris-et-argenteuil-testent-le-stationnement-connecte

Figure 101. Article Logistique urbaine : Paris et Argenteuil testent le stationnement connecté. Smart city, 2022

3. Actu transport logistique on-line magazine

   Article **Paris teste le stationnement intelligent**

   Available at:

   https://www.actu-transport-logistique.fr/routier/paris-teste-le-stationnement-intelligent-710006.php

Figure 102. Article Paris teste le stationnement intelligent. Actu transport logistique

4. Supply chain magazine

   Article **Paris teste le stationnement intelligent**

   Available at:

   https://www.supplychainmagazine.fr/routier/paris-teste-le-stationnement-intelligent-710006.php

Figure 103. Article Paris teste le stationnement intelligent. Supply chain magazine

5. Supply chain journal. N°3652.

Article: AIRES DE LIVRAISON Parissemet au stationnement intelligent avec S+LOADZ

Supply Chain

PAYS :France
PAGE(S) :3-4
SURFACE :21 %
PERIODICITE :Quotidien

JOURNALISTE :Ad

▪ 9 novembre 2022 - N°3652

AIRES DE LIVRAISON

Paris se met au stationnement intelligent avec S+LOADZ

Paris va expérimenter pendant six mois l'application de gestion de zones de chargement/livraison du projet S+LOADZ. Développé dans le cadre d'un appel à innovation lancé par l'organisme européen EIT Urban Mobility en 2021, ce projet s'appuie sur une plateforme et une application mobile développées par la start-up espagnole Parkunload. Dotés de ces solutions, les communes peuvent réguler, contrôler, surveiller et analyser leurs zones de chargement/livraison afin d'augmenter la rotation des véhicules, réduire le stationnement illégal, établir des avantages spéciaux pour les véhicules à faibles émissions ou encore définir des réglementations spécifiques en fonction de l'heure, du type de véhicule et de la capacité d'absorption du flux de la zone concernée. Parkunload régule numériquement les zones de stationnement au moyen de son application mobile et de dispositifs Bluetooth installés sur les panneaux de signalisation délimitant chaque zone. Dans la capitale, la solution concernera 160 zones de stationnement pour activités de chargement/déchargement dans le 10ème arrondissement. Mais Paris ne sera pas la seule commune à tester la solution. Celle-ci a déjà commencé à être testée ou va l'être à Argenteuil (Val d'Oise), ainsi que dans la commune espagnole de Vic (Catalogne) et à Ankara (Turquie). Toutes ces entités font partie du consortium constitué autour du projet S+LOADZ, qui comprend aussi 5 partenaires commerciaux (Parkunload, Factual Consulting, Artech, Fermvial, Keita Mobility) et 2 centres de recherche (université Gustave Eiffel, Fraunhofer-Gesellschaft). **AD**

S+LOADZ a déjà commencé à être testé dans la commune espagnole de Vic (Catalogne).
© DR

Figure 104. AIRES DE LIVRAISON Parissemet au stationnement intelligent avec S+LOADZ. 5. Supply chain journal. N°3652, 2022.

6. **L'Officiel.** Page 38. Diffusion 827

Article: Paris et Argenteuil testent la solution S+LOADZ

l'Officiel

PAYS :France
PAGE(S) :38
SURFACE :47 %
PERIODICITE :Hebdomadaire

DIFFUSION :8627
JOURNALISTE :Antoine Oufeu

▪ 18 novembre 2022 - N°3133

STATIONNEMENT CONNECTÉ

Paris et Argenteuil testent la solution S+LOADZ

Figure 105. Paris et Argenteuil testent la solution S+LOADZ. L'Officiel , 2022.

Apart from the digital media, the city of Paris also prepared and distribute continuously a leaflet for drivers, which includes relevant information over the pilot and the instruction of how to use the App.

