

Senator

Smart Network Operator Platform enabling Shared, Integrated and more Sustainable Urban Freight Logistics

[D8.7] RAR. Regular Activity Public Report -
year 4



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List of abbreviations

ABBREVIATION	TERM
AI	Artificial Intelligence
CEF	Connecting Europe Facility
DALY	Disability-Adjusted Life Year
DL	Deep Learning
DSI	Digital Service Infrastructures
EC	European Commission
EDA	Event Driven Architecture
GA	Grant Agreement
LCA	Life Cycle Assessment
LCC	Life Cycle Costing
LEZ	Low Emission Zone
MCDA	Multi Criteria Decision Analysis
ML	Machine Learning
PO	Project Officer
RP1	Reporting Period 1
SDA	Service Driven Architecture
SDG	Sustainable Development Goal
SECAP	Social Environmental and Climate Assessment Procedures
SotA	State-of-the-Art
SULP	Sustainable Urban Logistics Plan
TSP	Traveling Salesman Problems
UCC	Urban Consolidation Centres
ULL	Urban Living Lab
VM	Virtual Machine
VRP	Vehicle Routing Problem
WP	Work Package

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1 Executive Summary

Within the monitoring of the project implementation strategy of SENATOR, a set of 4 Regular Activity Public Reports are planned to be developed as deliverable documents to delivery to the European Commission (EC) in months 10, 22, 34 and 46 (*i.e.* according to SENATOR's Grant Agreement (GA)). Those documents aim to monitor the technical progress of each Work Package (WP) during the project lifetime.

The current deliverable D8.7 "*RAR. Regular Activity Public Report – year 4*" is a single document that summarises the main advances in all the WPs during the first 33 months of the project. All SENATOR partners have been involved in the preparation of D8.7, highlighting the progress done and identifying delays or major problems detected. The document includes also upcoming risks to allow preparing the countermeasures.

2 Introduction

2.1 Purpose

The main objective of the deliverable D8.7 “*RAR. Regular Activity Public Report – year 4*” consists of giving an overview of the work done during the first 45 months of implementation of the project, that is, until the end of May 2024. This overview describes the technical progress, which includes tasks developed, results and deliverables, as well as the monitoring and updating the identified risks. Furthermore, this deliverable lists the specific objectives of each WP, compliance with the WP schedule, comments on the milestones that have been accomplished and deviations from Annex 1. All this information is included in Section 3.

The description of deviations has been made considering the current official version of the GA approved by the EC.

2.2 Relation to other project documents

This deliverable is in consonance with the deliverables D8.3 “Project Management Handbook: Quality Plan - second update” and an updated version of D8.4 “*RAR. Regular Activity Public Report - year 1*”, D8.5 “*RAR. Regular Activity Public Report - year 2*”, and D8.6 “*RAR. Regular Activity Public Report - year 3*”.



3 Work carried out in the last 33 months per WP

3.1 WP1 - Use Case definition and requirements analysis

3.1.1 WP objectives

WP1 proposes to set-up the project infrastructure that will shape the cornerstones of the solution in the definition of the use cases to be tested. Identifying and defining the operational needs and requirements, as well as the physical and technological security needs to be developed in the pilots of the project. The use cases in this WP have been at a high-level definition, having to expand some of the requirements in the definition of the pilots and their development within WP5, for the most specific solutions to be tested. This has been due to delays in obtaining information and difficulties in starting the project, but it will not delay the overall development of the project or diminish the quality of the results.

WP1 aims to:

1. Define the user needs for the use cases.
2. Define data requirements and data harmonization for the SENATOR Platform including its data acquisition layer per vertical domain.
3. Identify suitable storage means for data- and meta-data storage as well as event persistence.
4. Assess IT requirements such as SDA, EDA, data storage mechanisms, information flow, but also performance and availability needs.
5. Define security requirements of data within the platform like digital passport definition or Digital ID (for all actors involved: citizens, vehicles, logistics workers, etc.).
6. Assess security requirements and ensure cloud-compliance of the solution to the SENATOR architecture.
7. Address physical security constraints that play a major role in the SENATOR context.

3.1.2 Work progress and achievements during the period covered

WP1 started in M1 (September 2020) and finished in M12 (August 2021). It consists of three completed tasks. During the period covered by this Regular Activity Report, WP1 had no development and all the information regarding this work package can be found on deliverable

8.6 “Regular Activity Public Report - year 3”



3.2 WP2 - Operation & Execution for dynamic planning using simulation and learning

3.2.1 WP objectives

The purpose of WP2 is to research the SOA and investigate solutions that support smart logistics, e.g. that enable simulation of routes, optimization of delivery schedules or the prediction of future events considering knowledge of the past.

WP2 focuses on the design and development of the dynamic planning module of SENATOR, aiming to:

1. Review the SoA in dynamic planning of last mile logistics and defining a set of benchmark instances and data sets, as well as baseline of performance for optimization and machine learning algorithms;
2. Design and implement a novel optimization model for dynamic planning of last mile logistics, which will allow dynamism, simultaneous optimization of various objectives considering the user's preferences and to adjust the robustness of the solutions provided according to the users' risk aversion profile;
3. Design and developing an advanced resolution algorithm to solve the previous model based on hybrid metaheuristics and novel distributed computation frameworks;
4. Develop new Machine Learning algorithms to identify potential improvements for network and urban planning;
5. Develop a simulation tool for scenario assessment and decision-making support in policy making and SUL&MP definition.

3.2.2 Work progress and achievements during the period covered

WP2 started in M3 (November 2020) and officially ended in M27 (December 2022) with the delivery of D2.5. During the period covered by this Regular Activity Report, WP2 had no development and all the information regarding this work package can be found on deliverable **8.6 "Regular Activity Public Report - year 3"**.

3.3 WP3 - ICT platform integration and services implementation

3.3.1 WP objectives

WP3 was foreseen to develop the main result of SENATOR project infrastructure. The ICT platform integrates and implements the services, the data acquisition layer and internal messaging bus and data flows interchange systems, as well as data visualisation and monitoring tools for operation and execution of logistics in real-time.

It must be aligned with the results of the previous work done at WP1 and the background modules of the data processing and dynamic planning that are themselves being developed within WP2.

Expected results will be ready at the end of the WP, whereas the 4 modules will be fully developed providing the following outcomes: 1) On-demand Platform manager OPM (state of freight, position, collection point for receivers), 2) Multimodal Fleet Manager MFM (availability, capacity status), 3) Smart Routes Manager SRM, (Position, Shippers info, demand, capacity status for logistics operators and shippers) and; 4) Diagnosis of Urban Infrastructure DUI (parking, traffic restrictions, council regulation for infrastructure managers).

WP3 aims to:

1. Design, develop and integrate the ICT components that constitute SENATOR platform, mainly: i) the common resources of the platform in charge of guaranteeing the optimal persistence of the data and providing the synchronous/asynchronous mechanisms that guarantee the appropriate communication for each distributed microservice; ii) The four main services that make up the SENATOR platform (1) OPM, (2) MFM, (3) SRM and (4) DUI.
2. To develop and implement the global Dashboard of the platform SENATOR including a visualization tool supported on open-source GIS.

In this period (covering from M35 to M46), the initial objective was to finish the documentation as the work package should have ended at M36 with the submission of deliverable D3.7 “SENATOR ICT Platform and Services Integration. Release 2” in September 2023. Unfortunately, as was advanced in the previous Regular Annual Reports (months 22 and 34), there have been unresolved incidents that have impacted directly and delayed the work of Tasks T3.3 Global Dashboard and User Interface implementation and T3.4 Implementation and ICT integration for months, and in the last 12 months, efforts have been invested in finishing the pending functionalities to be included in the final release of the SENATOR platform. This milestone is planned to be ready at the end of summer 2024.

So, in the current planning of this work package, the work done within the two aforementioned tasks, mainly from T3.4, has been focused on addressing the execution of pending tasks and the subsequent adjustments that have arisen from the tests and results of the first attempts of Pilots (within WP5).

3.3.2 Work progress and achievements during the period covered

The WP3 started at M3 (November 2020) and was expected to be completed at M37 (September 2023). It is formed by 4 tasks, of which T3.1 and T3.2 were completed as stated in the Regular Activity report of second year of execution, and the other two T3.3 and T3.4 are active and ongoing at the time of this reporting. As advanced before, the development has suffered major delays that have affected other parts of the works within WPs that depended on this one, such as WP4, WP5 and WP6.

Task 3.1 Definition of system architecture

Status: Completed. The work started at month M3 (November 2020) and finished at 13 (October 2021).

The main objective of this task was to agree the internal architecture of the SENATOR platform and the specification of the four services to implement in the framework of this project, as said, (1) On-demand Platform manager, (2) Multimodal Fleet Manager, (3) Smart Routes Manager and (4) Diagnosis of Urban Infrastructure. To do that, work to land the services requirements to IT concrete specification was made, also to theoretically describe the main components of the SENATOR ICT platform and design them, including relations between each module, data flows security and the visualization of the information to be provided to the users.

The design efforts were focused on content and benefits the module itself construction, services implementation tasks and their further validation and improvements in consequent tasks. The specification and design of the overall SENATOR architecture were carried out successfully with the end result of the deliverable “**D3.1 SENATOR architecture and detailed design**” was submitted to the commission for evaluation at month 13 (October 2021) and was accepted in June 2022.

Task 3.2 Data acquisition and Messaging Layer

Status: Completed. The work started at month 12 (August 2021) and finished at month 21 (May 2022).

The objective of this task was to establish the data acquisition and messaging layer as the information interchange backbone of the SENATOR platform. It further aimed to develop, customize, or and integrate software modules that guarantee optimal data persistence and reliable communication using synchronous and asynchronous protocols. The fulfilment of this objective was one of the corner stones of T3.4 “Implementation and ICT” integration which is supported by the definition of the data layer including messaging and acquisition.

As messaging interchange tool, the commercial solution of Software AG called Universal Messagingⁱ was deployed and customized on the SENATOR requirements. This solution allowed real-time streaming of multiple sources with very low latency using a light-weight protocol such as MQTT supporting diverse data interchange formats. In M21 the technical infrastructure for data handling was deployed and ready to use. During the following 6 months it was active, but the use case providers and their data privacy restrictions forced it to be replaced by an open-source solution called RabbitMQⁱⁱ in November 2022.

The task was considered as finished then, and achievements as done. As result of all the efforts Deliverable **D3.2 “SENATOR data acquisition and messaging layer”** was produced, submitted to review in May 2022 and approved by the commission in November 2022. The remaining discussions on information and details of data continued having a direct impact on the definition of data storage in terms of where (it will be stored) and how (adjustments to the current data model). This was covered from then onwards within T3.4 as described in the regular annual report year 3, submitted in M34.

Task 3.3 Global dashboard and User Interface implementation

Status: **Ongoing.** The work started at month 15 (November 2021) and it should have been finished at month 26 (October 2022) but is still ongoing at the writing of this report.

This task was divided in two main subtasks, including the design of all software components for the development of the visual information visualization tool (namely SENATOR Dashboard). These differentiated subtasks are the following:

- ST 3.3.1 Implementation of dashboard for real-time and last minute
- ST 3.3.2 Data visualisation tool and real time system for monitoring and control

Both subtasks intended to take a coordinated approach to implement an open-source GIS based frontend application for the user interaction with data, in order to show and update the logistics operations in real time in the cities. The most important aspects considered for this subtask were to accomplish the main objectives of the project, facilitating more efficient, sustainable and accessible logistics operations within the scope of a city through a usable and smart web application.

Deliverable **“D3.4 Dashboard code”** was submitted in July 2022 with 1 month of delay over the expected date because of the delays accumulated in the immediately previous one (D3.3). The following one **“D3.5 Dashboard delivery and user manuals”** was presented in October 2022. These two accomplishments should have been the proof of ending of developmental core work related to this task.

As previously mentioned on the annual follow up reports (M22, M34) and the last periodic report (M38), even when the work should be finished by November 2022, the expected implementation was not completed then. After lots of warnings, meetings and failed attempts, during 2023 DOTGIS made a commitment to speeding up its work in order to

complete the related to T3.3 milestone as soon as it was possible. Deusto as WP leader and Correos as coordinator of SENATOR and potential user of the platform, have been closely working as a team with DOTGIS through weekly meetings and delivery reviews to ensure compliance with the required scope. The pending functionalities have not been solved at the time of writing this report, Therefore the full objectives of this task have not been reached up today and are still pending in May 2024(M46). In this period the work has result on the first version of almost fully functional Front-End application that can show most of the expected information that the project needs to provide. From M35 until today the efforts addressed the end of all pending functionalities, such as users access and session management and SENATOR main services at least from the logistic operators' point of view. To do so, changes in the previous design and modifications in the developed wireframes were needed, as well as a real time management of the incoming information through the messaging bus, in order to update data in map. Deusto and DOTGIS worked together to include new functionalities. More detail in the next paragraphs.

OPM - On-Demand Platform Manager

This service aims to provide the end users of the SENATOR platform with a tool to visualize, consult and manage all the shipments to be delivered in a day by the logistic operators.

The status al month M34 was preliminary, parcels and packets to be delivered were shown in the map, but were not listed or able to be downloaded by that date. The current version of the Dashboard provides a GIS based visualisation that allows at a glance be aware of the global volume and particular characteristics of each shipping (origin and destination address, length, size and volume, delivery preferences, etc) to be moved in the city and differentiate if they are pick up or delivery actions (Figure 1).

Also, the Web application offers a tool to manually register new items in the platform, as can be seen below (Figure 2). This functionality is needed to test dynamism and automatic replanification, part of several pilots within WP5. It will be addressed properly in the next section, related to the work done in task T3.4

MFM - Multimodal Fleet Manager

The objective of this service is offering operators a graphical interface that will allow access to all the available resources of their own, susceptible to being used by SENATOR to optimise the logistic operation in the city. These resources must be understood as their managed operational infrastructures (as depots or UCCs) and fleets (vehicles and postmen/postwomen) associated to each previously mentioned infrastructure.

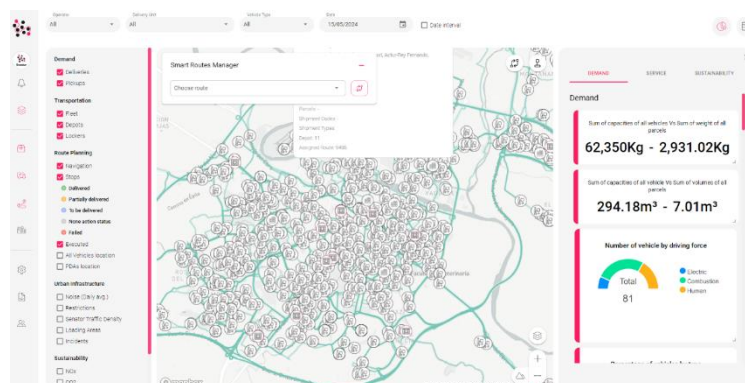


Figure 1: Current version of OPM visualization module and KPIs panels

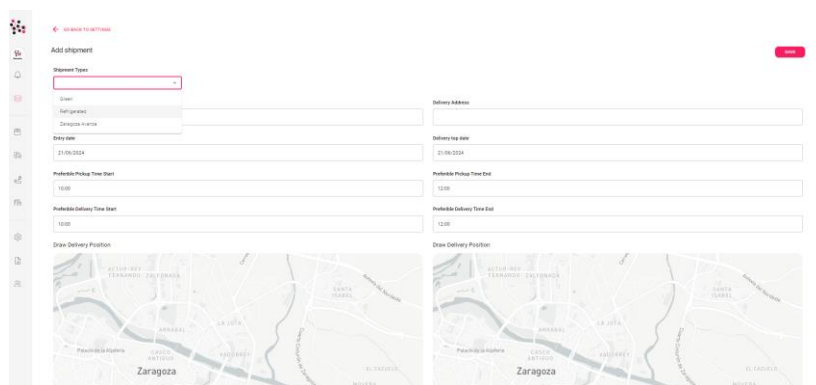


Figure 2: Add new shipment feature

At month M34 this service was not implemented in the Dashboard. There were no graphical nor static (Table) visualization for these kinds of resources. Now it can be considered as complete. In the next figure, the current status can be shown, with a capture of the list of available resources for Dublin and Zaragoza use cases can be seen respectively (vehicles Figure 3 and Figure 4, parcel lockers Figure 5)

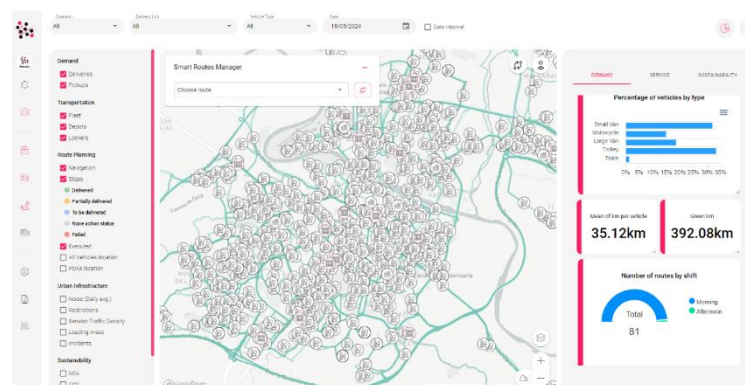


Figure 3: Current version of MFM visualization module and KPIs panels

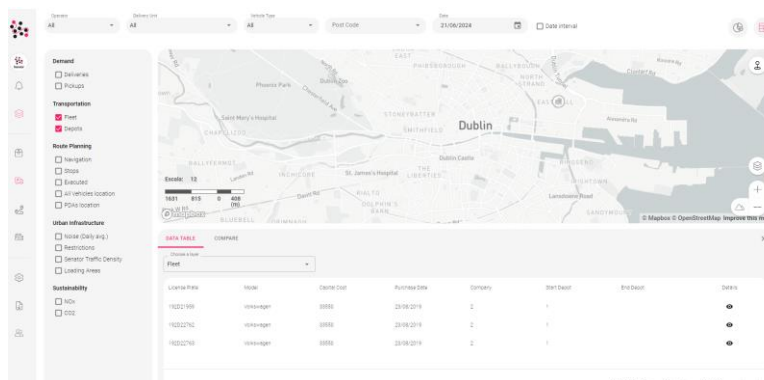


Figure 4: MFM: Fleet table visualization for Dublin use case

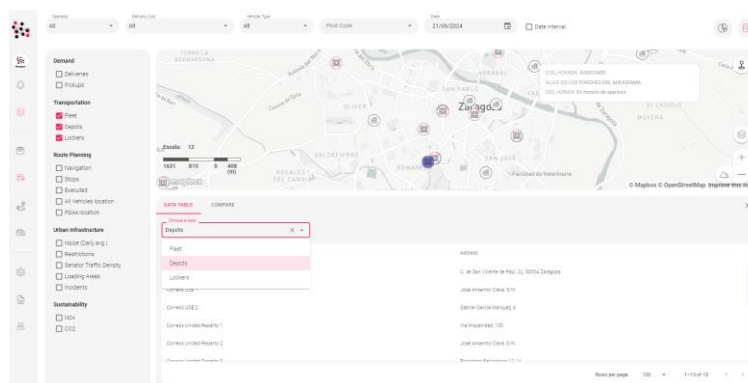


Figure 5: MFM Depots visualization (map and table) for Zaragoza Use case

A console has also been implemented in order to ease the management of the participating companies' fleet. This way, the system provides a tool to register new vehicles and enable or disable the existing ones in case of necessity or incident (Figure 6).

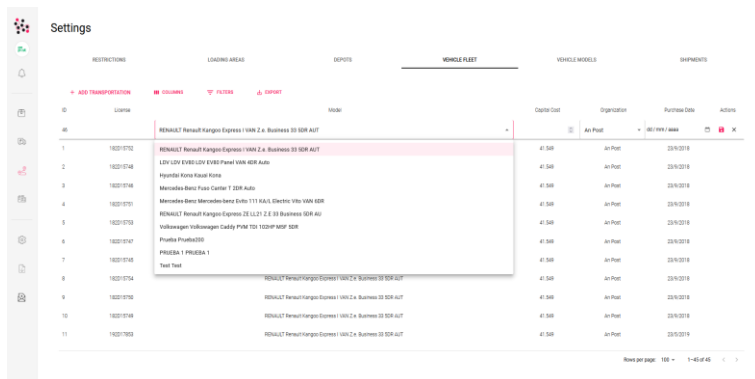


Figure 6: Figure 14: MFM configuration console (Dublin use case)

SRM - Smart Routes Manager

This service aims to become the tool for operators and transport agents to monitor planned and ongoing routes, providing mechanisms to develop dynamic and automatic re-planning when incidents and alterations occur in foreseen operation. This subtask included the

definition of the information architecture and layout that are part of the user experience, enabling accurate follow up of fleets (Position, Shipper's info, real time capacity status) and loads (success and failed deliveries, Pick-ups, transfers between logistics operators and shippers).

At month M34 this service was a work in progress, it was not implemented in the Dashboard. There were no graphical nor static (Table) visualization for the planned routes by the system (optimization module) nor a way to see the executed ones by the logistic operators in the consortium.

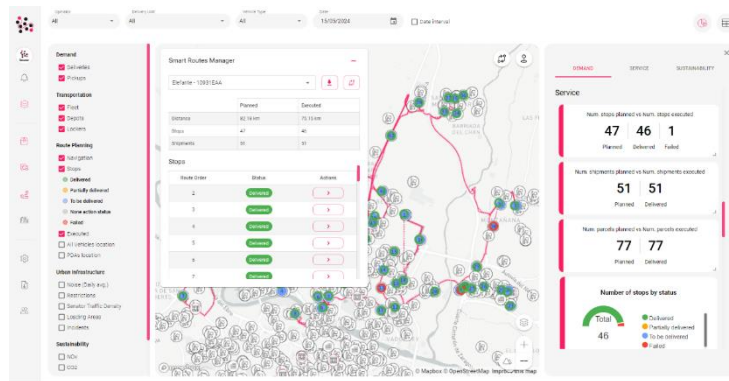


Figure 7: Current version of SRM visualization module and KPIs panels

As can be seen now (Figure 7), when a planned route is selected information related to the vehicle, load and planned vs. executed navigation (stops, route) details are shown. Note the current status of the Dashboard exposes mostly synthetic data, but is prepared to receive real time information, coming from IoT Devices or vehicles (for further details see next section) and differentiate between foreseen operation (continuous line) and really performed execution (simulated, dotted line) until current time.

All this information can be consulted for previous days and filtered by date, company and other concepts. It can be completed with the related KPI calculations, also available to export, this feature is currently under revision by DEUSTO to validate it.

If selected one route, the user can access to the specific details of its execution (historic information if it corresponds to a route already finished or real time information if is the current operation) and the planification SENATOR provided at the beginning of the day for the same route (Figure 8).

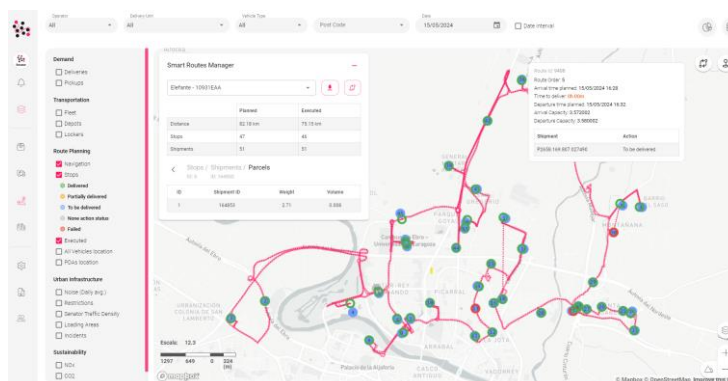


Figure 8: Real time monitoring of a route (planned and executed) for Zaragoza use case)

The delivery actions performed also are accessible in a visual manner, when a parcel has been successful delivered it is marked in green, when the delivery failed, it is marked in red (Figure 8 shipments in stops number 13 and 30 for this example).

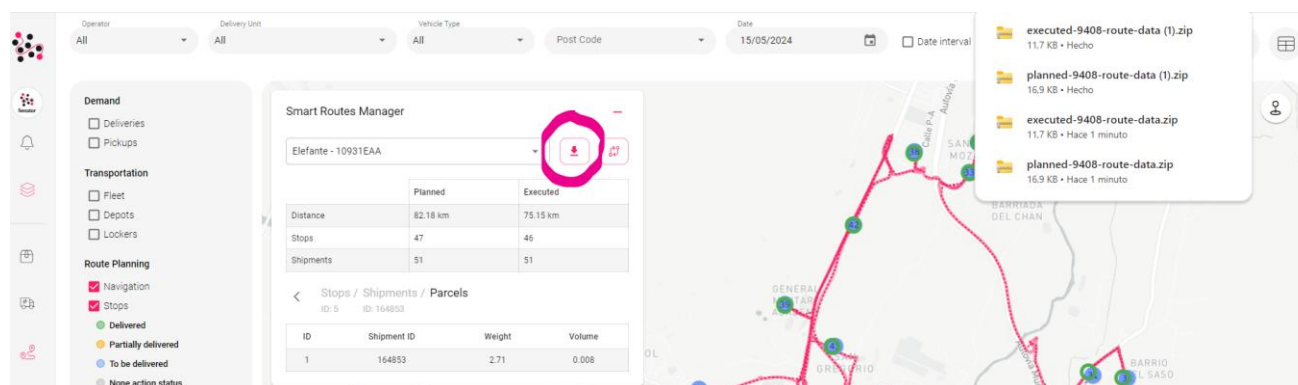


Figure 9: Downloading planned and executed routes information

The information about both planned and executed operation can be downloaded (Figure 9).

A time control has been attempted to be implemented by DOTGIS within the Dashboard itself (comparing the difference between planned and real execution time in red in the screenshot of figure 15) but it has been considered that it was not enough and can be improved so this process is being implemented by DEUSTO in the Backend within T3.4, as it is needed for incidents management. It will be described in the next section.

Due to impossibility of the Dashboard to manage the multiple routes information all together, the current version of the Dashboard can only show a maximum of three route at the same time, if the user asks specifically to do so (Figure 10).

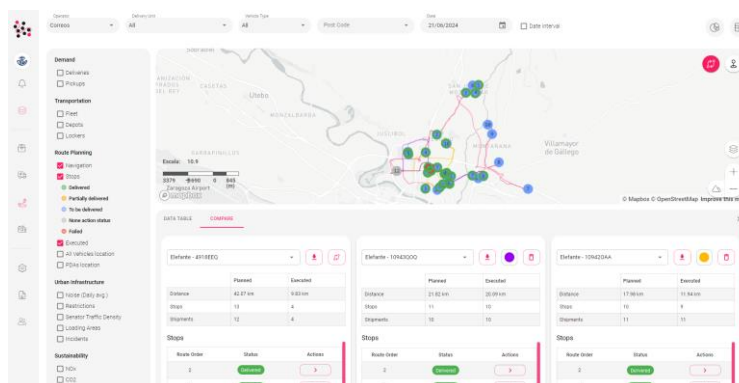


Figure 10: Comparison between three selected routes

Only a cumulative graphical representation of all the motorized routes, informative but without details is presented for both Logistic operators and municipalities' users. This functionality has been named Senator Traffic Density, intended to be as a vein map picturing the logistic movements in a city: where the delivery flux is bigger in the representation, the lines are stronger and darker, as a vascular system. Some information can be show, as it the number of motorized routes that passed by a point when selecting one point in the lines it as can be seen in figure 11).

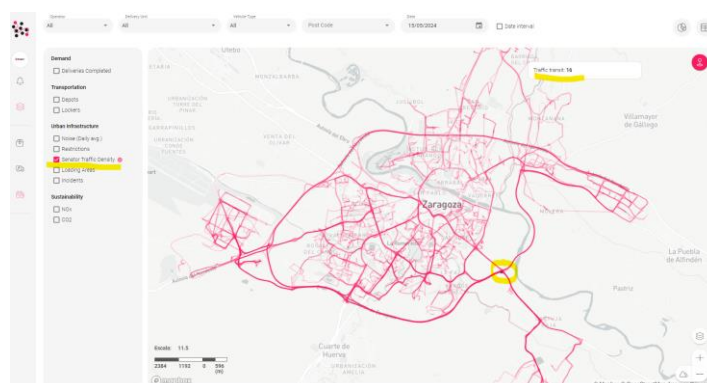


Figure 11: Senator traffic density view available for municipalities

There is no downloadable information in this last feature by the time of writing this report.

DUI Diagnosis Urban Infrastructure

The last service, dedicated to municipalities and infrastructure managers, aims to condense all relevant information generated by the Senator platform related to traffic restriction policies, municipal regulations and logistic operation impact in the city.

At month M34 this service was not designed nor implemented in the Dashboard. Only static information about traffic restrictions, loading and unloading areas and other infrastructures managed by municipalities was integrated in SENATOR platform, so the objective in this period was to implement it completely. A console has been developed to ease the introduction of new areas or modify existing ones by the corresponding authority.

To guaranteeing both privacy of information shared within the platform and to protect competition between logistic operators, strict rules and mechanism were deployed by DEUSTO within T3.4 in order to anonymize and aggregate information within DUI. Therefore, the Dashboard can provide the most useful information without compromising the sharing of sensitive data. This has been achieved through anonymization processes and the accumulation of information from T3.4 (see next section for further details), as well as the deployment of new endpoints that can be queried from the Dashboard.

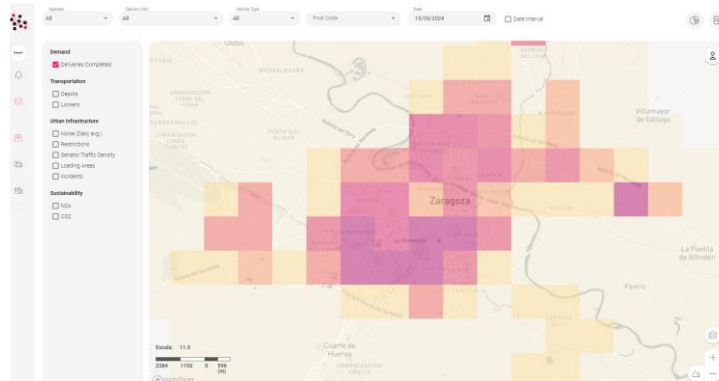


Figure 12: DUI visualization regarding successful deliveries in a day for Zaragoza use case

In the last months of this fourth annuity, by means of these new endpoints within T3.4, specific views for the municipalities have been deployed and should be ready to use and test in the next months within pilot phase (WP5).

Since February 2024, UCD is working on the integration environmental data from both living labs, and traffic information solving most of the pending integrations that have not been solved before. This will be reviewed in detail within T3.4 description.

Regarding the KPIS to be shown in the SENATOR platform, there are a list of 24 variables, agreed with the potential users and partner involved in the project, that are listed hereby:

Category	Name	Calculation
Demand	Sum of capacities of all vehicles in Kg Vs Sum of Kg of all parcels	Calculates the total maximum load capacity of the vehicles from planned routes and compares it to the total weight of parcels in the deliveries layer
Demand	Sum of capacities of all vehicles in Volume Vs Sum of volumes of all parcels	Calculates the total maximum volume capacity of the vehicles from planned routes and compares it to the total volume of parcels in the deliveries layer
Demand	Total number of Deliveries, Parcels and Weight	Compares the number of deliveries with the number of parcels and their total weight in the deliveries layer
Demand	Number of vehicle by driving force	Determines the number of vehicles grouped by the driving force model of each planned route
Demand	Percentage of vehicles by type	Calculates the percentage of vehicles for each driving force model in comparison to the total number of planned routes
Demand	Mean of km per vehicle	Calculates the average distance covered by each vehicle
Demand	Green km	Calculates the total distance covered by planned routes where the driving force model is Electric
Demand	Number of routes by shift	Determines the number of routes grouped by shift
Demand	Number of vehicles by type and occupation	Counts the total number of vehicles in the fleet data and compares it to the number of vehicles used in the planned routes
Demand	Top 5 Km per route	Arranges planned routes based on total distance parameter and selects the first five items
Service	Num. stops planned vs Num. stops executed	Compares the number of planned stops with executed stops and calculates the difference to determine the number of failed stops
Service	Num. shipments planned vs Num. shipments executed	Determines the number of shipments in planned stops layer and compares it to the number of shipments in executed stops layer
Service	Num. parcels planned vs Num. parcels executed	Determines the number of parcels in each shipment of planned stops layer and compares it to the number of parcels in each shipment of executed stops layer
Service	Number of stops by status	Determines the number of stops grouped by each stop status
Service	Number of shipments by status	Determines the number of shipments grouped by each action status
Service	Percentage of stop success	Calculates the percentage of delivered stops out of the total number of stops
Service	Percentage of shipment success	Calculates the percentage of delivered shipments out of the total number of shipments
Service	Planned Km vs Executed Km	Calculates the total distance covered by executed routes
Service	Planned time vs Executed time	Calculates the total time taken by executed routes
Service	Sum of capacities of all vehicles in Kg Vs Sum of Kg of all parcels	Calculates the total maximum load capacity from planned routes and compares it to the total weight of parcels in the deliveries layer
Service	Sum of capacities of all vehicles in Volume Vs Sum of volumes of all parcels	Calculates the total maximum volume capacity from planned routes and compares it to the total weight of parcels in the deliveries layer
Service	Total number of Deliveries, Parcels and Weight	Compares the number of deliveries with the number of parcels and their total weight in the deliveries layer
Sustainability	CO2 emissions planned vs executed	Calculates the total CO2 emissions by multiplying the CO2 emission model with the total distance of the routes
Sustainability	NOx emissions planned vs executed	Calculates the total NOx emissions by multiplying the NOx emission model with the total distance of the routes

Figure 13: KPIS available in SENATOR Platform

The KPIS Visualization for those that have to be calculated from the complete static information for each living labs or dynamically calculated depending on what is being selected/shown in the Dashboard is under review by DEUSTO, so to reduce the dependences

to access to those parameters or to assess if the calculations are correct -and if they are not, to correct them-, since the end of April 2024.

By the time of writing this report, part of SENATOR Dashboard tasks are still being executed, such as the implementation of “Events management” layers and the changes in the existing functionalities to alert users of the different events that may occur in real operation (To do).

Also, DOTGIS has been working to update the deliverable “D3.5 Dashboard delivery and user manuals” as the applications has evolved and changed since the previously refereed document, and it is expected to suffer more changes and improvements in the following weeks, so the expected deadline for submission the updated documents has been settled at the end of September 2024.

Task 3.4 Implementation and ICT integration

***Status:* Ongoing.** The work started at month 12 (August 2021) and it was foreseen to be finished at month 37 (September 2023).

During this period, covering from M34 to M46, the development of the SENATOR ICT Platform continued by ending the implementation of the general system functionalities that were developed but not tested to fully deploy the 4 main services and finishing the still pending features to reach expected outcome of the WP3, such as incident management and dynamic replanification, when it is needed.

Therefore, the main efforts have been focused on final stages of the deployment and testing of the 4 modules that SENATOR must provide (OPM, MFM, SRM, DUI) on the one hand, and on the other, on the upgrades needed both regarding to data model and endpoints to make them accessible from SENATOR Dashboard and SENATOR mobile APP. In the latest months of this period, started the final phase of dynamic replanning when incidents occur, aiming to give solution to undesirable situations that may compromise the proposed delivery plans by the optimization module.

In the next paragraphs each subtask will be presented in more detail, focusing on the work that has already been done.

Continuous Update of the data model

The current version of the SENATOR data model is in the ninth iteration (V9), presented in previous annual reports and updated in this period.

It must be noted that as most of the known particular cases of logistic operation are trying to be included, the complexity of the solution designed increases a lot. New relationships were also needed to ease the information flow towards the Dashboard, so they could use minor resources to visualize the data; as it was mentioned in the previous section, it has problems to manage or correlate huge amounts of data form different nature.

As one of the first enhanced features, users' management has been upgraded, so when a user will no longer be part of the project or of the system, it can be deleted or deactivated. This second option, aroused in those situations involving a user that, when was active, has performed relevant actions that need to be kept for audit. In this case, it cannot be simply deleted from the system, so it can be deactivated, and the result is similar to erase it, but without loss of its activity or processes' traceability.

Several new features have been added to different existing entities in the data model. For example, variables type "shipment" has been enhanced to distinguish between cold/refrigerated deliveries, common deliveries or namely green deliveries (those that could have a special treatment such as be always delivered by non-contaminant vehicles, for example). Also, they support preferable times for pickup and delivery to consider time windows in the operation. The "delivery actions" have now a new field named "substatus" so they can include various particular status in the daily operation. Parking spaces have been enhanced, to include specific features for Dublin ULL and allow accessing to their status (behalf the integration of Smart Parking service, for further details, see the section related to integrations within this section). This characteristic will be used when Zaragoza load and unload zones are also included in the system.

New entities have been added, such as Lockers tables to connect deliveries with new origin or destination points, when needed. The IoT (fleet or sensors) trackers already include a new field to get them ready to receive or send messages, getting them ready to be an active part within the incident management processes, activity that is a working progress in the time of writing this report. This new feature includes changes in the SENATOR Mobile APP and the Backend, that are described in the following paragraphs.

Upgrade of the general SENATOR backend

The implementation of the SENATOR backend was stated and almost finished in the previous years of execution, following the general architecture defined in T3.1.

In this fourth year several improvements to avoid blocks and guarantee functionality without interruptions have been addressed. Additionally, the APIs have been updated exposing new endpoints to (1) facilitate the access to the available information in the platform or (2) to expose new specific endpoints that add value to the final solution, for example those that provide cumulative information so the Dashboard could show it for users such as municipalities and guarantee that private or sensible information will not be shared with other companies.

Minor changes in the Backend of SENATOR were needed after the revision of some of the previously included data sources, such as the real-time information coming from the Correos PDAs, because of corporate changes that affected to those subsystems and the manner both systems connect and send information to SENATOR.

As advanced in previous regular annual reports, a CI/CD system was deployed, combining practices of continuous integration (CI) and continuous deployment (CD). There are two main and secured branches, one for development (for each use case/location) and another for production (when final releases are ready) with independent databases. When updated or evolutive versions are ready they can deploy in the Development framework and later on, when verified, in production.

Together with the API and by means of swagger¹ the documentation has been self-generated and is also accessible online to consultation. Both the API and its doc can be accessed at the following URLs (development branch):

<https://api-dev.zaragoza.senator.apps.deustotech.eu/api/docs/#/>

<https://api-dev.dublin.senator.apps.deustotech.eu/api/docs/#/>

Additionally, the branch for the city of Bilbao that was deployed last year, has been actively used to test developments related to the inclusion of restrictions that affect to a certain area in a city, also for the first cold pilot tests, as the data provided by Correos corresponded to this location. As has been said before, even when it is something that is out of the scope of this project, has been very helpful to facilitate the testing of the advances in SENATOR mobile APP through all the execution.

We can say now that the Production use case of Zaragoza is finally on use, not fully operative because of the daily demand is still not included in the platform, but the real time execution of distribution in the city can be currently be consulted there, at least, the operations regarding one of the Special Service units in Zaragoza, called USE 1, from CORREOS.

Briefly, the current version of the API will be reviewed in the following paragraphs. Each API was divided into four main blocks that correspond to the four SENATOR services, **On-demand Platform Manager**, **Multimodal Fleet Manager**, **Smart Routes Manager** and **Diagnosis of Urban Infrastructure**. Currently available endpoints for managing entities related to each of the services are shown in the next figures, examples of those that are new or have been modified will be only described in detail.

This capture (Figure 14) corresponds to the currently available endpoints for the **Smart Routes Manager** service; and the following one (Figure 15) can see the endpoint that returns the navigation points of a specific route.

¹ <https://swagger.io/>

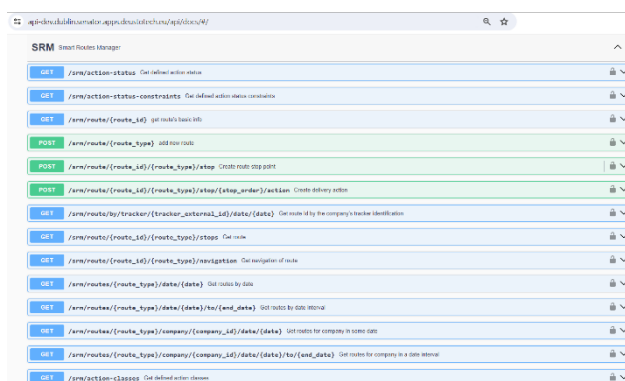


Figure 14: API for Smart Routes Manager service, use case Dublin

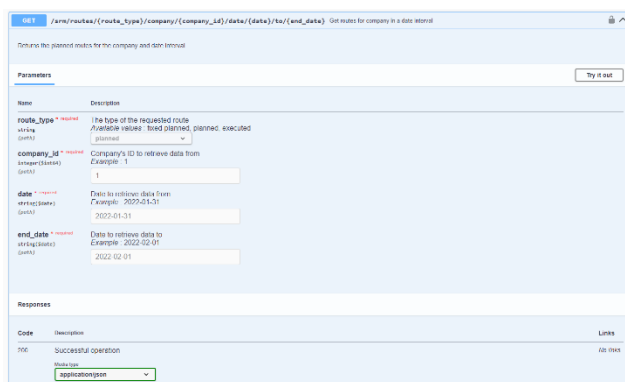


Figure 15: GET Returns the planned routes for the company and date interval case use Dublin.

The newest features included in the backend are those related to DUI service. New endpoints have been developed to allow visibility of demand or logistic movements in the city for municipalities, so they can be aware of the impact of deliveries in their cities and take conclusions or promote infrastructure changes consequently (see figure 16).

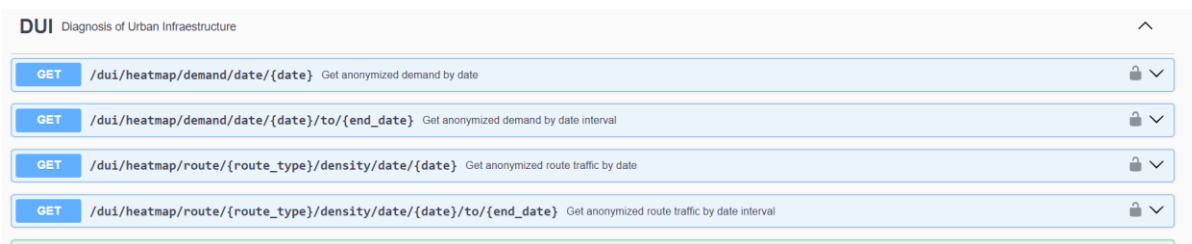


Figure 16: New endpoint created for DUI services

As the city councils do not have access detailed information regarding the planned distribution in a day, a new endpoint has been created. This service gives information of destination areas² where the deliveries are associated, without personal information (name or address of the receivers) nor shipments characteristics (type of shipment, volume, weight, dimensions) or company assigned (carrier), that are removed from SENATOR backend to guarantee secure and seamless interchange of information. The following captures (Figure

² Note that all the locations are anonymized, so the information gives account of major or minor areas of demand

17 and Figure 18) correspond to available consults that allow Dashboard to show on the one hand, heatmaps in this regard, and on the other hand, logistic traffic density. In this way no information is sent to external modules and eases the treatment of great volume of information, that is a restriction the web application cannot manage.