Figure 106. Leaflet of Paris for S+LOADZ pilot

6.3.3 S+LOADZ pilot: Vic

The main communication channel of the city of Vic regarding the project is its official website, specifically its mobility page. As shown in Figure 107, the mobility website of the municipality has included a direct access button to the pilot information, highlighted in the most relevant news section. From there, all citizens or interested parties could access a S+LOADZ pilot' dedicated webpage, which included all information related to the S+LOADZ pilot project (see Figure 108).

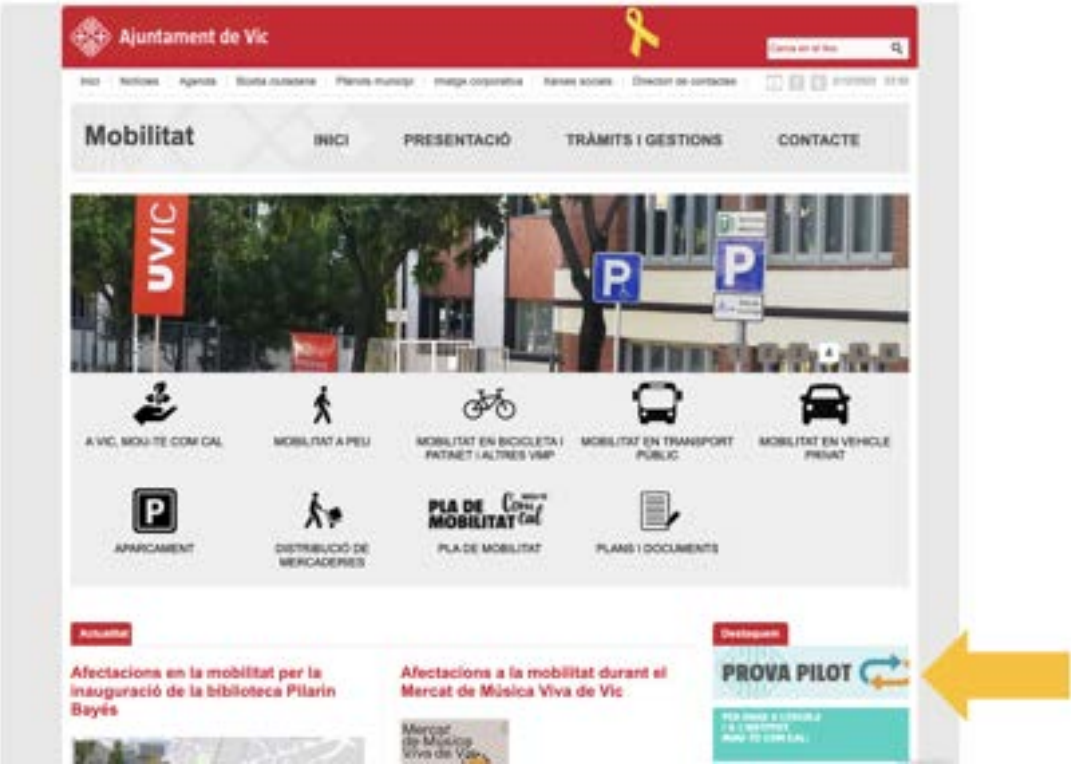


Figure 107. Mobility website of the city of Vic

Figure 108. Dedicated webpage for the S+loadz pilot in Vic

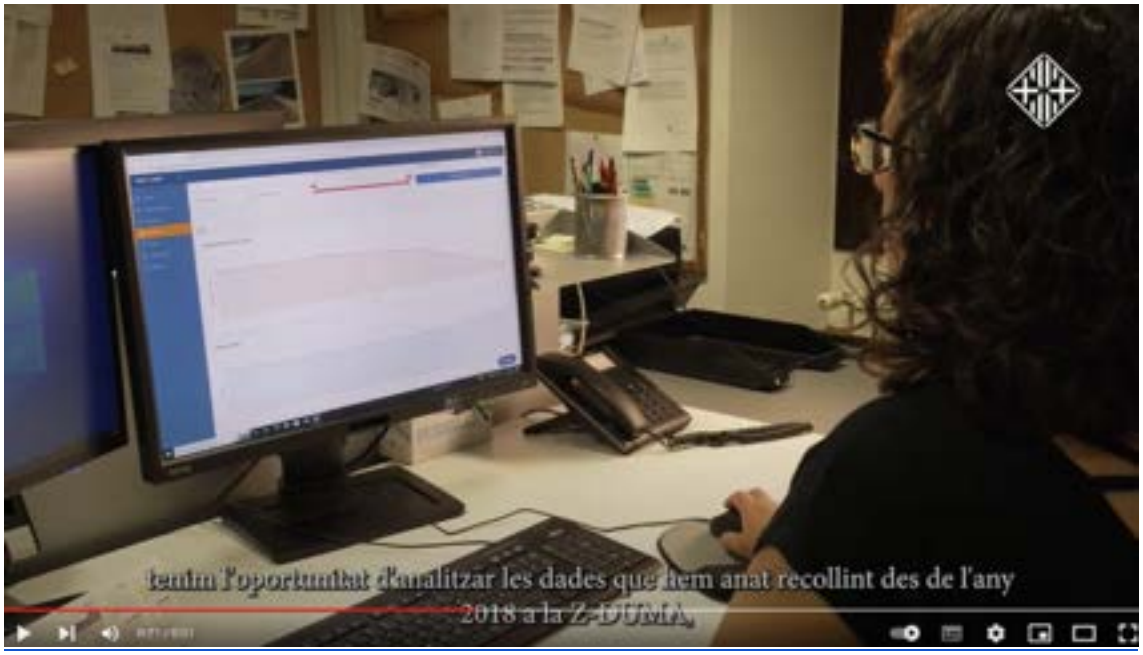
In the dedicated website of the project, the city of Vic has include four videos developed to explain detailed each of the 4 pilots:

1. Pilot project pharmacies (See https://www.youtube.com/watch?v=EnImQQQkC28)

2. Pilot project for commercial activities in pedestrian areas (See https://www.youtube.com/watch?v=YYwG47PNJf8)

3. Cargo-bikes' pilot project (See https://www.youtube.com/watch?v=PXRHa2VMnjA)

4. Pilot project for the collection of environmental information on freight vehicles (See https://www.youtube.com/watch?v=k8rHZgadkCc)



Additionally, the city of Vic has also disseminated the project to main stakeholders in their local newspaper (See Figure 109) and specific stakeholders meeting (See Figure 110)

Figure 109. Article of the S+loadz pilot in the local newspaper of Vic