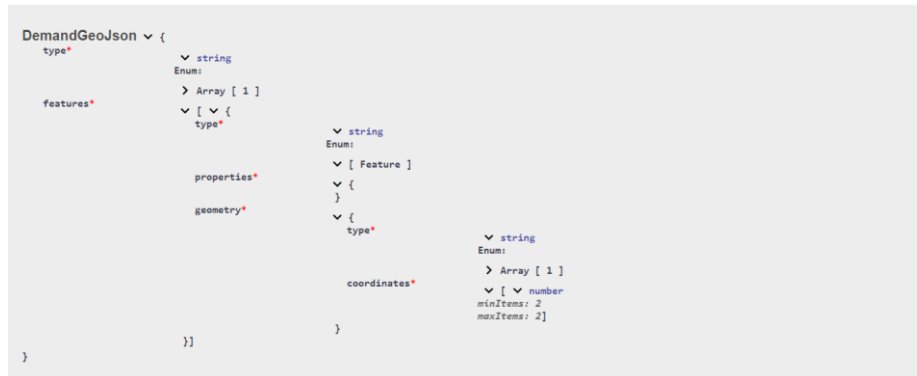


Figure 17: Endpoint that provides geolocated, cumulative and anonymized information about demand (locations where the shipments have to be delivered) in a certain date



Figure 18: Endpoint that provides geolocated, cumulative and anonymized information about logistic movements (segments of all the motorized routes in operation) in a certain date

Regarding the recent integrations with external systems, new endpoints have also been created within the DUI service to expose the loading areas or local loading areas and Smart Parking spots for the Dublin ULL and the Kerbside mapping information, unifying both providers designated by the municipality (Appyway and Curb IQ) into a single and complementary GEOJSON file (Figure 19).

POST	/dui/loading-area	Create a new loading area	🔒
PUT	/dui/loading-area	Update a loading area	🔒
DELETE	/dui/loading-area/{area_id}	Delete a loading area	🔒
GET	/dui/loading-areas	get the loading areas	🔒
GET	/dui/local-loading-areas	get the list of local loading areas	🔒
GET	/dui/lockers	get the list of lockers	🔒
POST	/dui/restriction	Create a new restriction	🔒
PUT	/dui/restriction	Update a restriction	🔒
DELETE	/dui/restriction/{restriction_id}	Delete a restriction	🔒
GET	/dui/restrictions	get the list of restrictions	🔒
GET	/dui/restriction-types	get the list of restriction types	🔒

Figure 19: DUI endpoints for infrastructure in Dublin use case

The update list of endpoints available from SENATOR Backend is shown in the next image (Figure 20)

OPM On-demand Platform Manager POST /api/depart/ Add a new depart PUT /api/depart/ Update a depart DELETE /api/depart/{depart_id} Delete a depart GET /api/depart/{depart_id} Get depart GET /api/departs Get departes POST /api/depart/{depart_id}/action Create depart action GET /api/inspection-types Get defined inspection types GET /api/product-types Get defined product types POST /api/shipment/ Add a new shipment PUT /api/shipment/ Update a shipment DELETE /api/shipment/{shipment_id} Delete a shipment GET /api/shipment/{shipment_id} Get a shipment GET /api/shipment/{shipment_id}/status Get shipment's last depart action status POST /api/shipments/csv Upload a CSV of shipments GET /api/shipments/assigned/date Get assigned shipments by date GET /api/shipments/assigned/date/date/{date}/to/{end_date} Get assigned shipments from date to date GET /api/shipments/assigned/company/{company_id} Get assigned shipments by company GET /api/shipments/assigned/company/{company_id}/date/date Get assigned shipments by company and date GET /api/shipments/assigned/company/{company_id}/date/date/{date}/to/{end_date} Get assigned shipments by company and date interval GET /api/shipments/for-admission/depart/{depart_id} Get shipments expected for admission GET /api/shipments/for-sorting/depart/{depart_id} Get shipments expected for sorting GET /api/shipments/unassigned Get unassigned shipments GET /api/shipments/status/{action_status} Get shipments by action status GET /api/shipments/status/{action_status}/depart/{depart_id} Get shipments by action status	MFM Multimedial Fleet Manager GET /api/driving-fences Get defined driving fences GET /api/fleet Get all fleet registered in SENATOR GET /api/fleet/company/{company_id} Get all fleet registered in SENATOR by a company GET /api/fleet/type Get all fleet of a certain type registered in SENATOR GET /api/fleet/type/{type}/company/{company_id} Get all fleet of a certain type registered in SENATOR by a company GET /api/fleet/available/date/date Get available fleet for the date GET /api/fleet/available/date/date/{date}/to/{end_date} Get available fleet for the date interval GET /api/fleet/available/company/{company_id}/date/date Get available fleet of company for that date GET /api/fleet/available/company/{company_id}/date/date/{date}/to/{end_date} Get available fleet of company for that date interval GET /api/logistic-companies Get logistic companies POST /api/mode/ Create new mode PUT /api/mode/ Update a transportation mode GET /api/mode/type Get modes of a certain type GET /api/mode/type/type Get modes GET /api/refrigeration-types Get defined refrigeration types POST /api/tracker/ Post a new tracker device or app POST /api/tracker/{tracker_id}/tracking/ Post a tracking point of a tracker app GET /api/tracker/{tracker_id}/tracking/date Get tracking info of a tracker app for a date GET /api/tracker/{tracker_id}/tracking/date/{date}/to/{end_date} Get tracking info of a tracker app for a date interval GET /api/tracker/company/{company_id} Get trackers registered for company GET /api/tracker-types Get defined tracker types POST /api/transportation Create a new transportation GET /api/transportation/{transportation_id} Get transportation PUT /api/transportation/{transportation_id}/availability Update transportation availability POST /api/transportation/{transportation_id}/tracking/ Post a tracking point of a transportation GET /api/transportation/{transportation_id}/tracking/date Get tracking info of transportation for a date GET /api/transportation/{transportation_id}/tracking/date/{date}/to/{end_date} Get tracking info of transportation for a date interval GET /api/transportation-types Get defined transportation types
SRM Smart Route Manager GET /api/action-status Get defined action status GET /api/action-status-conditions Get defined action status conditions GET /api/route/{route_id} Get route basic info POST /api/route/{route_type} Add new route POST /api/route/{route_id}/route_type/type Create route stop point POST /api/route/{route_id}/route_type/type/stop/stop_order/action Create delivery action GET /api/route/{route_id}/route_type/type/status Get route info by the company's route identification GET /api/route/{route_id}/route_type/status Get route GET /api/route/{route_id}/route_type/navigation Get navigation of route GET /api/route/{route_type}/route/date/date Get routes by date GET /api/route/{route_type}/route/date/date/{date}/to/{end_date} Get routes by date interval GET /api/route/{route_type}/company/{company_id}/route/date/date Get routes for company in some date GET /api/route/{route_type}/company/{company_id}/route/date/date/{date}/to/{end_date} Get routes for company in a date interval GET /api/route-classes Get defined route classes	DUI Diagnosis of Urban Infrastructures GET /api/heatmap/demand/date/date Get accumulated demand by date GET /api/heatmap/demand/date/date/{date}/to/{end_date} Get accumulated demand by date interval GET /api/heatmap/route/{route_type}/density/date/date Get accumulated route traffic by date GET /api/heatmap/route/{route_type}/density/date/date/{date}/to/{end_date} Get accumulated route traffic by date interval POST /api/loading-area Create a new loading area POST /api/loading-area/ Create a loading area DELETE /api/loading-area/{area_id} Delete a loading area GET /api/loading-areas Get the loading areas GET /api/local-loading-areas Get the list of local loading areas GET /api/loaders Get the list of loaders POST /api/restriction Create a new restriction POST /api/restriction/ Update a restriction DELETE /api/restriction/{restriction_id} Delete a restriction GET /api/restrictions Get the list of restrictions GET /api/restriction-types Get the list of restriction types GET /api/route Get all routes GET /api/route Get all routes

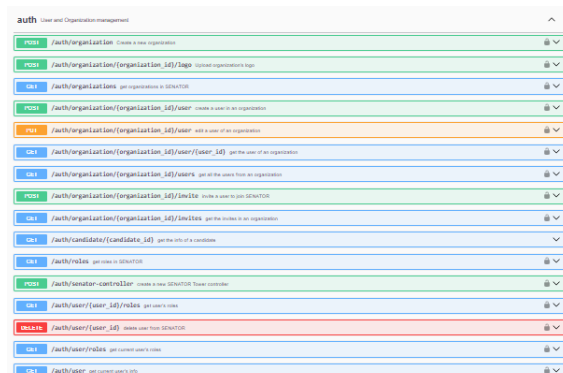
Figure 20: Currently endpoints available at SENATOR platform.

The authentication system was finally used and the first real users from organizations in the consortium have been created and invited to access. As advanced from the beginning of the project execution, it was based entirely on using the authentication and authorization system of Correos³, adapted to the current project needs, that will be named SENATOR ID. The authentication flow was made finally through the API rest consumption offered by SENATOR ID, based on CORREOS ID API⁴ as part of the platform. Some upgrades have been made in these months, in order to be compliant with RGD latest modifications or to be coherent with the changes in CORREOS ID deployments. Some minor changes could be needed in the

³ CORREOS ID : <https://www.correos.es/es/en/customer-service/other-queries/correos-id>

⁴ <https://azam-t-correosid-a0-svc-netcore-correosidservices-01.azurewebsites.net/swagger/index.html>

following months, such the migration to another authentication procedure, more secure and optimized to ensure avoiding potential information loss or thief.



Method	Endpoint	Description
POST	/auth/organization	Creates a new organization
POST	/auth/organization/organization_id/logo	Uploads organization logo
GET	/auth/organizations	Get organizations in SENATOR
POST	/auth/organization/organization_id/user	Creates a user in an organization
POST	/auth/organization/organization_id/user	Edits a user in an organization
GET	/auth/organization/organization_id/user/user_id	Get the user of an organization
GET	/auth/organization/organization_id/users	Get all the users from an organization
POST	/auth/organization/organization_id/delete	Deletes a user in SENATOR
GET	/auth/organization/organization_id/delete	Get the roles in an organization
POST	/auth/candidates/candidate_id	Get the role of a candidate
GET	/auth/roles	Get roles in SENATOR
POST	/auth/senator-controller	Creates a new SENATOR. These controller
POST	/auth/user/user_id/roles	Get user's roles
DELETE	/auth/user/user_id	Deletes user from SENATOR
GET	/auth/user/roles	Get current user's roles
GET	/auth/user	Get current user's info

Figure 21: Current endpoints to support identification for users and organizations management within SENATOR

As can be seen, the system provides the necessary endpoints to perform the authentication of any application that is developed and wants to integrate with SENATOR ID (Figure 21). In this year two new endpoints have been included, one for updating the Logo of each company participating in SENATOR and for deleting an existing user.

Pre and postprocessor module

From the tests and pilots that have been analysed in the last nine months, several logistic situations have aroused and as they are real operation situations because of the requirements of signed contracts with their clients or internal procedures of the logistic operators, all of them have to be considered in SENATOR platform.

The optimizer is responsible for performing a search function to solve a VRP problem, that is, assigning orders to one or more of the available vehicles. In our case, it could also assign orders to already existing routes. This is an NP-complete problem; therefore, it is not feasible to explore the entire spectrum of possible solutions to find the best solution (technically unfeasible). What the algorithm does is search for possible solutions to find the best one. As stated in previous reports, the optimization module designed and developed within WP2, requires input files in json format, and as a result of the optimization, it returns an output file that is not automatically the planification output the service SRM can handle.

In order to manage the multiple casuistic of inputs and outputs to be considered by the optimization engine, an internal module has been developed to include all the processes to send and receive the input and output to/from the optimization module and give the correct information the SENATOR services need.

Therefore, the pre-processor will be responsible for adequate the input data (resources of the logistic operators, shipments to deliver with their characteristics of time windows, priority etc) to split/modify the input JSON files into smaller files (with fewer orders and vehicles, modifying the characteristics of the orders and/or vehicles, etc.) to facilitate the

work of the optimizer, generating smaller and more manageable executions and avoiding the exploration of solutions that can be known from the start to be suboptimal (e.g., vehicles at one end of the city delivering orders at the other end when there are closer vehicles).

This module will also be responsible for post-processing the optimizer's output data to adjust the output of these sub-scenarios generated by the pre-optimizer into a single final output JSON and adapt them to the conditions of the original scenario (for example, if we have modified the origin of a vehicle, we will need to add the trip from the original depot to the new location).

SENATOR Mobile APP

The objective of the mobile app developed is to facilitate access to the services deployed by the platform to the carriers and/or managers within the delivery units, focusing the functionality on this case to their own operations, optimizing aspects such as the admission of packages, their sorting and departure to route or the management of logistics with traceability services and monitoring of the status of deliveries in real time. The multiplatform mobile application, acts as a FrontEnd of the APIs included in the SENATOR platform, allowing the access to logistics agents that do not have own systems capable of integrating directly with the platform.

The SENATOR mobile app was presented within Deliverable D3.6, and from May 2023 to the date of writing this report, it has evolved considerably to provide advanced functionalities beyond those available then. On the one hand, during this period, internal token management has been developed, enabling the SENATOR system to identify apps/mobiles at both the bus level and the push messaging system (See figure 22).

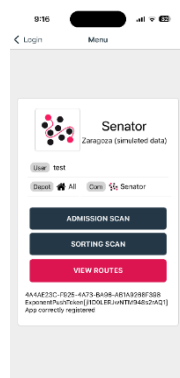


Figure 22: Token management within SENATOR APP

This was necessary to correctly receive and send information between all agents, and also to manage incidents in real-time operations. As previously mentioned, incident management is a critical functionality that is currently being finalized. It needs to receive and manage the life cycle of multiple disruptions within the logistics operator. Therefore, the capability of sending events from the SENATOR mobile app and receiving incoming messages to/from the Rabbit message bus is mandatory.

In the following images, the main screen of the SENATOR mobile app can be seen, where the postmen/postwomen already have the possibility of reporting incidents such as 'Vehicle Breakdown' or 'Relevant Delay' (Figure 23).

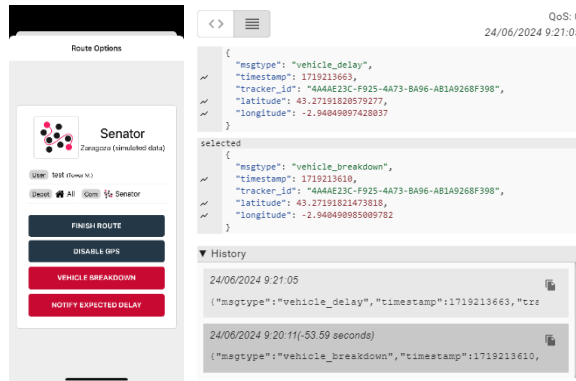


Figure 23: SENATOR mobile APP sending incidents and captures of those messages received on the bus

In the same way, when the SENATOR platform is managing incidents, notifications can be sent to the involved agents (Dashboard, routes affected through each postman/postwoman's SENATOR mobile app). In the following figure, screenshots of the reception of two examples of these notifications are presented. The left one notifies that a replanning is ongoing, and the second one, when the previous process has ended, warns the postman/postwoman on route that their plan has been changed, so they should reload it and consider the new pickups and deliveries added to the previous ones. (Figure 24)

On the other hand, changes in the shipments' label scanning feature have also been developed. Since the information managed by the SENATOR platform is anonymized, a translation from the original label attached to the package (owned by each logistics operator) to the SENATOR internal unique identifier must be performed (Senator SE codes), as can be seen in Figure 25

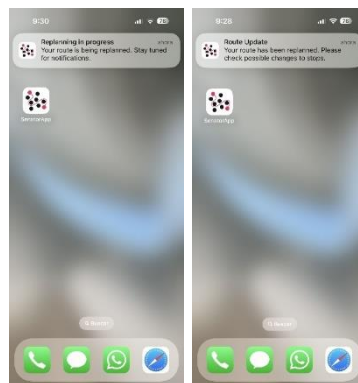


Figure 24: SENATOR mobile APP: Receiving messages and notifying changes on the current route of a postman/postwoman

Review, monitor and confirm integrations with IoT devices

SENATOR receives tracking information and delivery actions from connected fleet and the work devices (PDAs) from the logistic operators. Even though most of the integrations were successfully made in previous reporting periods, changes have been necessary in recent months due to modifications made by external providers or confirmation of the connected devices (fleet or PDAs) provided by the logistics operators involved in the pilots.

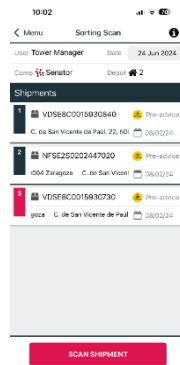


Figure 25: Scanned shipments with SENATOR ID

Currently, the SENATOR system has registered 377 items for the Zaragoza use case, out of which 180 are vehicles registered as part of the fleet, with the remainder being mail carriers. These items are distributed between two companies and associated with different service units. Approximately 30 of them, corresponding to 17% of the registered fleet, send tracking information.

A similar functionality was also included with the integration in SENATOR of the CORREOS ' postmen/postwomen rugged and commercial PDAs connection. It gives SENATOR capacity to trace their location, and hereby the goods they are delivering. Also gives information about the delivery actions (is each shipment is successfully delivered or failed for several reasons). At the date of writing this report, 63 PDAs are registered associated to any of the special delivery unit from Correos in Zaragoza and SENATOR has received data from at least 37 at some point of execution.

Regarding the Dublin use case, 45 vehicles are registered but correspond to old information and must be reviewed for the pilot phase. No integration with Anpost systems or devices has been performed, so there are no more items included.

Pending Open Data integrations

In the Dublin use case, SENATOR includes the challenge of enhancing the logistics operation with the inclusion of Virtual Kerbside Information Management and Digital Parking/Loading Bay Management. In the previous year, the platform faced the integration of Dublin's kerbside management services (where two providers exist in the pilot area: Appyway and CurbIQ). This last 12 months we addressed the integration of the digital parking/loading bay

management (with a commercial platform by Urbiotica customized by UTS Technologies LTD for the city of Dublin) after Dublin City Council Installed sensors on the loading bay.

The backend is responsible for transparently calling these APIs, allowing customers (Dashboard and SENATOR Mobile App) to consume these services in a homogeneous and seamless manner.

Regarding the kerbside mapping datasets, after the contracts with the external providers ended, the efforts were focused on processing the original files to extract the geometries of these zones and compose a single GEOJSON file that will be utilized by the mentioned agents. Regarding the integration with real-time/dynamic information of parking and/or loading bays, Deusto's efforts focused on implementing the mechanisms for monitoring the status of each parking bay and updating it, which is obtained from a connection with a communication bus. In the latter months, those two functionalities have been concluded with the collaboration of UCD and now are exposed as part of the visualization of Loading areas, as can be seen in Figure 26 for Dublin use case.

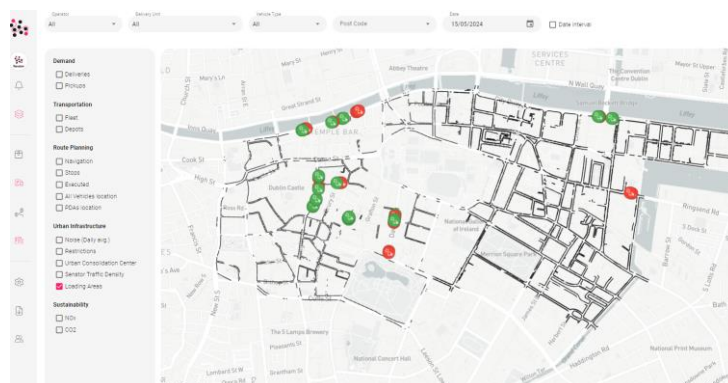


Figure 26: Kerbside Mapping and Smart Parking stops for Dublin ULL

To date, work is being done on integrating traffic and pending environmental data from open data sources available in both use cases.

Real data load to SENATOR

As mentioned before, data privacy-related concerns have delayed the automatic load of the information to the SENATOR platform until today. Currently, for the Zaragoza use case, Deusto receives a daily file by email containing a prediction of the deliveries to be dispatched throughout the entire city, coming directly from CORREOS systems. This report must be downloaded from the email, semi-automatically processed to adapt the included fields/variables to the SENATOR format, and then uploaded to the platform so that the demand information can be stored in the database and considered for the ongoing day.

From the analysis done by Deusto, it has been concluded that only 33% of the shipments that went out for delivery on a normal day were included in the predictive file. This is a low indicator, so other possibilities for forecasting information are being explored, such as using

the data from the first registration of each item at the unit, which some months ago was slightly better (35% accuracy) but is being improved by IT teams within Correos.

As there is no real guarantee that those deliveries are actually orders for the current day, the system does not use that information to provide planned routes, but it serves when real operation delivery events arrive, allowing the storage of the executed routes actually made by the postmen/postwomen.

When a delivery event is received from each PDA, the system internally searches for the SENATOR identification and if it exists, the order is created and the action can be stored in the SENATOR database, and therefore can be further consulted and retrieved (for example via Dashboard).

Tasks of correlation have also been necessary to associate vehicle location information with that of the PDAs, in the sense of considering them as part of the same route when motorized, but not confusing them when they correspond to different routes that intersect in a nearby area at some point during the day. By the date of writing this report, Correos is addressing this issue by introducing new features in the messages sent from their PDAs to SENATOR, including linking with the vehicle plate where applicable (if a route is on foot, this step is unnecessary and will be considered as pedestrian). By date of writing this report this circumstance is being addressed by Correos, introducing new features in the messages from their PDAs towards SENATOR, including the link with the vehicle plate when apply (if a route is on foot there is no need to do so and it will be considered as Pedestrian).

Restrictions on mobility.

The inclusion and validation of the restrictions, considering them as a new variable to be considered in the routes planification and implementation, that internally uses the optimization module, was developed in this period by DEUSTO. Those different circumstances may affect the logistic operation (as a Low Emission Zone, where only non-emission vehicles can access to) have to be considered in the planned routes that are provided by the platform.

Three types of restrictions on mobility are considered in SENATOR, all of them will affect the access to certain city areas totally or partially depending on the vehicle characteristics. They are briefly described in the following paragraphs:

General (Type GENERAL): affects all types of resources (postman, vehicle of any type, bike, drone). They could be street/lanes closures due to events (demonstrations/massive concentrations), works or other reasons.



Pedestrian zone (type PEDESTRIAN): affects vehicles of all types (combustion, electric, non-motorized): street closures to any motorized vehicle (to be studied in the new theoretical pilot in Dublin ULL).





LOW EMISSION Zone (type LEZ): affects only specific types of vehicles: polluting (combustion) vehicles. It can be triggered by Municipalities when episodes of high pollution.

The results of the tests done in December 2023 were very conclusive and it is very well received by the consortium. In the following figure, there is an example of including a LEZ in Bilbao. As it can be seen in Figure 27, the SENATOR planned routes considers the Low emission zones, providing accurate options that avoid passing by them except if the vehicle is allowed to do so.

In the image different journeys from point 1 to point 2 are proposed, as postmen (pedestrian route, green line) can cross a LEZ but a route by combustion vehicle has to border it (magenta line).

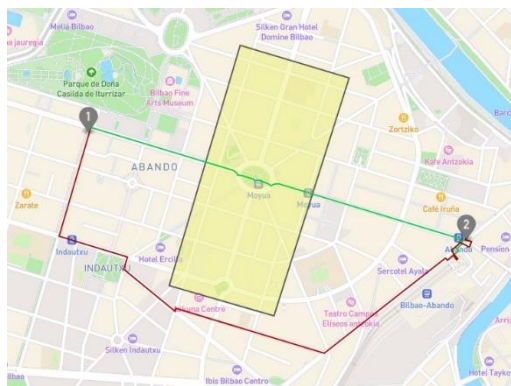


Figure 27: LEZ impact in routes with SENATOR

Incident design and management,

The approach of the Incident Manager is that incidents can originate from different sources (APP/Dashboard/SENATOR system/Backend) depending on the circumstances. Three types of incidents will be considered within SENATOR and need to be monitored:



On-route Incident, resulting from a vehicle breakdown or failure, compromising all undelivered shipments on the vehicle.



Significantly delayed route, due to critical issues in meeting planned route commitments (deliveries, time windows, priorities). Performance times compared to proposed ones in the original routes will be monitored from the backend, and an incident will be triggered when executed times make it impossible to complete all deliveries.

- **Restrictions to mobility.** These would correspond to incidents which can be due to several factors:





- Environmental impact (pollution alert, air quality measures) where the city restricts circulation to certain types of vehicles. For the system, this would be akin to activating a Low Emission Zone (LEZ) on a broader scale, which can be simulated relatively easily (a pollution alert cannot be triggered on demand).
- Traffic cuts/new restrictions (traffic closure) prohibiting any vehicle from circulating in specific areas. This could be a specific case under 'Route Incident' in scenarios involving congestion.

The SENATOR platform must be capable of managing and updating their status while incidents are active. Various mechanisms are being implemented to resolve them, and until resolution, these status updates will be communicated through the message bus, ensuring all systems are informed simultaneously and in real-time. The overarching concept is that events or incidents will always be transmitted through the existing message bus, supporting necessary handling throughout their integrated life-cycle management and the implementation of their corresponding message catalogue. Different messages will be sent based on the type of event (4-5 types defined), which must be processed by the systems responsible for their management and/or display.

In general, incident messages will be sent from each ULL through the corresponding channel/topic (topic: city(-dev)/operator), and they may be received by the logistics agents involved, not universally, along with the Control Manager listening to all channels.

3.3.3 Risks and deviations

The following table lists the possible risks for WP3 identified in Annex 1 of the GA, as well as the proposed risk-management measures. In addition, information on if the risks were materialised and if the proposed risk-management measures were applied is provided.

Table 1. List of possible risks for WP3 identified in Annex 1 of the GA.

Risk No	Description of Risk	Proposed risk-mitigation measures	Was the risk-mitigation measures applied?	Was the risk materialised ?
8	Foreseen solutions are not affordable, or are technically non-feasible to deploy	Research, implementation and evaluation will focus on establishing what restricted sub-domains of the transport logistics uses cases can generate reliable predictions. A techno-economic analysis of each solution in each different situation/application, will be carried out prior to any use cases deployment.	NO	NO

9	Different components of the platform are not compatible to each other, failing integration, putting pilots at risk	Using a well-structured requirement analysis, the SENATOR solution tackles the issues related to physical interoperability and product data interoperability, by providing a precise definition of adapter interfaces related to standards within the SENATOR architecture	YES	NO
10	Solutions doesn't reach the expected results	During monitoring phase (WP5) any negative deviation of the objectives will be analysed by the PTC, supported by the use cases leaders and the partners involved	YES	YES
11	The low technological maturity of certain operators involved hinders integration	The SENATOR platform will include different levels of integration (T3.4) based on the digitalisation of the logistics operators integrated in the SENATOR platform, providing different integration mechanisms according to the requirements established in WP1.	YES	YES
12	Data availability and connections to be used	Consultancy dedication in order to analyse all inputs of data and their conditions (T3.1)	YES	YES
13	Data format so a hard work in data collection would be needed	Consultancy dedication in order to analyse all data formats and their conditions with specific solutions for each one (T3.1).	YES	YES
14	Bad or uncertain requirement definition	Long term dedication to define solutions and requirements (WP1)	YES	YES
15	UX not defined besides necessities	Intense work near the end user with design thinking and UX/UI techniques (WP1)	YES	YES
16	Software performance	Highly dedication to performance tests once platform is deployed (T3.4)	YES	YES

Relevant technical deviations have occurred in WP3, particularly in:

- **ST3.3.1:** The final version of the Dashboard seems not being able to manage huge amounts of information and that is the reasons why it limits the number of data (shipments or Routes) to be exposed at a once. The developments continue being slower that it should at this point of the execution.

- **T3.4** (*i.e.* ST3.4.1-4): Access to the necessary data (Location of all the packets to be dispatched) from Logistic operators is still partly restricted. This is critical to launch the platform optimized routes in a daily basis, so the system is not fully ongoing by today.

These two issues impact other activities, such as the initial pilots in the Zaragoza use case. Data must be managed and visualized in external web applications supported by DEUSTO because it is not feasible to directly load the original incoming information into the SENATOR database. Furthermore, the results of the optimization plans need to be manually integrated into the system to be accessible via the Dashboard.

3.3.4 Deliverable and Milestones status

The following tables summarise the deliverables submitted, and milestones reached within WP3.

Table 2. Deliverables submitted for WP3. (*WP3 leader DEUSTO asked to re-submit new versions of D3.4 and D3.5 by DOTGIS when the works have ended).

Del. No	Deliverable name	Lead Beneficiary	Type	Diss. level	Due date in Annex I (month)	Submission Date
D3.1	SENATOR architecture and detailed design	DEUSTO	R	PU	M13	28/10/2021
D3.2	SENATOR data acquisition and messaging layer	SOFTWARE AG	DEM O	CO	M21	30/05/2022
D3.3	Dashboard solution design	DOTGIS	R	PU	M18	31/03/2022
D3.4	Dashboard code*	DOTGIS	O	PU	M22	29/07/2022
D3.5	Dashboard delivery and user manuals*	DOTGIS	R	CO	M26	31/10/2022
D3.6	SENATOR ICT Platform and services integration. Release 1	DEUSTO	DEM	CO	M30	28/02/2023

Table 3. Milestones reached in WP3.

MS. No	Milestone name	Lead Beneficiary	Due date in Annex I (month)	Means of verification
MS4	Finalize the technical architecture as a blueprint for development	DEUSTO	13	MS4 was achieved on October 28 th , 2021, <i>i.e.</i> one month later than the original plan (September 30 th , 2021). Nevertheless, the delay was communicated in advance to the EC. The MS4 milestone was reached once the architecture design of each of the subsystems was accepted by

the WP3 partner team. The fulfilment of this milestone coincided with the joint approval by the consortium of the D3.1 deliverable "SENATOR architecture and detailed design", which includes the detailed design of the SENATOR ICT platform architecture.

MS5	SENATOR ICT Platform and services integration. Release 1	DEUSTO	30	This milestone was reached by submitting D3.6.
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3.3.5 Planning until the end of the project

As mentioned earlier, two out of the four tasks within WP3 that were supposed to be completed in this reporting period are still ongoing. The developments, originally planned to be completed by September 2024, are focused on (1) finalizing T3.3 with all the required features and (2) completing the pending activities of T3.4, particularly dynamic route replanning and incident management, both of which are still in progress as of the writing of this report. These delays stem from previous years and the time spent monitoring other partners, as well as instances where DEUSTO had to manage incomplete data samples and employ alternative tools or methods to utilize them and provide visual applications for reviewing optimization and testing results.

The critical issue remains unchanged from previous reporting periods: the SENATOR platform still requires real-time information from logistics operators to truly provide optimized routes and effectively monitor and support real operations. As of the writing of this document, there is no concrete solution to resolve this issue, and it appears that WP3 will conclude before this matter can be fully addressed.

3.4 WP4 - Urban planning validation and governance tools

3.4.1 WP objectives

WP4 involves analysing the current status of SENATOR cities and prepare the ground to low carbon logistics proposed in the project by the development of a guideline for sustainable urban logistics plans and connecting the needs of citizens and cities with logistics, urban planning, and municipal regulations so that everything is harmonized to achieve the efficiency and sustainability objectives sought in the project.

In WP4 a set of new strategies to define the 4 governance schemes will be produced for: 1) User demand planning, 2) Transport mode planning, 3) Logistics planning and 4) City infrastructure planning. Critical elements and requirements for the implementation of sustainable governance will be identified and Guidelines for SUL&MP will be defined providing a robust regulation framework and governance tools.

WP4 aims to:

1. Use SENATOR dynamic planning tool and knowledge/techniques/best practices acquired, to produce a complete set of governances (including guidelines and directions) for urban planning which integrate freight, logistics and citizen mobility (SUL&MP).
2. Study logistic services, routes, policies and regulatory framework towards the redaction of Sustainable Urban Logistic Plans, leveraging the processing techniques developed in WP2 and delivering robust tools for urban planning integrating not only logistic aspects, but also Smart&ICT agenda, low carbon transport plans, Sustainable energy plans (Social Environmental and Climate Assessment Procedures SECAP), etc.
3. Learn from the UCC first year operation to feed the Senator catalogue application.

3.4.2 Work progress and achievements during the period covered

The WP4 started at M13 (September 2021) and is expected to be completed at M48 (August 2024). T4.1, T4.2 and T4.4 are currently completed. T4.3 was completed in month 34 with a month delay. T4.5 started at M25 and is ongoing.

Task 4.1 Guidelines for Sustainable Urban Logistics Plan

Status: Completed. The work started at month 13 (September 2021) and it was finished at month 25 (September 2022).

Task 4.1 involved issuing 2 deliverables:

- Best practice catalogue
- SULP Guidelines

Deliverable D4.1 “Best practice catalogue” is related to case study mapping. This document includes an overview of projects in the field of urban logistics over the last decades, thus bringing to light the main steps and objectives achieved in this field over the years.

Themes such as the implementation of SULPs and SUMP in small, medium and large cities, sustainable mobility, energy efficiency, logistics, urban freight transport, application of technologies for urban logistics and use of ICT and ITS systems, public-private collaboration,

multimodality, development of pilot projects to test solutions and improve the liveability of major European cities are considered.

Comparing the analysed projects and in general projects in the field of logistics and urban freight transport with SENATOR, certainly the latter aims at creating a smart network operator supported by an ICT platform, involving the main stakeholders from the logistics point of view through a multi-collaborative framework based on a new urban logistics model to attend the requirements of the “on demand economy”.

The participatory process underlying the SENATOR project and thus the requirement to meet the needs of the main stakeholders through empowering their decision-making capacity & prioritizing urban mobility by an integrated approach is certainly the main element in which SENATOR differs from other projects, with the ultimate goal of promoting sustainability and shared-connected freight and delivery services in cities.

Deliverable D4.2 “SULP guidelines”, focused on the SULP Guidelines, has been articulated in five main sections for analysing and defining the most relevant issues to be considered in the formulation of appropriate guidelines and the significant components that should be considered an integral part of sustainable logistics planning processes.

The first section of the document has been dedicated to urban freight transport and logistics in the European context, describing the European policy framework, the existing European guidelines for urban freight planning, the correlation between the Sustainable Urban Logistics Plan (SULP) with the Sustainable Urban Mobility Plan (SUMP), exploring common characteristics, potential and critical aspects, and process framework for SULP elaboration and implementation. In this section, it is highlighted how the European context recognizes the need to activate planning processes able to manage the demand for urban logistics and modification of transportation according to an integrated and sustainable perspective, able to improve the efficiency and cleanliness of vehicles and fuels, but also to include logistics as essential for urban mobility. At the same time, the need to implement collaborative governance approaches, also based on the use of platforms for cooperation, data exchange and training for all actors involved in urban logistics is recognized as essential for improving the effectiveness of SULP.

The second section of the document faces sustainable urban logistics to address the 2030 Agenda on Sustainable Development and the New Urban Agenda, selecting some relevant Sustainable Development Goals (SDG) able to guide and support the logistics planning process.

In particular, SDG 8 - Decent Work and Economic Growth, SDG 9 - Industry Innovation and Infrastructure, SDG 11 - Sustainable Cities and Communities, and SDG 13 - Climate Action are considered most pertinent to urban logistics and planning processes to implement the New Urban Agenda and to realize sustainable transport solutions. The adoption of the SDGs

as a prerequisite and a purpose of logistics planning and implies considering as essential the identification of transformative pathways, the integration of science, technology, and innovation, the strengthening of collaborative and good governance, the improving financing models and tools, the focusing on capacity-building, technology cooperation and data management, the implementation of change model through individual and collective behaviours. The selection of targets and indicators connected to the SGDs makes it possible to identify the most significant issues to be taken into account in the various phases of the Sulp: study area knowledge, elaboration of strategies and scenarios, impact assessment and monitoring.

The third section of the document has focused on the measures for sustainable urban logistics, relevant reducing the negative effects, promoting the involvement of different stakeholders, and activating innovative processes. The main measures are described considering five categories: User-demand planning; Transport mode planning; Urban logistics planning; City infrastructure planning; and ICT systems. For each of the different measures the strengths and weaknesses have been identified to identify the opportunities for implementation of each of them, but also the limits to be taken into account.

The fourth section has been dedicated to the analysis of the two cities of the SENATOR project, Zaragoza and Dublin, describing policies and urban planning, logistics and transport strategies. The experiences of the two cities allow understanding of which issues are considered relevant, which approaches have been applied and with which results, and which needs should be met through the development and implementation of appropriate Sulp.

The fourth section has focused on the elaboration of an interaction path with the cities of Zaragoza and Dublin for the detection of relevant issues and preferences on Sulp.

A survey was structured and disseminated among the main stakeholders of the two cities to identify their points of view, collect their suggestions and identify the considerations to be taken into account for the development of the Sulp guidelines starting from the ongoing urban logistics processes, city needs and requirements, future developments and ICT support to achieve sustainable targets.

The survey made it possible to investigate Sulp's sustainable goals and strategic actions consistent with the Sustainable Development Goals of the Agenda 2030 and related to some specific thematic fields such as user-demand planning, transport mode planning, urban logistics planning, and city infrastructure planning.

Through surveys carried out in the cities of Dublin and Zaragoza, it was discovered that urban planning is extremely important to stakeholders in the supply chain. Relevant infrastructures and services need to be planned to make the logistics system efficient and, at the same time, city governments need to encourage sharing among different stakeholders both know-how but also means and spaces.

The results obtained by the survey identify priorities that recognize the central role of the SDGs in guiding and supporting logistics planning processes.

For the city of Zaragoza, the priority is GOAL 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all; while the priority for the development of Sulp in the city of Dublin, is GOAL 11: Make cities and human settlements inclusive, safe, resilient and sustainable. The two different perspectives highlight the need to integrate logistics within the systemic planning of the city and the territory to promote the economic dimension for Zaragoza and to improve the quality of life and well-being for Dublin. The adoption of sustainable measures oriented to reduce the negative impacts and improve the positive impacts, implementing innovative modes to manage multi-stakeholder processes able to support Sulp elaboration and implementation.

The lessons learnt from the cities of Dublin and Zaragoza underline that sustainable urban logistics is a particularly topical and interesting subject not only for researchers but also for practitioners. Nevertheless, the lack of unification and the diversity of approaches and methods have often been criticized as a hindrance to the support process for decision-making by the different stakeholders involved in urban logistics.

This report presents a view of sustainable urban logistics and provides an analytical framework for supporting the decision-making process oriented to this objective, promoting openness and complementing the contemporary visions of sustainable urban logistics, especially at the international level.

The vision of sustainability presented goes beyond the consideration of the three classical spheres (economic, environmental and social/societal) and their three interactions (viable, workable and equitable) to introduce the notions of capabilities (awareness, action, anticipation and avoidance) and aspects of dualities (short-term and long-term, local-global, simple-complex and competition-cooperation), principles that are summarized in the SDGs of the 2030 Agenda and the New Urban Agenda.

In this regard, this report has proposed a set of steps to draw up the Sulp with the aim of being easily transposable, understood and interpreted by the various stakeholders working in this field.

The fifth section describes the articulation of the seven main different steps of the Sulp Guidelines: Step 1 - Sulp decision context exploration; Step 2 - Definition of Sulp vision and strategies; Step 3 - Construction and Evaluation of scenarios; Step 4 - Set-up of the evaluation framework; Step 5 - Sulp implementation roadmap; Step 6 - Sulp promotion and communication; Step 7 - Monitoring plan.

Each step is divided into activities that allow defining the steps in a specific way, identifying a process scheme that considers “What, How, Who and When” for the different activities included in an incremental decision-making process, made up of feedback, parallel and

integrated activities, which develops combining multi-scale and multi-dimensional approaches and tools. The Sulp guidelines, which result from the work carried out by the SENATOR partners, started from existing guidelines, are updated with the sustainability objectives dictated by the 2030 Agenda and summarized by the SDGs.

The methodological framework that supports the Sulp Guidelines is based on the continuous and constant interaction of problem-setting and problem-solving approaches, evaluating the possible changes and the related impacts.

It was possible to draw some relevant questions draw some conclusions about the objectives and tactics that a Sulp ought to pursue, including some relevant issues:

- Decreasing carbon emissions in response to climate change;
- Encouraging dissemination of the culture of sharing: knowledge, means, space and equipment to optimize loads and routes;
- Optimizing product and waste logistics, implementing reverse logistics, increasing transportation efficiency, increasing dedicated infrastructure on the ground (urban hubs, smart locker and collection point);
- Reducing the number of transports and miles travelled by transportation agencies implementing adaptable site-specific solutions;
- Concentrating on specific facets of urban logistics, neighbourhood trade, and urban regions' social reform, including urban micro-hubs as places for products collecting;
- Promoting information and communication campaigns on the benefits of utilising cutting-edge technologies and on the adoption of responsible behaviours;
- Raising more awareness of the environmental impacts that the logistics sector produces.

These issues can support and guide on Sulp development, providing local authorities and logistics urban design experts with a methodological framework for the implementation of strategies and actions able to address the challenges of a sustainable urban logistics policy and plan, including stakeholders' collaboration and participation and measures scaling up in different urban contexts.

Task 4.2 User demand planning

Status: Completed. The work started at month 13 (September 2021) and it is was finished at month 33 (May 2023).

The main objective was the identification of critical questions to be cleared with the citizens (+90 surveys and 2 co-creation events in municipal markets) with regards to urban logistic interventions with a focus on participatory processes, which results reflect the identification on critical questions to be cleared with citizens as well as outlining best practices with regards to urban logistic interventions.

Zaragoza's team has been addressing an approach to a quantitatively prospective analysis of a user demand planning that is able to indicate to the potential future impact on demand

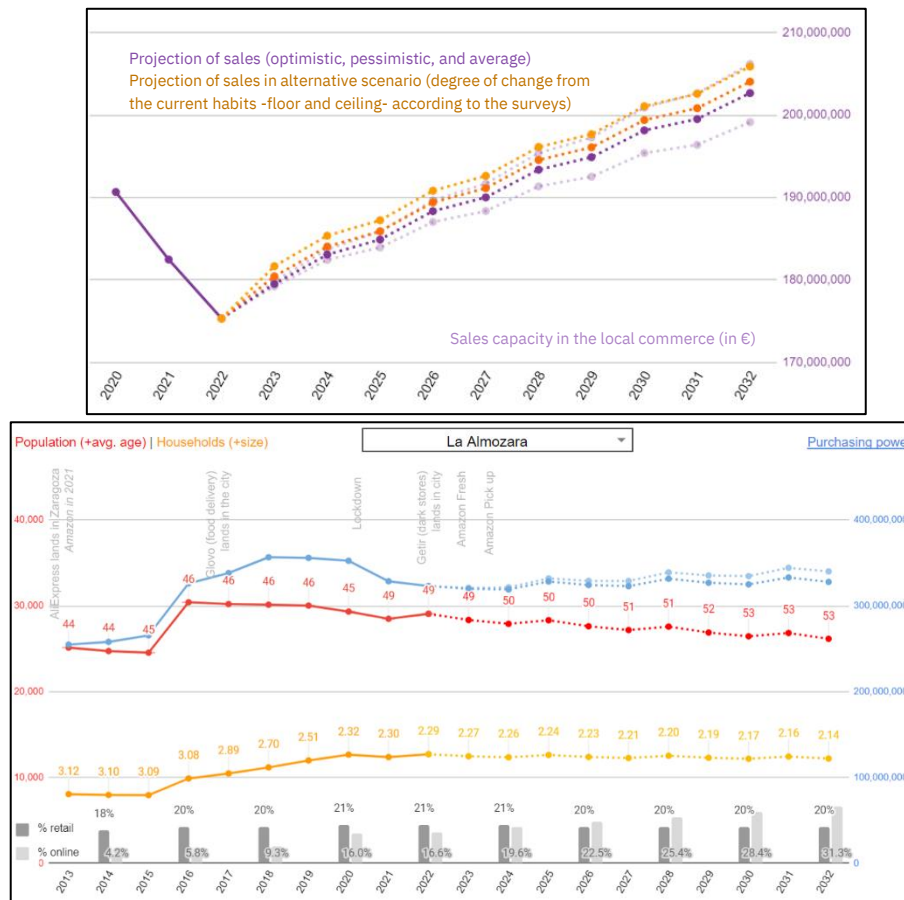


Figure 28: Prospective model and projection of alternative scenarios

behaviour of applying different scenarios, including KPIs that can be used as a comparable figure among different case studies and locations. The study gathered more than 10 social-economic variables including forecasting to 10 years onwards, accompanied with +90 surveys linked to habit of consumption among the citizens.