Figure 110. S+LOADZ' Stakeholders meetings in Vic

Apart from this, the city of Vic prepared a printed flyer for the drivers, citizens, and local commerce, to inform them about the pilot and give them clear instructions over the use of the App.

Figure 111. Leaflet from Vic for S+LOADZ pilot

6.3.4 S+LOADZ pilot: Ankara

On April 27th of 2022, the Mayor of Ankara Metropolitan Municipality, Mansur Yavaş, together with BELKA and Artech International held a socialisation event in the Ankara Wholesale Market, to disseminate S+LOADZ' pilot objectives and gain the trust of the key stakeholders

Figure 112. S+LOADZ' dissemination event at Ankara' wholesales market

To continuously disseminate the project, the Ankara team used a leaflet printed in the local language, delivered on the ground to all drivers for several weeks.

Figure 113. Communication leaflet Ankara

6.6 Assessment of communication activities

The results of the communication and dissemination campaign are compared below with the initial target values agreed with the EIT Urban Mobility.

Communication indicator	Target value	Reached value	Assessment
Number of visits S+LOADZ S+LOADZ website	100	550	**Over performed**
Number of news created the Website	6	15	**Over performed**
Number of appearances of #S+LOADZ hashtag in social media	20	24	**Over performed**
Number of Press Releases /City	2	4	**Over performed**
Dissemination video	0	1	**Over performed**
Number of internal/external events to create awareness of S+LOADZ	4	7	**Over performed**