The detailed plan was communicated in February 2023 with the rest of the agents involved (DCC, UCD and RINA-C), and completed with the co-creation activities carried on by Zabala within the municipal markets.

By the end of M33 deliverable **D4.3 “User demand planning report”** was peer-reviewed and submitted which demonstrates an approach on how user demand can be quantitatively planned (and/or foreseen) through an approximation of a predictive model based on more than 14 social economic variables, most of them defined for the Zaragoza case study, which allowed verifying the impact (in purchasing and selling power) of potential solutions towards the promotion of the small commerce.

This study has helped the city to identify some key aspects linked to the use of the local incentives and the trends in the use of local commerce by different age/locations that may help better reshape policies towards the promotion of local commerce which, in turn, directly lowers carbon footprint in last-mile delivery, among other social economic benefits.

It should be noted that the activities included in this task have had a high participatory and especially inclusive content. In this way, the report (**D4.3 "User demand planning report"** M33) that was generated at the end of it, can serve as a legitimate complement and support tool to mid-long term mobility and urban planning decisions.

Dublin City Council, in order to gather direct feedback from the users, have created a Freight, Delivery and Services (FSD) Working Group. The group consist of representatives members from Ireland's leading parcel delivery and logistics organizations such as, AnPost, UPS, DPD and Cyclone, also business representatives such as Dublin Town and Dublin Chamber of Commerce along with members from Dublin City Council. The working group has been operational since 2022 and has been meeting on a quarterly basis with the main objective of identifying urban logistics intervention for sustainable last mile deliveries.

Description of the work already done within the period:

- a work plan with orientation programming of the task has been defined and started. In particular, the following activities were launched:
 - Parameters in case study mapping to prepare a list of parameters and KPIs for analysis of consumption habits in line with SUMP.
 - Study of relevance of information in terms of orientation and data acquisition.
 - Cases study mapping already identified during SENATOR activities and beyond.
 - Forecasting studies
 - On-field surveys
 - Integration of the co-creation activities
 - Peer-review of methodology and results
- draft of D4.3

Task 4.3 Transport mode planning

Status: Completed. The work started at month 13 (September 2021) and it was finished at month 34 (June 2023). An extension of 1 month was requested, which has been approved by the UE.

The objective of this task has been to analyse SENATOR cities' (Zaragoza and Dublin) Municipal Orders / Regulation in relation to sustainable transport mode to identify the investment needs in terms of infrastructure and considering the most suitable low emission transport modes.

The work began with the analysis of the municipal regulations in the cities of Zaragoza and Dublin, as well as the infrastructural and regulatory needs for the proper management of designated spaces to promote new low-emission transportation models. The main objective

of this study is to meet the demand trends of users the logistical procedures of first and last mile.

Throughout this work, we have conducted in-depth research on the current regulations in both cities, taking into account key aspects such as urban planning, road safety, and environmental policies. Additionally, we have carefully analyzed the necessary infrastructures for the successful implementation of these new transport models, considering elements such as charging stations, distribution networks and fleet management system.

Furthermore, regulations and procedures required to ensure efficient operation of designated spaces, such as low emission zones or restricted access areas, has been evaluated. Aspects such as updating and expanding existing regulations, key infrastructures, promoting the adoption of low-emission vehicles, and the implementation of effective control and monitoring systems have been considered.

For example, for Zaragoza case study it was proposed the municipal support for the purchase of electric vehicles, through subsidies for the renewal or acquisition of different types of vehicles, electric motorcycles and bicycles, etc. Incentives for the recharging of electric vehicles, through aid for the installation of fast recharging points, expansion of the network of subsidized public recharging points, etc. Free parking for electric vehicles and unlimited parking in regulated areas. The areas reserved for EVs will grow in proportion.

Task 4.4 Logistics planning

Status: Completed. The work started at month 13 (September 2021) and it was finished at month 33 (May 2023).

The outcomes of Task 4.4 Logistics Planning are detailed in **D4.5 “Logistics planning report”**. T.4.4 began with the analysis of local customers’ needs, with the goal of evaluating how urban infrastructure should be adapted to include freight demand trends provided by the SENATOR project, identifying how many endowment/intermediate logistics hubs are required by a neighbourhood or suburb. For example, the number of parcel lockers required, which delivery schedule results in the least amount of disturbance for citizens e.g. night delivery, traffic valley period, weekend period, backhauling. Through the task, the whole logistic plan including the integration of last mile logistics procedures (micro-logistics, night delivery, parcel lockers, cross-docking) was analysed.

The analysis was carried out by conducting the following:

1. Subject matter expert (SME) interviews
2. Citizen survey.

The findings from the SME interviews suggest that micro hubs could improve last mile logistics in population dense areas. They could also be used to overcome restrictions in cities

such as congestion and pedestrianisation by enabling last mile deliveries on eTrikes and other alternative transport modes.

The findings from the T4.4 indicate that pick-up points are preferred to parcel lockers, with 56% of survey respondents choosing pick-up point. Determining the number of pick-up points or parcel lockers is challenging, particularly when trying to determine the number of fixed locations.

The work carried out as part of T4.4 and detailed in D4.5 indicate that customers would be willing to receive deliveries between 6pm and 8pm but 8pm would have to be a cut off for home delivery and perhaps parcel lockers and pick-up point could be employed for later deliveries.

The findings from T4.4 indicate that a combination of pick-up points and parcel lockers should be employed and the use of these could be used to encourage later deliveries without having to disturb customers in their homes late in the evening. The findings also suggest that micro hubs can be useful, and their location does not have to be in the centre of a delivery zone. Customers want their deliveries to be sustainable, but not at an additional cost, therefore this needs to be a consideration for planning. Finally, investment in automation is required for more granular sortation of delivery items, without this implementing micro hubs, backhauling and cross-docking amongst other things will not be as efficient.

In determining how urban infrastructure should be adapted to include freight demand trends City Councils and logistics providers need to evaluate local information and existing research, much of which has been referenced in this report, and adapt it to the needs of each unique urban location. Based on our findings in this report, there is not a fixed standardised approach to optimising urban infrastructure for freight due to differences in geography, population and demand, all factors which vary greatly throughout European cities.

Dublin City Council published a Request for Information (RFI) Notice on 26th April 2023 to consult the market and gather feedback from all the interested parties who would like to operate and or provide services for the micro consolidation centres. The details on the consultation can be found on the eTenders website in the link here:

https://irl.eu-supply.com/ctm/Supplier/PublicPurchase/240845/0/0?returnUrl=ctm/Supplier/publictenders&b=ETENDERS_SIMPLE

The purpose of the market consultation was as following.

- Identify entities interested in facilitating, operating, or utilizing a sustainable delivery eco hub in city centre area.

- Solicit feedback from respondents on needed attributes to make a sustainable delivery eco hub efficient, sustainable, and economically feasible, as well as methods for compliance, enforcement, and overall management of such facilities.
- Solicit feedback on methods to facilitate shared use of a sustainable delivery eco hub by multiple operators so that the sustainable deliveries eco hubs is not unreasonably occupied by any single commercial vehicle operator.
- Solicit feedback from respondents on what limiting factors to be addressed to successfully operate and utilize a sustainable delivery eco hub in Dublin City, including but not limited to land use and zoning restrictions, and city rules and regulations.

Responses for this RFI Notice are sought from two distinct groups:

1. **Delivery and Logistic companies:** who are interested in current or potential micro distribution operations.
2. **Infrastructure Providers:** who could facilitate the micro distribution by providing space for the operations, for example, car parks, empty warehouses, off street parking etc.

The response to the PIN was robust, attracting participation from a diverse array of entities, including delivery and logistics companies, car park operators, and other relevant services. The collective responses form a comprehensive framework for the potential Eco Hub operation, incorporating various stakeholders with a vested interest. It is intriguing to envision the potential outcomes that could arise from a collaborative setting wherein all stakeholders converge to discuss their respective needs, challenges, and operational perspectives.

Task 4.5 City infrastructure planning

Status: **Ongoing.** The work started at month 25 (September 2022) and it is foreseen to be finished at month 48 (August 2024).

Objectives within this period: The goal of this task is to produce a design catalogue for Zaragoza and Dublin cities, demonstrating a tangible integrated road network design for a sustainable urban logistics system.

Description of the work already done within the period:

For this task, an activity planning has been started and a literature search has been launched for guidelines for the designing of streets, intersections, lanes, parking lots, etc. under consideration of cargo handling trying to evaluate the existence of specific standards for this type of design.

Research was conducted on the possible elements that would form the design catalogue and based on the research conducted, the elaboration of the design catalogue, in a general way, was started.

To identify the potential locations for small logistics hubs, socio-demographic data and open sources were collected and data analysis through ArcGIS was commenced.

Finally, we worked on how to recover the data from the Senator platform and how this data could be integrated into the analysis foreseen in deliverable D4.6

3.4.3 Risks and deviations

The following table lists the possible risks for WP4 identified in Annex 1 of the GA, as well as the proposed risk-management measures. In addition, information on if the risks were materialised and if the proposed risk-management measures were applied is provided.

Table 4. List of possible risks for WP3 identified in Annex 1 of the GA.

Risk No	Description of Risk	Proposed risk-mitigation measures	Was the risk-mitigation measures applied?	Was the risk materialised ?
17	Political deadlock that precludes any municipal ordinance strategy	SENATOR will consider stakeholder's engagement including local politicians, the logistics industry, the general public and city businesses. Additionally, it will be included legal services relating. Local public authorities representatives will be engage during WP5 workshops also highlighting the relevance of SUMP/SULPs to facilitate policy promotion and implementation	NO	NO
18	Reduced replicability and sustainability of the project's results in other EU public administrations	Specific tasks relate to the harmonization, alignment and establishment of the appropriate indicators, tools and procedures for data collection, analysis and monitoring from pilot deployments (WP6). Additionally, SENATOR will produce guidelines for long-term sustainability of further platform deployments (T5.1). Further than already engaged follower cities, SENATOR would also engage in the projects relevant EU city associations (EUROCITIES, ICLEI, UITP, Covenant of Mayors...) to facilitate the project impacts	NO	NO

achievement. SENATOR dynamic planning tool will be as much interoperable as possible to be used by different types of EU cities in terms of data availability to facilitate SENATOR replication.

3.4.4 Deliverable and Milestones status

The following tables summarise the deliverables submitted and milestones reached within WP4.

Table 5. Deliverables submitted for WP4.

Del. No	Deliverable name	Lead Beneficiary	Type	Diss. level	Due date in Annex I (month)	Submission Date
D4.1	Best practice catalogue	RINA-C	R	PU	M25	20/09/2022
D4.2	SULP guidelines	RINA-C	R	PU	M25	30/09/2022
D4.3	User demand planning report	ZARAGOZA	R	PU	M33	30/05/2023
D4.4	Transport mode Planning Report	CORREOS	R	PU	M33	30/06/2023
D4.5	Logistic Planning Report	AN POST	R	PU	M33	30/05/2023

Table 6. Milestones reached in WP4.

MS. No	Milestone name	Lead Beneficiary	Due date in Annex I (month)	Means of verification
MS7	Assessment of Zaragoza and Dublin scenarios, peculiarities and identification of local measures and interventions to be performed in each ULL based on SULP Guidelines	RINA-C	33	This milestone was reached by submitting D4.1 and D4.2.

3.4.5 Planning until the end of the project

The next months will be decisive for the closure of the activities relating to the WP4. During this time, it will be necessary to focus on the definition and development of production

guidelines for the design of roads, intersections, lanes, parking lots, etc. based on traffic simulation and local laws and requirements, activities necessary for T4.5.

3.5 WP5 - Sustainable on-demand urban planning and living labs

3.5.1 WP objectives

WP5 involves the development of the pilots on the ULL, testing the ICT platform of SENATOR, measuring results by accurate KPIs, and establishing a data process that ensure the proper development of the project objectives.

WP5 aims to:

1. Assess the KPIs and the environmental impact and emission of the proposed solution by LCA/LCC methodology.
2. Define the PDSA (Plan-Do-Study-Act) cycle approach for assessing and addressing the requirements and specifications for each pilot site.
3. Test, evaluate, and demonstrate the feasibility, effectiveness, sustainability and suitability of 2 ULLs performance, deployed in nodes of TEN-T Core Network (Zaragoza and Dublin) to validate the SENATOR platform.
4. Establish a data quality process and implement data validation rules to ensure the correctness, meaningfulness and security of the data collected by SENATOR platform.

3.5.2 Work progress and achievements during the period covered

All the WP tasks are now ongoing with the exception of T5.2 finished on M32 (April 2023).

Task 5.1 Environmental Impact and Emission assessment of the Logistic proposed approach

Status: **Ongoing.** The work started at M25 (September 2022) and it is foreseen to be finished at the end of the project.

Objectives within this period: The objective of this task has been to assess the KPIs related to sustainable impact and environmental impact considering the project approach and to assess the environmental impacts associated with all the stages of the project product/service's life considering both emissions of vehicles used in the logistic proposed scenario as well as life cycle aspects via a simplified assessment inspired by Life cycle assessment (LCA)/Life cycle costing (LCC) methodology.

Description of the work already done within the period:

Task 5.1 includes **D5.2 Pilot Cases environmental assessment and guidelines for replication** that is ongoing, and it will present the environmental assessment of SENATOR logistics solution and guidelines for replication applied to the pilot cases.

In this deliverable, the results of the pilots defined in deliverables D5.5 Pilot Case 1 results and follow-up (Zaragoza) Report 1 and D5.7 Pilot case 2 results and follow-up (Dublin) Report 1 will be analysed, an environmental impact assessment will be carried out and guidelines for the replicability of the SENATOR project in other cities will be defined.

Task 5.2 Pilot Cases requirements. Restrictions and constrains to develop pilots

Status: Finished. The work started at M13 (September 2022) and it finished at M32 (April 2023).

This task defines the PDSA (Plan-Do-Study-Act) cycle approach for assessing and addressing the requirements and specifications for each pilot site taking into consideration stakeholders needs. This task works in conjunction with WP6 (T.6.1) and WP7 (T7.2).

The progress made in this task have been in the deliverable **D5.4 “Pilot cases requirements_report2”**, and whose purpose is to clearly define the reference scenario considering the identification of the main needs to be realised in each ULL scenario, in terms of technology (T1.1), implementation and users’ requirements; Stakeholder management follow-up; Main KPIs related to living labs performance from T5.1, WP3 & WP4 inputs. This deliverable is alive and will be adapted to the needs of the pilot and its barriers. This deliverable has been elaborated by CORREOS with the contribution of partners and based on ZABALA internal procedures and templates. This deliverable has also been supported on the Consortium Agreement (CA) document.

The beginning of the pilot has posed a significant challenge for the team, as several barriers have been encountered. The most significant of these is the GDPR regulation, which has greatly hindered the development of their initial approaches. As a result, the team has experienced significant delays, as direct data cannot be shared in the Zaragoza pilot without undergoing a transformation to comply with legal regulations.

In the case of the Dublin pilot, it has not been possible to find another operator with whom to partner with for the UCC and innovative last mile transport modes trials. To overcome these obstacles, the team has focused on developing theoretical scenarios. In the coming months and until the end of the pilot, great progress is expected. This is due to the most significant barriers being identified and new approaches determined in order to meet the project objectives.

The virtual kerbside and digital parking/loading bay management trial is being conducted as a physical trial. Most importantly the Dublin pilot will help to ensure project replicability for future EU actions, as the barriers and learnings from the Dublin pilot will help to inform future EU actions and increase their chance of success.

Task 5.3 Pilot Case 1 development – Spain

Status: Ongoing. The work started at M17 (January 2022), and it was foreseen to be finished at M43 (March 2024) but is still ongoing. This task has suffered several delays as it is described at the end of this section, and a 6-month extension has been asked to CINEA.

Initially, the pilots were structured to be able to use the facilities of the San Vicente de Paul Market, provided by Zaragoza City Council (two premises, a cold store and a loading and unloading area). However, currently, due to the development of the pilots and the low number of “cold” shipments from the local markets, these facilities are not yet in use, but have been considered in the theoretical pilots, preliminary to the physical trial that will be conducted from September 2024 onwards, and the possibility of using these spaces for pilot 1D is not ruled out, based on the data obtained from the analyzes and studies of theoretical pilots 1A, 1B and 1C.

Since M37, several technological developments have been carried out that are enabling the pilots to be implemented. Before running the pilots, some of those developments include:

- **Data Anonymization:**

Due to GDPR, Spanish Postal Law, and Correos Group internal policy on Data Protection, any personal data cannot be shared with third parties. In one hand, that includes the name and address of receiver, shipment code or any data that can allow the recognition of receiver. In order to avoid data sharing, among operators and/or partners, the name of the receiver is not shared, the delivery code is anonymized, and the address is changed by the GPS coordinates with a 5 metres mistake to ensure the complete anonymization of the exact position, considered as personal data.

On the other hand, although both the PDA ID and the car licence plates are shared on the dashboard and can be followed in real time, no personal data of the user/driver is shared, therefore that cannot lead to identify the postal personnel. These requirements have been accomplished by Correos IT Team, as it was mandatory to ensure data anonymization before sending any data to the partners.

- **Regular Data Extraction:**

Once the Data Anonymization has been made, Correos IT team has continued doing the developments needed to obtain the data that will be used during the pilots and those developments are still ongoing to fit the formats required by the optimizer to work properly, the information needed in some cases is not available in the postal systems, so it has to be manually included by DEUSTO. Adapting the information from the IT systems of CORREOS

to this format, anonymising the information, and daily extract the information needed for the project, has increased the complexity of the IT developments and took months of development (from October 2023 to February of 2024 as well as continuous subsequent revisions and small adaptations). From 7th of February of 2024, daily data extractions are sent to the IT team of UDEUSTO, and those files have coordinates from 23rd of April and onwards. This delay has affected the pilots and developments within WP3. This file includes the prediction of the shipments that will be delivered in the Zaragoza city center that day. The problem faced with this is the ratio of shipments with coordinates, which is about 40%, and some studies are ongoing to increase this data quality for the physical pilots. The quality of the information from Correos shipments is uneven, which directly impacts this quality of the information necessary for the platform, so for the 1D pilot the pilot and obtaining information will focus on parcel shipments, ruling out including traditional postal shipments in route optimization, since the level of information necessary for the optimizer to work can only be obtained with this type of shipment.

- GPS coordinates of the deliveries:

Correos usually works with addresses, but in order not to share personal data, Correos IT team has run a development to extract the GPS coordinates of all the deliveries, which have an error of ± 5 meters to avoid giving the exact address. For those shipments that the actual development can't obtain the coordinates, other solutions are being evaluated to have this issue solved before the pilot 1D, this includes the potential use of IA.

- Other technological developments:

In order to be able to share the real position of the vehicles participating on the pilot, a development to link the GPS of the vehicles was developed and integrated with the ICT platform. Some vehicles are not sending properly the information and are being analysed by Correos to have it solved as soon as possible, specially before starting the pilot 1D (physical pilot), these issues arise from compatibility API problems between the senator platform and the system of the vehicles, but also problems due to physical disconnections currently in the process of resolution.

Additionally, a new IT development was conducted and integrated to share the GPS position, based on the GPS included in the PDAs used by Correos postal delivery workers; also another development was conducted to link the licence plate with the device (PDA), and help the identification of the motorised routes and the vehicles sensorization in the ICT platform. As of the date of writing this document, they are in the process of final integration and validation.

Pilot 1: Local market consolidation and cross-docking:

- A. Putting together all the shipments from Correos and Correos Express of one day.

Due to the high number of deliveries of both postal companies for one day, Deusto is reviewing the approaching to this part of the pilot. The algorithm response depends on the

amount of input data provided and the iterations and checks to cover all possible combinations until it gets the most efficient and reliable solution. From the first's tests, it was stated that if all the information is sent together, it takes the algorithm hours (or even days) to give the optimized routes, as it takes a long time to process all the information received and will not be able to give the route planification solution in a due time. For this reason, the problem has to be divided in small ones to include all the deliveries of one day for both Correos and Correos Express. The scope has been reduced from the whole city of Zaragoza to one delivery unit and its radius of action, for the 1D pilot, because if it is launched with all the deliveries of one day for both Correos and Correos Express, it takes the algorithm hours (or even days) to give the optimized routes, as it is not strong enough to process all the information received in a due time.

In parallel, Correos is working on a technological development to obtain the unit dispatch file (This file will be the one obtained after reading all the parcel shipments that arrive at a delivery unit) that includes all the fields necessary for the algorithm to work correctly, including GPS coordinates, instead of using a predictive bigger file, and focus on the parcel deliveries for the 1D pilot (physical one). This will ensure having all the information needed in time and quality.

For this pilot (1A), extraordinary data extractions were carried out by the technological team of Correos and CEX, to obtain a complete day's data of all shipments from Zaragoza delivered by both companies, as far as the predictive file has not 100% of the information on the format required. These anonymized data were obtained by completing the information that was not available (coordinates) with the delivery coordinate of the shipments, anonymized with a geopositioned error of ± 5 meters.

B. Including picking up in the planning:

Using the anonymized data of the shipments of a customer of Correos, which proposes established routes with delivery order and distribution times, a comparison is being made with the routes proposed by the optimizer. The optimizer has been configured with the restrictions of shifts, times and order of deliveries settled by the provider.

Two scenarios have also been proposed, using the San Vicente de Paul market as a consolidation point, and the result has been that the delivery time and the number of km carried out can vary depending on the start time of the delivery routes.

Those results are being analyzed by the operations, finance, and sustainability teams of Correos and discussed in several meetings, also calculating the KPIs to properly evaluate the solutions of the optimization system. These results analysis is being conducted in parallel with the 1D pilot planification (the physical pilot) and working meanwhile to solve the possible problems that will need a solution before starting it. Also, the process and physical design of the pilot has been initiated.

In parallel, Deusto is making the necessary technological development to be able to include a new shipment from markets once the routes have started. This development will cover the dynamic planification established in the pilot definition.

Pilot 3. Regional market (mercaZaragoza) consolidation

For the development of this pilot, various analyzes are being carried out to study the logistical but also economic viability of this consolidation. To do this, we have analyzed the information on the economic and logistical activity of Mercazaragoza, the central market of the region, and the retail trade in the city of Zaragoza that purchases raw materials in Mercazaragoza.

These analyzes will allow us to determine whether there are potential operational and efficiency improvements in the management of resources as well as the economic impact that it would have if an operator like Correos could consolidate the merchandise in Mercazaragoza and then distribute it to the retailer and final consumer.

These results are expected to be finished before September 2024.

Pilot 4: Smart management for loading bays around a public market and in parking areas in four strategic points around the city

Zaragoza has published a public call for tenders to carry out a Study for a better quality service for load/unload bays in the city of Zaragoza and other regarding the car park for loading and unloading unit and the use of an app that will allow the reservation of parking spaces for that use and that it is intend to be integrated with SENATOR.

Task 5.4 Pilot Case 2 development – Dublin

Status: Ongoing. The work started at M17 (January 2022) and it is foreseen to be finished at M43 (March 2024). This task has suffered several delays as it is described at the end of this section, and a 6-month extension has been asked to CINEA.

Dublin's pilot is investigating *Virtual Kerbside Management, Digital parking/loading bay management, Urban consolidation centres (UCC)* and *Innovative last mile transport modes* through:

1. stakeholder engagement
2. historical delivery data
3. physical and theoretical trials

As laid out in the Grant Agreement (GA) it is envisaged that the Dublin pilot will be trialled in a number of different city centre locations in a variety of activity zones (e.g. retail, residential and commercial). With this in mind the Dublin 2 area was chosen as the ULL, this region in Dublin contains approximately 7,000 residential addresses and hosts a significant breakdown of commercial and retail organisations.

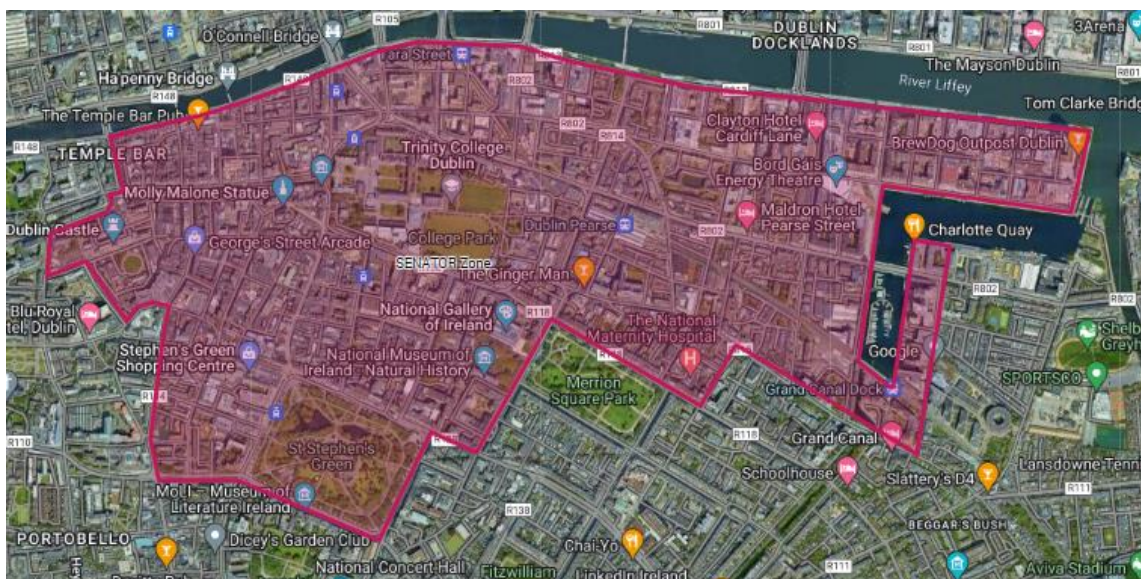


Figure 29: Dublin ULL

UCC & Innovative Last Mile Transport Modes

It was envisaged that a physical UCC trial would be conducted in the Dublin pilot. For this trial An Post would provide the infrastructure and staffing. An Post's Delivery Service Unit (DSU) on Ravensdale road would be used as the UCC and An Post's vehicle fleet and postal operatives would be used to carry out deliveries. Ravensdale DSU is located north of the ULL, it was chosen as the UCC because it serves the Dublin 2 area. Figure 10 below illustrates, at a high level, how it was hoped the UCC would operate in Dublin.

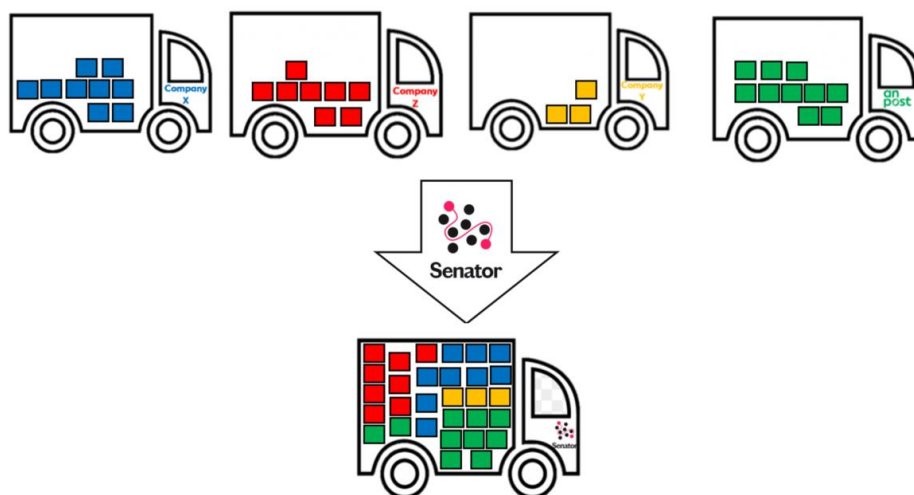


Figure 30: Planned UCC Operations in Dublin

As shown by the latest development of the project, physical trials might not be feasible, so the planned operational process will be simulated instead. The simulation will consider factors such as processing times to ensure accuracy.

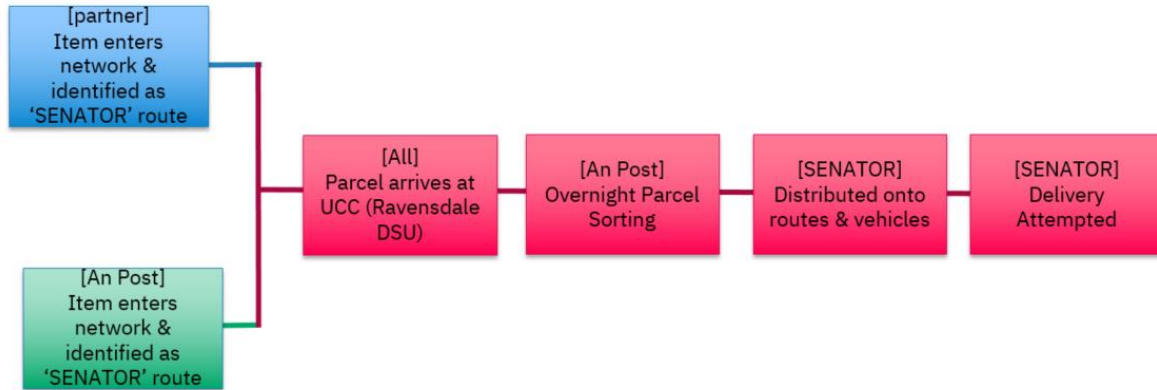


Figure 31: High Level Overview of Planned Operational Process in UCC

The Dublin ULL was reviewed in detail by the An Post Route Optimisation Team, and the Final Mile Delivery Team. The teams used their knowledge of the area and applied the project brief to identify two optimal routes to be tested within SENATOR.

Through a number of workshops and meetings with other delivery companies, great detail was looked at for the UCC trial. Unfortunately, during our collaborative work there were some barriers to crucial delivery elements within the trial which the group could not overcome in the lifetime of the project. As a result of the barriers, the decision has been made to conduct a theoretical UCC trial. The advantage of a theoretical is that limitless scenarios can be tested and explored, enabling us to identify the most sustainable and efficient ways to deliver in to European cities.

The stakeholder engagement, technical progress and barriers related the UCC trial mirror the innovative last mile transport modes trial, therefore, this will also be a theoretical trial. Similar to the theoretical UCC trail this presents an opportunity to test scenarios that would not have been otherwise possible.

The barriers included:

IT & Scanning

Tracking data is used for:

- Operational purposes (e.g. reporting, route sorting)
- Customer communication.

- Significant operational, reporting and customer service issues would arise if these processes were impacted in a negative way.
- A physical trial without an IT integration was explored:
- This would require a manual process in place to indicate the volumes of items from each delivery partner arriving to the UCC.
- A manual handover process for the transfer of delivery items from delivery partners in to the UCC would also be required.
- The risk associated with this (e.g. items unaccounted for during the handover and who would be responsible in this scenario) was the most significant concern.

Scanning:

- The scanning programs used by each delivery organisation is different.
- Barcode specification also varies.
- For a physical trial the scanners and barcodes would have to be adapted, this would require a level of investment, time and resources that would surpass the budget and timeline of the project.
- A physical trial without scanner and barcode adaptation was explored:
- The postal operatives delivering would use a scanner from each delivery partner participating.
- Postal operatives would have to use multiple scanners at one address, impacting delivery times.

Missed Deliveries

Not all delivery items are successfully delivered, for example if the customer is not home to receive their delivery. Different delivery organizations have different processes in place to deal with this.

Working Agreements

An Post would provide the infrastructure, vehicles and staff for a physical trial. Different delivery companies operate with varied staffing models, for instance directly employed staff or contracted staff. There have been legal barriers associated with removing deliveries from contracted staff.

Additional Barriers

Each delivery company has commercial agreements to complete deliveries for commercial customers. Some delivery organisations complete their collections when delivering, others have separate collection routes/duties. Each delivery company has different delivery time

commitments including express and same day delivery. Penalties could be incurred for deliveries that did not meet their delivery promise.

The advantage of theoretical trials is that limitless scenarios can be tested and explored, enabling us to identify the most sustainable and efficient ways to deliver it to European cities. It will also provide important learnings for future projects. The theoretical trials will be conducted using An Post delivery data (where possible) and simulated delivery data.

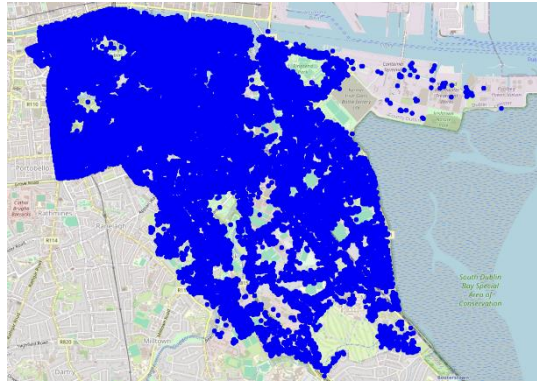


Figure 32: Simulated data in the dublin pilot



Figure 33: Different scenarios to be investigated

The different scenarios that will be tested using delivery data from three periods, in particular 1) Baseline delivery period, 2) Peak delivery period, 3) Quiet delivery period.

Virtual Kerbside Management & Digital parking/loading bay management

To manage the varied environment within SENATOR ULL in Dublin, Dublin City Council (DCC) initiated the creation of a digital inventory of kerbside assets. This inventory includes kerb assets, geolocation information, current regulations, signage, fixtures, and uses. Recognizing the need for a suitable, cost-effective, and time-efficient surveying technique for Dublin streets, DCC decided to test two methods: LiDAR surveying with Appyway and Augmented Mobile Mapping with Curb IQ.

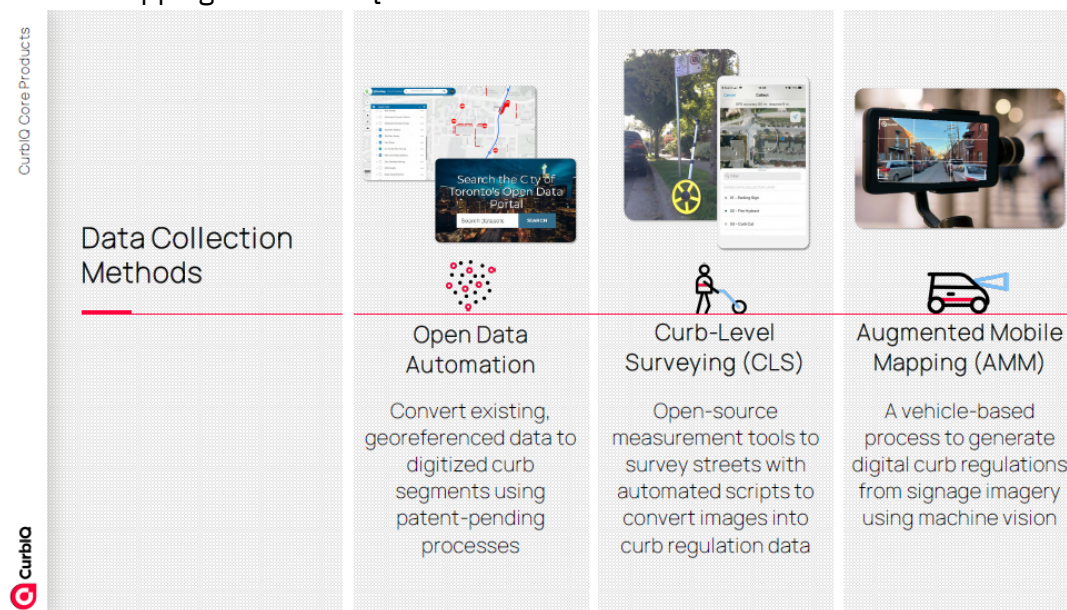


Figure 34: Curb IQ' Augmented Mobile Mapping

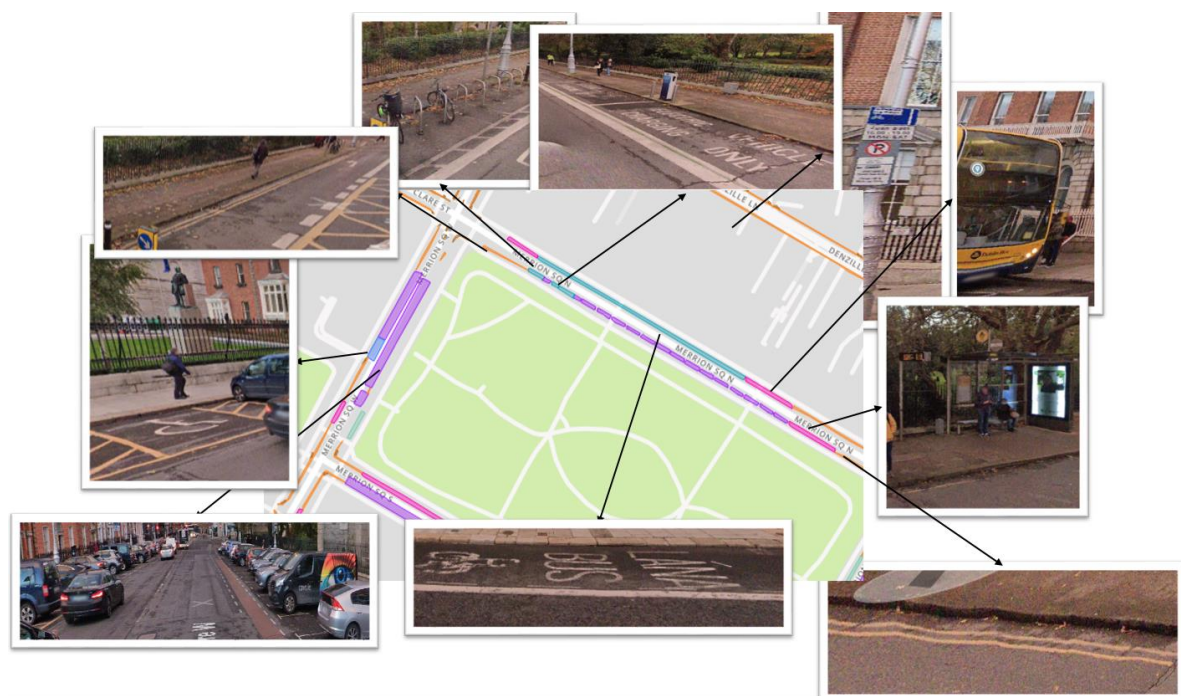


Figure 35: Appyway LiDAR Survey

The list of kerb side assets available on the platform can be found below.

Table 7: List of extractions from Appyway and Curb IQ

APPYWAY AND CURB IQ LIST OF EXTRACTIONS		
Bays/Signs/ Markings	Dedicated Lane Zones	Limits
Resident Bay	Pedestrian Zones	Speed Limit
Paid Bay	Cycle Lane	Weight Limit
Permit Bay	Bus Lane	Height Limit
Disabled Bay	Yellow Box Junction	
Electric Bay		Traffic Restrictions
Car Club Bay	Pay and Display Device	Prohibited Turn
Loading Bay	Kerb Extension	No Entry
Taxi Rank	Kerb Cut	Prescribed Turn
Bus Stand		One Way
Pedestrian Crossing	Mobility Assets	
Shared Use Bay	Bicycle Rack	Public Realm
Single Yellow Line	Bike Stations	Bins
Double Yellow Line	Bus Stops	Public Seating
School Marking		Lamp Poles



Mapper

Dublin City - Baile Átha Cliath

Static Orders

Viewing active restrictions - Read only

Orders Data edits Features Operating Hours Tariffs Public Holidays Exemptions Suspensions

Deselect all Filter by selection

Zone	Restriction	Operating hours	Tariffs	Public Holidays	Exemptions
Outside Zone (4)					
fenianstreet	Cycle Hire Bay	Operating hour 1 > CP	Not applicable	Not defined	Not defined
Magenris Place	Double Yellow Line	Operating hour 1	Not applicable	Operating set 1	Not defined
Sandwich Street Lower	Paid Bay	Set 7 C, Yellow Banner > PAD, PBP	Yellow tariff PAD > PAD	restrictions not applied	DB
Sandwich Street Lower	Bus Bay	Operating hour 1 max 2h > PADB	Yellow tariff PBP > PBP		
		coach tariff > PADB		Not defined	Not defined

Figure 36: Real Life Instances from the Platform

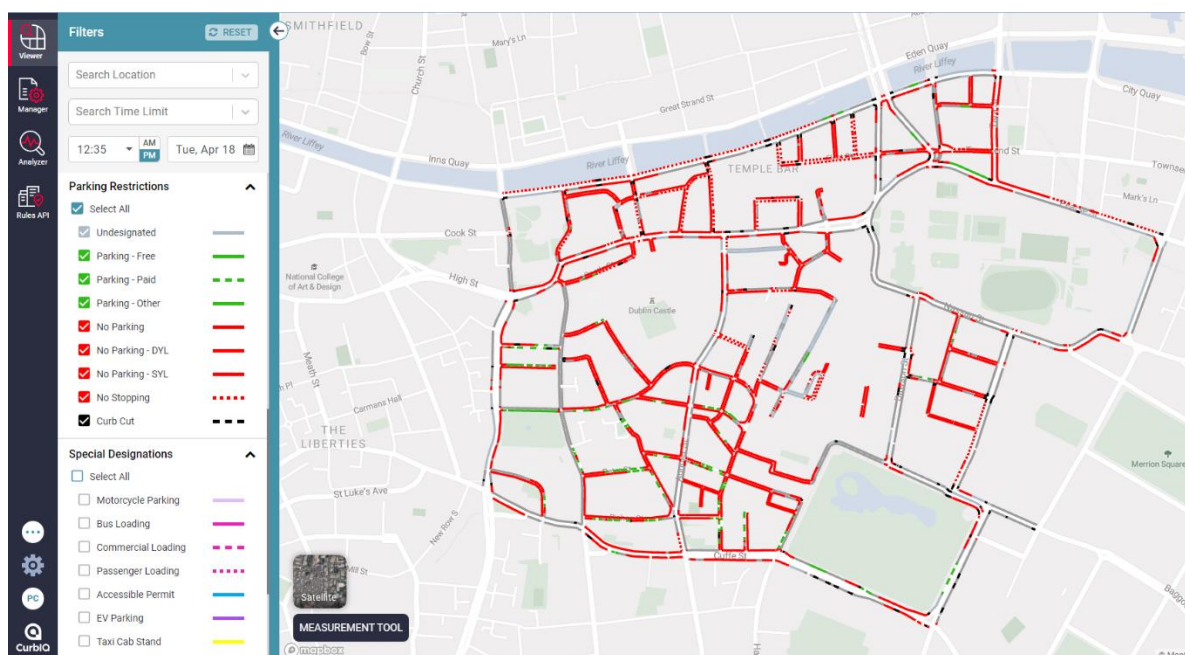


Figure 37 Curb IQ Platform

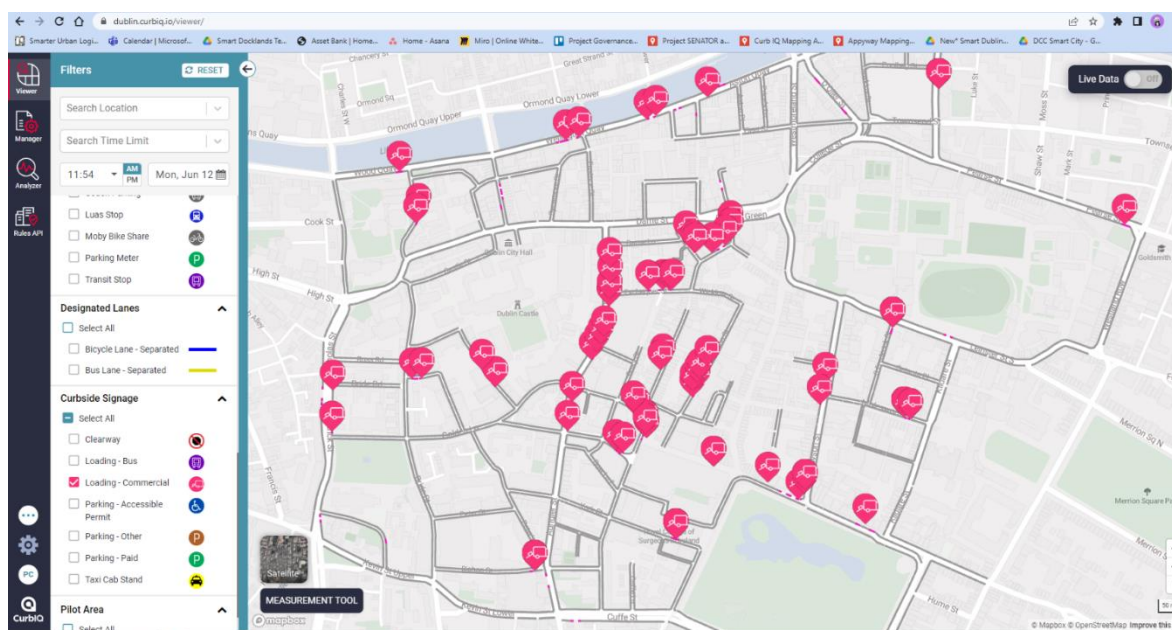


Figure 38 Loading Bays Locations on the Curb IQ platform

The Digital Kerbside Pilot, initiated in October 2022, has been integrated with the SENATOR platform via CSV files. This integration provides maps detailing the locations of loading bays in the SENATOR zone, a data stream that previously did not exist. The API through the Curb

IQ platform has been extended to An Post to test the integration of this data with their internal systems. Details of the kerbside journey can be found below.