Assessment of S+LOADZ communication campaign

7 Results

Living Labs results

The S+LOADZ consortium articulated its ambition in terms of the number of sustainable loading zones it would deploy – setting an ambitious objective of 280 zones. Table 1 presents the deployment achieved in terms of operational new zones. A total of 130 new zones have been deployed in four cities across three EU countries. Table 1 shows the numbers of tickets and driver APP users achieved during 6 weeks of the first months of operation. Making the pilots operational, and having results within a 12-month project, represents a considerable achievement. The Living Lab chapters tell the stories behind these figures; it is apparent that the ambitions of those sites that started from scratch were excessive. In the case of Ankara work started by translating the solution into Turkish, and a pilot new use-case (zones at the Metropolitan Wholesale Market) was achieved. In the case of Metropole du Paris, a public selection process was required prior to starting the collaboration with the city of Argenteuil.

Table 18. S+LOADZ new zone deployments with operational KPIs for the initial 6 weeks of operation

	Vic (Spain)	Ankara (Türkiye)	Argenteuil-Métropole du Grand Paris (France)	Paris-District X (France)	Total 2022
S+LOADZ	27	2	20	81	130
Deliver tickets	679	35	27	175	916
Driver App users	319	13	17	80	429
No. Vehicles	339	13	17	83	452

Part of the success of the project is attributed to having a mix of cities with different levels of experience / engagement with ParkUnload's solution. This is seen in Table 18 where the new zone deployments are presented in the context of the cities' on-going efforts to deploy and manage smart digital kerbsides. The addition of 130 new zones is a significant push forward when it is seen as an addition to a base figure of 165 zones. Of primary significance is an appreciation of how two new types of zones have been defined and piloted in Vic adding to the 28 loading zones which were made fully operation (i.e. warden APP also fully deployed) to achieve a city-wide smart zone pilot, and the fact that Paris continues to work on the pilot it had previously made in District IV (such that there are over 250 zones where data is being collected to figure out how to amend national regulation and facilitate a fully digital system deployment - including APP-based enforcement).

Table 19. S+LOADZ total deployed zones with operational KPIs for 6 weeks of operation in Oct/Nov. 2022

	Vic (Spain)		Ankara (Türkiye)	Argenteuil-Métropole du Grand Paris (France)	Paris (France)		Total
	Existing zones	New zones			Existing zones: District IV	New zones: District X	
S+LOADZ	28	27	2	20	137	81	295
Deliver tickets	9935	679	35	27	613	175	11464
Driver App users	1638	319	13	17	207	80	2274
No. Vehicles	1839	339	13	17	221	83	2512

Table 19 reflects a "work in progress", and the operational KPIs are expected to evolve as cities continue with their deployment strategies. However, already it is clear that with thousands of users making tens of thousands of registrations a Big Data Tool is needed to facilitate the management of digital kerbsides. In terms of product development, this is an important part of what has been achieved in S+LOADZ; glancing through the chapters of the Vic and Paris Living Labs it can be appreciated how this new Big Data Tool constitutes an important improvement of the IoT platform - assisting practitioners to take the next steps in adjusting configurations or other actions to bring about digital kerbside services in their cities.

Communication results

The project was widely communicated at the local level of each living lab, disseminated in person by each of the city councils and through the local media. The S+LOADZ website was widely used to communicate project progress and the general idea of S+LOADZ. The consortium partners also disseminated the project results at multiple conferences and the commercial partners disseminated their product at relevant events, such as the Smart City Congress.

Product development results

The core KPI of the project, to develop a marketed innovation, was achieved satisfactorily. The commercial partner Parkunload has created and tested an innovation in their existing platform, the dashboard for cities, which allow cities to manage, follow up and evaluate the deployment of loading/delivery zones. The surveys showed that the design of the APP is appreciated by drivers – further endorsing the high APP rating, and the interviews with cities showed that there is a high interest in data driven decision making supported by the cities' dashboard. In addition, it should be noted that the pilot tests within the framework of S+LOADZ have shown that this product can be adapted to different control needs in different areas and for different users: it is an application that allows multiple uses of parking control.