To address the challenge of regularly updating the platform, Dublin City Council (DCC) is collaborating with Inakalum to digitally map the pilot area, ensuring that data on the existing platforms remains current. This collaboration will help DCC maintain an up-to-date inventory of kerbside assets.

Kerbside Journey So Far..

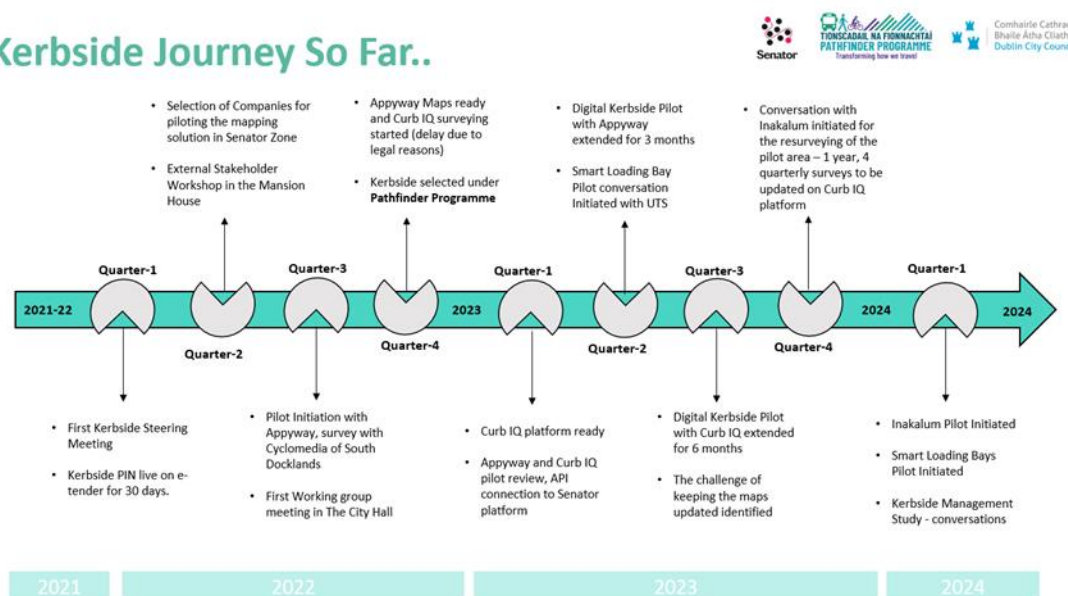


Figure 39: Timeline of the Kerbside

Notably, this initiative has been selected as one of the 35 projects under the **National Pathfinder Programme**, an initiative by the Department of Transport aimed at achieving Ireland's net-zero targets. More details can be found [here](#).

Additionally, Dublin City Council has installed 49 sensors in nine strategically identified loading bay locations, selected by the DCC transport team and the An Post SENATOR team as the busiest areas. These sensors provide real-time availability of the loading bays via a web platform and a mobile app, allowing delivery drivers to navigate to available bays, thereby reducing circling and air pollution.



Figure 40: Sensor Installation on the loading bays

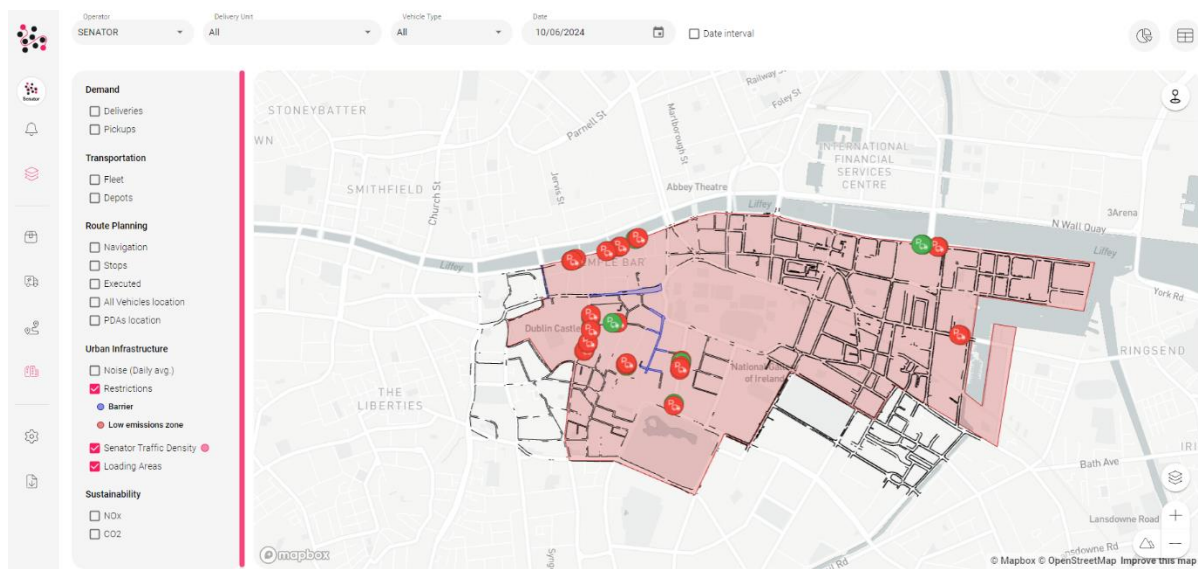


Figure 41: Smart Loading Bays on Senator Platform

Task 5.5 Data Validation - Data Quality

Status: Started. The work has started at M40 (December 2023) and it is foreseen to be finished at M48 (August 2024).

This task will define means by which the SENATOR environment will validate its data and establishes a data quality process which ensures valid, verified, standardized and reusable data as an outcome.

The analyses of the quality of the information have begun in parallel to the pilots, since the data is the starting point of the optimizer, and several developments have been carried out by the Correos technological teams to find solutions following an agile methodology, and will be collected in deliverable D5.9.

3.5.3 Risks and deviations

The following table lists the possible risks for WP5 identified in Annex 1 of the GA, as well as the proposed risk-management measures. In addition, information on if the risks were materialised and if the proposed risk-management measures were applied is provided.

Table 8. List of possible risks for WP5 identified in Annex 1 of the GA.

Risk No	Description of Risk	Proposed risk-mitigation measures	Was the risk-mitigation measures applied?	Was the risk materialised ?
19	Not all scenarios for each use case can be validated in real world conditions	During the elaboration of this proposal, conversations have been held with different cities (Lisbon, Ghent, Amsterdam), and they expressed interest in participating in SENATOR 's proposal. In the event of such a risk, one of these cities could be involved in WP5	YES	YES
20	Urban living lab delays due to technical problems, lack of support from stakeholders , or business priorities	The ULL cases are designed for stimulate cocreation processes involving multiple stakeholders. Additional participative processes can be provided enhancing stakeholder involvement. This is expected to increase the support from crucial actors, boosting a more solid foundation for the implementations. Each ULL coordinator will be made considering critical pathways, risk analysis and Project Management (PM) methods (e.g. PMP or IPMA) in WP5 tasks. Moreover, a monitoring procedure will be established,	YES	YES

		where the status of each ULL is reported to WP leader at least every three months.		
21	Urban living lab needs huge modifications that the proposal promises to study due to technical problems, lack of support or business priorities	ULL leaders will schedule during pre-commission stage in WP5 a specific risk management procedure for each ULL. If any kind of modification were needed, all demonstrative ULLs are very versatile and adaptable based on initial requirements (WP1) and stakeholder engagement (WP7). Project Management (PM) methods will be applied. In addition, IAB members also include supporting European cities. These cities will provide one alternative ULL area in case of one initial ULL cannot be demonstrated.	NO	NO

Other technical deviations have occurred in WP5, particularly in:

In Dublin it was necessary for local delivery companies to collaborate in order for the planned consolidation centre to operate. However, it was not possible to reach an agreement among the companies as each company had working agreements for its staff (e.g., contracted staff that can undertake a specific number of deliveries) and commercial agreements with its customers (e.g., for exclusivity, penalty in case of delays or missed deliveries) that could not be adjusted for the shake of the pilot. The Dublin Urban Living Lab (ULL) partners dedicated time in exploring different alternatives with no positive outcome to allow the timely completion of the physical trial. Therefore, they request additional time to simulate the operation of the consolidation centre and connect it with the on-going kerbside management activities.

In Zaragoza, new and updated data privacy regulations (European and Spanish) and data sharing policy on third party data (imposed in Correos) necessitated an update of the foreseen data collection, storing, and sharing plans. An updated data collection plan and updated data anonymization strategy have been defined at the end of RP2. Unexpected delays were realized due to the vote by mail elections in Spain (May and June 2023) that increased the workload of Correos in a critical phase of the project. As they overcame the data-related barrier, the Zaragoza ULL partners request more time to implement and complete the pilot activities.

Additionally, obtaining the data necessary for both, the development of the Zaragoza pilots and the simulations of the Dublin pilot, have not been available until beginning of 2024. This represents at least a year of delay in obtaining the data, its availability is an essential piece to begin testing the technological solutions, they need to be processed and analysed in

parallel to the final phases of development, to properly test the algorithm, and are essential to complete the pilots and final results and deliverables.

3.5.4 Deliverable and Milestones status

The following tables summarises the deliverables submitted and milestones reached within WP5.

Table 9. Deliverables submitted for WP5.

Del. No	Deliverable name	Lead Beneficiary	Type	Diss. level	Due date in Annex I (month)	Submission Date
D5.1	Life cycle assessment for the emission/environmental impact evaluation of SENATOR's scenarios	RINA-C	R	CO	32	28/04/2023
D5.3	Pilots cases requirements_report 1	CORREOS	R	CO	18	30/03/2022
D5.4	Pilots cases requirements_report 2	CORREOS	R	CO	32	29/09/2023
D5.5	Pilot Case 1 results and follow-up (Zaragoza) Report 1	CORREOS	R	PU	30	28/02/2023
D5.7	Pilot Case 2 results and follow-up (Dublin) Report 1	AN POST	R	PU	30	28/02/2023

Table 10. Milestones reached in WP5.

MS. No	Milestone name	Lead Beneficiary	Due date in Annex I (month)	Means of verification
MS8	Environmental assessment: evaluation algorithms finalized and integrated in SENATOR planning tool	RINA-C	32	This milestone was reached finalizing the environmental assessment and integration of the tool and by submitting D5.1.
MS9	Pilot cases requirements ready for pilots' development to start	CORREOS	18	D5.3 submitted.

3.5.5 Planning until the end of the project

The following tasks linked to WP5 are foreseen to be carried out in the following months:

- Finalisation of the theoretical pilots defined in T5.3 Pilot Case 1 development - Spain: this includes, not only defining and carrying out the theoretical scenarios established in pilot 1A to 1C, but also the analysis of the results obtained, as well as the extraction of the relevant conclusions and insights to properly develop the 1D physical pilot.
- Likewise, once the necessary technological developments have been finalised, pilots 1D and 2 will be launched, with the participation of the logistics operators Correos and Correos Express, which will carry out a day of operations following the routes determined by the optimiser. Once the pilots have been completed, an analysis of the data obtained will be carried out and a comparison will be made with the operations currently carried out by both logistic companies.
- In reference to the pilot 3, Regional market (MercaZaragoza) consolidation, the analysis of the data obtained in the realisation of the above-mentioned pilot will be finalised. In addition, a public tender will be carried out which will consist of the realisation of a Demand analysis to understand the habits and needs of the citizenship, as well as Co-creation sessions with different stakeholders (retailers, logistics operators, citizens, civic associations, etc.) to define scope, objectives, needs, new ideas, etc.
- Finally, the technological developments necessary for the implementation of the pilot 4 Smart management for loading bays around a public market and in parking areas in four strategic points around the city will be carried out by Zaragoza and will include, among other actions, the publication of two public tenders, on the one hand a study on Last mile dedicated traffic loads in LEZ (quantitative/qualitative campaign and diagnose) and on the other hand a study on Locker location mapping for more efficient and sustainable last-mile delivery.

3.6 WP6 - Business models

3.6.1 WP objectives

WP6 involves monitoring the business environment within which the SENATOR solution is being developed (policy, legal and market aspects) and defining the existing business models generally used for 'last mile' urban logistics; it then involves developing a business plan and investment model for the SENATOR solution, ensuring that emerging Intellectual Property Rights (IPR) is protected and developing an Exploitation Plan for the project partners for the future.

WP6 aims to:



1. Define the business models and methods for the newly market niches and services opportunities obtained from project implementation and digital decision-making tools developed in the sustainable urban planning area.
2. Define and develop a strategy to appropriately protect the IPR and manage the knowledge of the consortium.
3. Define the investment models for planning the growth opportunities for the last-mile logistics services and analyse the exploitation opportunities that emerge from the project.

3.6.2 Work progress and achievements during the period covered

The WP6 started at M1 (September 2020) and is expected to be completed at the end of the project. Task 6.1 was completed during Year 4, while Tasks 6.2, 6.3 and 6.4 are all still in progress.

Task 6.1 Technical and market-regulatory recommendations for integrated flexibility services; Market barriers, SWOT analysis, stakeholder influence

Status: **Completed.** The work started at M1 (September 2020) and was completed in Month 45 (May 2024).

Following a kick-off meeting for the WP in late 2020, progress was focused initially on drafting and submitting **D6.1 “Business environment analysis: technical and market-regulatory recommendations Report 1”**, which was one of the earliest deliverables for the project (delivered in M6). This report was updated as **D6.2 “Business environment analysis: technical and market-regulatory recommendations Report 2”** for delivery in M21, with a final update as **D6.3 “Business environment analysis: technical and market-regulatory recommendations Report 3”** which was delivered in M45.

These deliverables describe the business and regulatory environment within which the SENATOR products and services would be provided, considering both policy/regulatory and market-based issues. In particular, they set out the physical logistics business models that are being deployed in the market for ‘last mile’ urban logistics in Europe; it is one or more of these physical logistics models which will be made more efficient and/or effective by the ‘SENATOR system’ and therefore lays the foundation for further work in WP6 on the business model for SENATOR itself (Task 6.2).

The deliverables have concluded that the major emerging issues and associated policy/market-based measures are as follows:

- The key issue in relation to urban logistics is the need to minimise the environmental impact of urban deliveries and therefore public policy seeks to both minimise the impact of urban logistics and enhance the wider urban environment, while at the

same time acknowledging that goods still need to be efficiently delivered to ensure that urban areas remain economically competitive and attractive places to live or work.

- The key long-term objective currently with respect to minimising the environmental impact of urban logistics is the replacement of diesel- and petrol-powered freight vehicles by other forms of propulsion (principally battery electric vehicles) and the greater use of non-road modes where feasible such as cargo-bikes, so called 'portering' and, in some more limited cases with urban areas, rail and barge.
- The other main area where the environmental impact of urban logistics can be mitigated is through the application of highway management powers. These powers assume the use of diesel- or petrol-powered road freight vehicles, but the type and time of day they can operate is restricted through weight and length restrictions, time restrictions and restricting or banning vehicles which generate the highest levels of gaseous and particulate pollutants.
- A number of urban areas have introduced road charging schemes either to reduce road congestion (congestion charges) or to improve air quality (Low Emission Zones).
- Urban consolidation centres are where multiple freight operators (3PLs and own account operators) initially deliver goods into a warehouse type facility located on the urban fringe. However, where their use has been voluntary, take-up to date has been very limited because additional handling adds cost to the supply chain, large-retail chains are already receiving deliveries in full loads and 3PLs (such as parcel couriers) are already in effect consolidating cargo from multiple shippers into shared transport capacity. As a result, freight vehicles are already running fully-laden (or approaching fully-laden) on the initial inbound flow into urban areas. Further large-scale take-up of urban consolidation centres is therefore unlikely, except where special/specific circumstances have been demonstrated and necessitate some form of consolidation.

A significant change in D6.2 compared to 6.1 is that the European Commission has published a New EU Urban Mobility Framework within which there is a significant emphasis on urban logistics within the context of the overall subject of urban mobility. It recognises that urban logistics is essential to the functioning of urban economies, while also aiming to completely decarbonise urban freight deliveries and collections by 2030. The more explicit inclusion of urban mobility - and urban logistics – into the TEN-T should help to improve the integration of longer distance freight movements with first and last mile collections and deliveries via multi-modal distribution parks on the edge of urban areas and increase accessibility to EU funding for necessary infrastructure.

In addition, a case study on the application of the EU Postal Services was completed which suggests that full market competition has generated an open and highly competitive environment for parcel services, resulting in significant market choice in terms of the range of services offered, improved quality of service and lower costs to end-users. It has also

necessitated efficient working practices in order to remain competitive and retain/win business. This partly explains the growth of e-commerce (ability to access commercially competitive delivery services). While the Universal Service Obligation (USO) has been maintained at the same time as the introduction of full market competition, future urban delivery policies and technologies will need to recognise and accommodate the provisions of the Postal Services Directives. In particular there is the need to maintain a fully open and competitive market for parcel delivery services alongside the inability to specify/grant special privileges or rights to certain operators.

D6.3 “Business environment analysis: technical and market-regulatory recommendations Report 3”) was published in M45 (May 2024) and included an additional section on technological developments which affect the business environment within which the SENATOR platform has been developed. It also provided policy updates on the TEN-T, guidance on Sustainable Urban Mobility Plans (SUMPS) and on legislative initiatives to reduce the carbon emissions from road freight transport. Finally, it included some of the lessons learned within the project on the application of GDPR in Spain and its impact on the Zaragoza Urban Living Lab.

Task 6.2 Emergent business models for On-Demand economy. Business model generation (Canvas and Cost-benefit analysis)

Status: Ongoing. The work started at M12 (August 2021) and it is foreseen to be finished at M36 (August 2023).

The first deliverable from Task 6.2 was **D6.4 “Business Model Report 1”**, and its public version **D6.5**, which was the first draft of the Business Plan for the emerging SENATOR Platform. It described the rationale for how an organisation that owns the SENATOR Platform can create, deliver and capture value.

Given the business-focussed nature of D6.4, the description of the SENATOR Platform - the ‘product’ that would be offered to the market - is summarised in terms of its Services Layer which provides the business functionality that would be perceived by users:

- On-demand Platform Manager
- Multimodal Fleet Manager
- Smart Routes Manager
- Diagnosis of Urban Infrastructure

The deliverable suggested that the key sources of added value at a strategic level provided by the SENATOR Platform compared to in-house platforms operated by individual Transport Providers in urban areas are likely to be as follows:

- The ability to collaborate by transferring information between different operators to reduce costs and environmental emissions;

- The ability for demand to be met in a multimodal manner, whether by electric LGV, e-cargo bike or by walking depending on the choice of the user; these choices could, for example, be to minimise costs or minimise carbon emissions.

Given the lack of available data from the two Living Labs at the time, D6.4 could only then discuss the theoretical value generated by the availability of the SENATOR Platform in both Dublin and Zaragoza, such as being able to facilitate consolidation of loads to zero emission vehicles, which would allow the inbound Transport Provider to avoid its vehicles having to drive into the city centre and offering continuing choice of providers for the Receivers of goods as all Transport Providers are able, indirectly, to offer a last mile delivery service into city centres. In addition, environmental benefits would be secured for society through the zero emission last mile service (principally lower greenhouse gas emissions, improved air quality and adding to the quality of place in the city centre); there would also be potential ESG (Environmental and Social Governance) benefits for Shippers and Transport Providers in terms of helping them to monitor and demonstrate that they are working towards meeting their carbon reduction targets.

The deliverable then discussed some of the quantified benefits from a case study in Chester city centre where the SENATOR Platform could, in principle, enable a delivery service into the pedestrianised city centre to be feasible throughout the working day (i.e. even when it is closed to traffic) by providing software to coordinate and plan a transfer of parcels from inbound Transport Operators to last mile delivery by e-cargo bikes.

The benefits of the service - to set against an estimated additional €2 per parcel operational cost - would be as follows:

- Potential efficiencies available elsewhere in the supply chain (generating cost savings for the inbound transport provider), due in particular to the inbound Transport Providers being able to avoid its vehicles having to drive into the city centre and carry out the deliveries, so that they are available to carry out other work;
- The quality of service benefits for Receivers with the greater flexibility and convenience from being able to receive deliveries throughout the day;
- The environmental benefits secured for society through the e-cargo bike service as a result of the availability of the zero emission service (principally lower greenhouse gas emissions, improved air quality and adding to the quality of place in the city centre).

Based on the above, a preliminary SENATOR Business Model based on canvas methodology was developed. The canvas summarises all the elements of a company's business model, including its Value Proposition (its products and services and how they add value), along with its customers (Customer Segments), how the company relates to them and delivers the product/service (Customer Relationships and Channels). It also highlights the Key Activities required to deliver the Value Proposition and the human, physical and digital resources (Key

Resources), as well as the financial resources (Revenue and Costs) that would be required to run the company.