8 Conclusions and Lessons learnt

From the one-year project S+LOADZ, we can summarize the following main conclusions and learnings:

- The kerbside management has become a pressing problem, supported by the unrestrained growth of e-commerce, which has led to increased congestion, pollution, and misuse of public space in city centres. Solving this problem effectively is a relevant task for European cities.
- It is possible to manage, control and follow up the loading zones with digital solutions, such as Parkunload. However, it is important to keep in mind that the digitisation of loading/delivery activities implies a new behaviour among drivers, traffic officers and policy makers, so adoption rates are time-dependent. Whilst the implementation of new kerbside regulation is a time-consuming process, the S+LOADZ approach has achieved significant results within the project – results that are expected to become more visible in the medium term.
- S+LOADZ pilot has proved that the Parkunload solution can support different configurations of use-cases – extending the range of users who can be managed at kerbsides and even controlling parking spaces at markets.
- A common success factor among the pilot cities is political will, strong support from traffic officers and a comprehensive communication campaign, which spreads the word about the project and educates end-users in the use of digital tools.
- Each living laboratory is unique, so when implementing S+LOADZ, each city must take into account its own local characteristics, regulations, administrative procedures and culture.
- Digitising loading and delivery activities and collecting this data, which was previously not available to cities, is of great value for urban planning and project monitoring.
- Modifying a regulatory framework, where the driver's APP is mandatory to use the zones, and the traffic agents' APP enforces it, has proven to be a very effective measure to facilitate the implementation of S+LOADZ. In the current project, only Vic was able to do this, and the results (highest levels of APP usage and zone registrations) reflect this. The enforcement effort (200 penalty fine notices per month) made at the existing zones during the first semester (see Vic Baseline) is identified as one important factor behind the good levels of APP uptake and use in the tables above. When the system is set-up as in Vic the enforcement tasks is largely a simple task of issuing penalty fine notices to vehicles not using the APP (only 3% of penalty notices are for overstays).
- The results of the project shows that the design of the APP is appreciated by drivers – further endorsing the high APP rating.
- The 12-month timeframe was a major challenge. Even in Vic, which had experience from two previous phases of zone deployment, a major effort was needed to develop the results in time, as the pilot involved a change in the status quo of its loading zones, from single users (delivery drivers) to multiple users of the zones, from one type of vehicle to multiple types of vehicles including cargo-bikes, and from parking spaces to parking zones, which implied new challenges of coordination and communication to the new stakeholders. The French cities faced additional administrative challenges to select the zones, selecting the city of Argenteuil and selecting District X in the respective cases of Metropole du Paris and Mairie de Paris, apart from the enormous effort needed to align and communicate with all stakeholders.
- As the solution is extended by medium-sized cities – or is piloted by big cities such as the French Capital – the need for integrating a Big Data Tool has become manifest. The challenges of developing a (digital kerbside) process for a the metropolis like Paris cannot be fully tackled in a 12-month pilot project, but:
    - Establishing multiple pilots including hinterland cities is a key step forward

    - Finding a configuration that adapts to the current regulatory framework and demonstrates added value is another.
- The deployment of 130 new smart loading/parking zones in collaboration with the solution provider and other experts means that four EU cities are managing almost 300 zones to involve almost 2,600 drivers in realising over 12,000 kerbside registrations during six weeks in October / November of 2022.
- Digitally-managed kerbsides and parking spaces are a good way of rationalising the services cities provide to users of vehicles in streets where the various demands for space create tensions. As a result of S+LOADZ, there is increased knowledge about how cities can set-up, deploy and fine-tune pilot smart loading zones – even when the regulatory framework is not supporting a mandatory use of the (driver) APP. The toolset is extended – both in terms of the ways the data is presented to practitioners (including the zone-use breakdown by vehicle emissions categories) but also as a result of an integrated management of environmentally-friendly vehicles such as electric cargo-bikes

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10 Annex List

1. Vic evaluation instruments
2. Paris evaluation instruments
3. Ankara evaluation instruments
4. Métropole du Grand Paris (Argenteuil) evaluation instruments
5. S+LOADZ brand guidebook