A further more detailed assessment of the costs and benefits from the Living Labs in Zaragoza and Dublin will become available for the 2nd Report for Task 6.2, following the implementation and trialling of the platform in the Urban Living Labs (ULLs) in mid-2024.

In preparation for this, WP6 developed generic cost models for the different modes of transport, resulting in a fixed operating cost per minute and a variable cost per kilometre for each mode for inclusion in the SENATOR platform. These costs allow the platform to provide outputs in terms of changes in user costs, which will be an important element of the value created by SENATOR. Also, in preparation for the drafting of D6.5/6.6, WP6 organised a workshop with the partners involved in WP5 in February 2024 to explain the main types of potential benefits from SENATOR (reductions in user costs and non-user costs and increases in wider economic benefits) and the methodology for collecting them, which is based on comparing the “BEFORE SENATOR” counterfactual with the “AFTER SENATOR” scenario. WP6 has also been developing a methodology to allow the quantified benefits that emerge from the ULLs in WP5 for Dublin and Zaragoza to be grossed up on a reasonable basis to the European level, so that the value proposition for the potential SENATOR business opportunity can be estimated.

Task 6.3 IPR and Knowledge Management Strategy

Status: Ongoing. The work started at M1 (September 2020) and it is foreseen to be finished at M48 (August 2024).

On this task, four deliverables have been completed, with the work mainly being completed by CORREOS but MDST reviewing the final deliverables. The following two deliverables were submitted on time in Month 6:

- **[D6. 8] “IPR and Knowledge management strategy Report 1 (Confidential)”.**
- **[D6. 9] “IPR and Knowledge management strategy Report 1 (Public)”.**

Their main objective of these deliverables was to provide a defined strategy that ensures an appropriate management of IPR and knowledge management, which is aligned with the strategies of each partner of the project in their own organizations. One of the main pillars of this strategy is to establish and implement specific IPR and Knowledge management mechanisms to preserve the ownership of the data and knowledge generated. Thus, these deliverables show the main bases of the IPR and Knowledge management strategy that will be implemented during the lifetime of the SENATOR project.

Updates of the above reports (**D6.10 “IPR and Knowledge management strategy Report 2 (Confidential)”** and **D6.11 “IPR and Knowledge management strategy Report 2 (Public)”**) were delivered in Month 27.

Final Updates of the above reports (**D6.12 “IPR and Knowledge management strategy Report 3 (Confidential)”** and **D6.13 “IPR and Knowledge management strategy Report 2 (Public)”**) will be delivered at the end of the project, with a greater focus on managing the IPR of the SENATOR platform beyond the end of the project itself.

Task 6.4 Exploitation Plan

Status: Ongoing. The work started formally in M31 (March 2023) and it is foreseen to be finished by the end of the project. The Exploitation Plan for the project will be developed under the supervision of the Exploitation Board (EB) which is scheduled to meet at least every six months until the end of the project. At the meeting of the EB on 28th April 2023, it was agreed that the chair of the EB (MDST) will hold confidential one-to-one discussions with representatives from each partner in order to understand the extent to which each partner is considering either:

- Directly exploiting the results of the SENATOR platform; and/or
- Indirectly exploiting other results that the individual organisation has itself developed during the SENATOR project.

The key themes from these one-to-one discussions at time (mid-2023) were that there was a lack of a ‘complete’ and tested SENATOR platform, which made it difficult to assess whether there was a tangible output to exploit further, but there was some interest in the potential of the SENATOR Platform to solve problems and provide data outputs. There was a more positive response at the time on indirect exploitation, involving the commercial exploitation of consultancy services and continuing the relationships developed within the project.

In advance of the Project Partnership Meeting in Dublin in September 2023, the partners were asked to complete an on-line survey of what they regard as being the emerging Key Exploitable Results (KERs) from the project. In total 12 KERs were identified by the partners and these were then presented by their ‘promoters’ at the meeting in Dublin. These KERs will help to develop the Exploitation Plan and also provide value propositions for inclusion in the Business Plan for SENATOR in Task 6.2.

3.6.3 Risks and deviations

The following table lists the possible risks for WP6 identified in Annex 1 of the GA, as well as the proposed risk-management measures. In addition, information on if the risks were materialised and if the proposed risk-management measures were applied is provided.

Table 11. List of possible risks for WP6 identified in Annex 1 of the GA.

Risk No	Description of Risk	Proposed risk-mitigation measures	Was the risk-mitigation measures applied?	Was the risk materialised ?
22	Difficulty of validation of the business models in the short term	Simulations of the business models based on preliminary requirements from WP1, market analysis, surveys and open urban data will enable feeding the econometrical models for measuring market size as well as determining the impact of the crucial factors on the demand. This testing of the business model on high empirical ground ensures more precise validation of the business concept.	NO	NO
23	Changes of market parameters, in terms of new regulations	A continuous update and flow information with retailers, providers, end-users, transport organisation and associations, policy makers etc. will be done. T6.1 and T6.2 will assure a deep analysis of the existing market aspects. Several consortium partners have well established commercial networks throughout EU and broader which assure convenient assessment of all relevant regulation and other influential factors. However, if new markets appear due to new urban logistics mobility, business opportunities will be generated accordingly.	NO	NO
31	Exploitable results have similar prioritization level within characterisation and assessment criteria	The exploitation plan in WP6 will describe and characterise Key Exploitable Results. A second prioritisation process will be carried out considering a priority map under risk assessment: partnership, technological, market, IPR, financial and sustainability risks factors will be considered. In addition, involvement of IAB, stakeholders or external exploitation services with cross-checking feedback rounds will be done.	NO	NO

32	Inability to reach an agreement on the IPR background knowledge & results among the partners	As part of innovation management activities processes will be implemented to minimise the risk of IPR conflicts among partners, especially in terms of precious background knowledge and data that must be provided. It will also be secured that adequate freedom to operate analyses is done	NO	NO
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3.6.4 Deliverable status

The following table summarises the deliverables submitted within WP6.

Table 12. Deliverables submitted for WP6.

Del. No	Deliverable name	Lead Beneficiary	Type	Diss. level	Due date in Annex I (month)	Submission Date
D6.1	Business environment analysis: technical and market-regulatory recommendations Report 1	MDST	R	PU	6	25/02/2021
D6.2	Business environment analysis: technical and market-regulatory recommendations Report 2	MDST	R	PU	21	31/05/2022
D6.3	Business environment analysis: technical and market-regulatory recommendations Report 3	MDST	R	PU	45	31/05/24
D6.4	Business Models Canvas and CBA Analysis Report 1 (Confidential)	MDST	R	CO	30	28/02/2023
D6.5	Business Models Canvas and CBA Analysis Report 1 (Public)	MDST	R	PU	30	28/02/2023
D6.8	IPR and Knowledge management strategy Report 1 (Confidential)	MDST	R	CO	6	25/02/2021
D6.9	IPR and Knowledge Management Strategy Report 1 (Public)	MDST	R	PU	6	25/02/2021
D6.10	IPR and Knowledge management strategy Report 2 (Confidential)	MDST	R	CO	27	25/11/2022

D6.11	IPR and Knowledge Management Strategy Report 2 (Public)	MDST	R	PU	27	01/12/2022
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3.6.5 Planning until the end of the project

The main focus over the next months until the end of the project will be on:

- Continuing to work on the Business Plan for the SENATOR platform, which will be determined very largely by the evidence on the value generated by the SENATOR platform development (WP3) and from its application in the Living Labs (WP5); due to delays in testing of the SENATOR platform within the ULLs, there have also been delays in data on benefits being available. Data should be available in the summer and early autumn of 2024, so that Task 6.2 can be completed by the end of the project.
- Developing and completing the final IPR and Knowledge Management Strategy for SENATOR Platform, which will need to focus on the management of the IPR beyond the end of the project itself. This will be completed right at the end of the project.
- Developing and completing the Exploitation Plan for the SENATOR Platform, which will emerge from on-going discussions with partners about what they regard as the key exploitable results from the project. This will be completed right at the end of the project.

3.7 WP7 - Social awareness, stakeholder engagement, dissemination and communication

3.7.1 WP objectives

WP7 entails the implementation of the dissemination, communication and stakeholder engagement actions of the SENATOR project, as well as the co-creation processes and social impact assessment. WP7 aims to:

1. Design and implement a comprehensive strategy for the SENATOR stakeholders' full engagement, based on the Design Thinking approach framed on the Human Centred Design.
2. Boost citizen contribution through participative processes and awareness campaigns under project operative process considering a Plan-Do-Study-Act (PDSA) methodology from design to real-time execution.
3. Implement dissemination and communication strategies integrated within the engagement of the stakeholders and participatory citizenship.

4. Develop recommendations based on best practices and lessons learnt for potential replicators at European level and consolidating the project visibility and identity among stakeholders and end-users at European, national, regional and local level.
5. Define and develop a training strategy to logistic operators about the technologies tested at the ULLs.
6. Analyse the ethics and data privacy requirements of the project.

3.7.2 Work progress and achievements during the period covered

Task 7.1 Stakeholder management, dissemination & communication strategies

Status: **Ongoing.** The work started at M1 (September 2020) and it is foreseen to be finished at M48 (August 2024).

This task started in month 1 with the creation of the “**Dissemination and Communication Plan**” (**D.7.1**) and will be developed throughout the project. The D&C strategy is deployed in three different phases:

1. Launch phase (M1-13): focused on communication and promotion of the project. Establishment of all tools and procedures, development of a community and visibility of the project.
2. Consolidation phase (M13-25): showcasing progress and achievements and development of the first workshops. Dissemination of first results, networking with other EU projects and initiatives and stakeholders' participation.
3. Sustainability phase (M25-48): intensification of the dissemination of results and final workshop development with a SENATOR community of stakeholders already well engaged.

In this report, the first two phases of the plan are fully described, and the last one is almost half way through: how the SENATOR brand was created, the launch of the channels, the media impacts, the materials produced and the participation in events. As part of the second phase, some of SENATOR's progress, dissemination of first results and participation of stakeholders have also been shown. The progress made from months 1 to 12 is detailed in deliverable **D7.2 - "Report 1 on dissemination and communication activities"**. The first iteration to this deliverable was produced in month 25 (**D7.3 "Report on Dissemination and Communication activities Report 2"**), and the second iteration occurred in month 37 (**D7.4 "Report on Dissemination and Communication activities Report 3"**). The final updated version will be developed in month 48.

ST 7.1.1 Dissemination strategy and activities

The subtask 7.1.1 is led by ZABALA and needs the participation and collaboration of all the partners to succeed. It requires a strategic Plan of Dissemination of Results (deliverable D7.1

mentioned before) that compiles dissemination and communications tools and actions in order to spread research results generated during the project.

Previously to the production of scientific dissemination of results some procedures were established in the frame of the SENATOR project to facilitate and promote this subtask:

- The identification of some journals and magazines as well as the procedures for the fulfilment of Open Access have been included in the Dissemination Plan.
- Internal procedure for the review of scientific articles by the Consortium and its approval according to the Grant Agreement.

Following the progress of the project, SENATOR has published its first scientific paper in MDPI Open Access. The paper, produced by UCD, DEUSTO and SAG, included some of the results of the deliverable D2.1 “State of the art in optimization and machine learning algorithms applied to last mile logistics” as a clear SotA of the SENATOR project and was published on the 28/04/2022⁵.

The second indexed publication resulting from the SENATOR project’s research contributions was initially submitted on May 20, 2022, and accepted on January 05, 2023. This publication, part of a Special Issue related to the HAIS 2021 conference in collaboration with the Logic Journal of the IGPL, became available online on March 26, 2024⁶. It has been published in the Logic Journal of the IGPL by Oxford Journals⁷.

Progress in dissemination activities has continued steadily, resulting in the approval and publication of several papers that were submitted during the second and third years of the project. Specifically, a conference paper was published as part of the IPIC 2023 Conference papers and posters contribution⁸, and three new papers were approved and made available online in June 2023⁹ and February 2024^{10,11}, respectively.

⁵ Giuffrida, N.; Fajardo-Calderin, J.; Masegosa, A.D.; Werner, F.; Steudter, M.; Pilla, F. Optimization and Machine Learning Applied to Last-Mile Logistics: A Review. *Sustainability* 2022, 14, 5329. <https://doi.org/10.3390/su14095329>

⁶ Diaz, J.; Rodriguez, H.; Fajardo-Calderin, J.; Angulo, I.; Onieva, E. A variable neighbourhood search for minimization of operation times through warehouse layout optimization. *Logic Journal of the IGPL*, jzae018, <https://doi.org/10.1093/jigpal/jzae018>

⁷ <https://academic.oup.com/jigpal>

⁸ Fajardo-Calderin, J.; D. Masegosa, A.; Elejoste, M.P.; Moreno Emborjuo, A.; Cantero-Lopez, X.; Angulo, I. An Artificial Intelligence-based software module for the optimization of collaborative delivery in last-mile logistics. IPIC 2023 Conference papers and posters Contribution

⁹ Moslem, S.; Pilla, F. A hybrid decision making support method for parcel lockers location selection. *Research in Transportation Economics*, Vol. 100, 2023, 101320, ISSN 0739-8859, <https://doi.org/10.1016/j.retrec.2023.101320>.

¹⁰ Moslem, S. Gündogdu, F. K., Saylam, S., & Pilla, F., (2024). A Hybrid Decomposed Fuzzy Multi-Criteria Decision-Making Model for Optimizing Parcel Lockers Location in the Last-Mile Delivery Landscape. *Applied Soft Computing*, 154, 111321. <https://doi.org/10.1016/j.asoc.2024.111321>

¹¹ Moslem, S.; Pilla, F. Planning location of parcel lockers using group Analytic Hierarchy Process in Spherical Fuzzy environment. *Transportation Research Interdisciplinary Perspectives*, Vol. 24, 2024, 101024, ISSN 2590-1982, <https://doi.org/10.1016/j.trip.2024.101024>.

Additionally, the outcome of a paper submitted in December 2023¹² is awaited. SENATOR has also been acknowledged paper by UCD¹³.

The progress and outcomes of these dissemination efforts align with the established target indicator for this task, while further contributions with new publications of the project's results are anticipated.

The SENATOR public deliverables developed until this moment —with the exception of Deliverables 6.7, 6.3, 7.11, 5.6, and 5.8, which have been delayed— have been disseminated on the project website and promoted through social media: D6.1 “Business environment analysis: technical and market-regulatory recommendations Report 1”, D6.9 “IPR and Knowledge Management Strategy Report 1”, D2.1 “State of the art in optimization and machine learning algorithms applied to last-mile logistics”, D7.2 “Report on Dissemination and Communication activities Report 1”, D3.3 “Dashboard solution design”, D6.2 “Business Environment Analysis Technical and Market_Regulatory Recommendations Report 2”, D3.4 “Dashboard code”, D4.1 “Best practice catalogue”, D4.2 “SULP guidelines”, D7.3 “Report on Dissemination and Communication activities Report 2.”, D3.1 “SENATOR architecture and detailed design”, D2.5 “Feedback from ZGZ and DUBLIN about first usage of the SENATOR dynamic planning tool”, D6.11 “IPR and Knowledge Management Strategy Report 2”, D6.5 “Business Models Canvas and CBA Analysis Report 1”, D5.5 “Pilot Case 1 results and follow-up (Zaragoza) Report 1”, D5.7 “Pilot Case 2 results and follow-up (Dublin) Report 1”, D4.5 “Logistics planning report”, D8.6 “RAR. Regular Activity Public Report – year 3”, D7.4 “Report on Dissemination and Communication activities Report 3”, D7.6 “Portfolio of success stories Report 1”.

For documents deemed relevant enough to stakeholders, further dissemination occurs based on decisions made during the monthly consortium meeting. For instance, articles summarizing public deliverables like [D3.3 “Dashboard solution design”](#) or [D6.5 “Business Models Canvas and CBA Analysis Report 1”](#) were produced to enhance accessibility and effectively disseminate the results. This more in-depth and explanatory coverage also extends to some of the papers published within the project, such as the article “[Optimizing Last-Mile Logistics Operations by Means of Artificial Intelligence Techniques](#)”.

Partners are presenting SENATOR in highlighted events of the sector and are using the communication materials package to introduce the project among the stakeholders. Listed below are the events SENATOR has participated in from M35 to the present (M46). Previous events are detailed in D8.6 RAR. Regular Activity Public Report - year 3.

¹² “Optimizing Parcel Locker Locations for Last Mile Delivery Services: A Realistic Approach Considering Locker's Capacity and Uncertainty in User's pick-up period”

¹³ A Systematic Review of Analytic Hierarchy Process Applications to Solve Transportation Problems: From 2003 to 2022. [Enlace](#)

Table 13 Events in which SENATOR has been presented

Type of activity	Partners involved	Name of the event	Summary	Date	Location	.
Special session and project poster	CORREOS, DEUSTO	Transport Research Arena (TRA) 2024	CORREOS participated as a speaker during the special session "Innovation in Urban Logistics: Public and Private Sectors Thriving Together". Ángela Nuñez Gonzalez, SENATOR's project coordinator from Correos, shared valuable insights into the platform's journey, shedding light on our experiences, achievements, and lessons learned in urban logistics. Furthermore, DEUSTO displayed a project poster at the stand of ECTRI's cluster to which it belongs.	16/04/2024	Dublin, Ireland.	https://www.senatorproject.eu/news-and-events/innovation-in-urban-logistics-insights-from-tra-2024-session/
Cluster Meeting	CORREOS, ZABALA	CIVITAS Spring Urban Freight and Logistics	Regular meeting of the member initiatives of the CIVITAS cluster. The objective of the Spring cluster meeting was to identify areas for collaboration between projects, common topics of interest, and thematic challenges faced by the projects. SENATOR's Project Coordinator and Dissemination Managers attended this meeting.	22/03/2024	Online	
Participation to an Event other than a Conference or a Workshop	DCC	CILT Mobility & Supply Chain Skillnet Knowledge Day- The Future of Supply Chain	Payal Pandya from Dublin City Council (Smart Dublin) will delve into the lessons learnt from the SENATOR project in the session titled "Last Mile Delivery Projects." The event is directed to recent graduates in supply chain and logistics disciplines.	01/03/2024	Ireland	https://www.eventbrite.ie/e/cilt-mobility-supply-chain-skillnet-knowledge-day-tickets-807646461307?aff=oddtcreator
Participation to an Event other than a Conference or a Workshop	DCC	Mobility Talks Series	Payal Pandya presented the work accomplished under SENATOR for last-mile logistics in the online event organised by EIT Urban Mobility. The session focused on reflecting on the role of innovation in improving city logistics to create added	13/12/2023	Online	https://www.eiturbanmobility.eu/events/mobility-talks-22-santas-coming-to-town-innovation-

			value for companies, cities, and inhabitants.			in-city-logistics/
			They explored how innovative planning practices, advanced technologies, and fresh logistical approaches can be implemented on a large scale, reshaping urban logistics for the benefit of companies, cities, and residents alike.			
Participation to an Event other than a Conference or a Workshop	SOFTWARE AG	ITEA Smart City Advisory Board	Frank Werner was the keynote speaker at the online ITEA Smart City Advisory Board (SCAB) meeting. The ITEA Office Smart City Advisory Board (SCAB) is a dynamic forum that unites representatives from various European cities who have been actively involved in discussions surrounding the pressing needs and challenges of Smart Cities. This collaborative effort is dedicated to uncovering innovative software solutions that can effectively address these challenges. During his keynote address, Frank Warner will shed light on the application of Big Data, data processing, and related technologies within the context of Smart Cities. Within this framework, he will introduce the SENATOR project, showcasing how it's paving the way towards a future where cities are not just smarter, but also more efficient and eco-friendly.	27/11/2023	Online	https://itea4.org/smart-city-advisory-board.html
Session	ZARAGOZA	ULaaDS Final event	ULaaDS partners will explore the lessons learned in the trials, and discuss a wide range of urban logisticsrelated themes. SENATOR participated in a session.	16/11/2023	Barcelona, Spain	
Paper presentation	DEUSTO	IPIC 2023 9th International Physical Internet Conference	Presentation in STREAM E - Urban logistics & city distribution networks - 2.E Smart Cities and Digital Twins. Paper: "An Artificial Intelligence-based software module for the optimization of collaborative delivery in last-mile logistics", developed within the framework of the SENATOR project. By Jenny	13/10/2023	Athens, Greece.	https://www.senatorproject.eu/news-and-events/ipic-2023-9th-international-physical-internet-conference/

Fajardo Calderín. Assistant Professor. University of Deusto. IPIC2023, organized by ALICE and supported by various entities including the EC, provided a platform for sharing innovative insights and solutions in the field of logistics and transportation.

<https://trimis.ec.europa.eu/event/ipic-2023-9th-international-physical-internet-conference>

Participation to a Workshop	SOFTWARE AG	Driven by Data - mFUND DbD Workshop Series	In 2021 the German Federal Ministry for Digital and Transport (BMDV) initiated a series of workshops within the mFUND programme to promote an exchange between stakeholders dealing with data innovations for mobility at European level. The former workshop series "Data Innovations for Smart Mobility in Europe" is now continued under the name "Driven by Data - The mFUND workshop series about mobility innovation in Europe"	18/10/2023	Online	https://bmdv.bund.de/SharedDocs/EN/Articles/DG/mfund-eu-workshops.html
			The fifth workshop of the series will address "Efficient and Sustainable Freight and Logistics". SENATOR will present the ideas and outcomes of this project as input for discussions.			
LEAD sister project's final event - Participation in a session	DCC	Urban Logistics Innovation Day	SENATOR participated in Session II of the Urban Logistics Innovation Day, the final event organized by sister project LEAD. Payal Pandya, SENATOR Project Manager from Dublin City Council, shared insights from the SENATOR Dublin Urban Living Lab, focusing on urban space optimization and alignment with sustainable urban logistics. The event, organized with ALICE-ETP and POLIS, showcased various urban logistics innovative projects and featured live demonstrations of digital solutions developed by LEAD.	26/09/2023	Brussels, Belgium.	https://www.senatorproject.eu/news-and-events/urban-logistics-innovation-day/

Research presentation	Software AG	ITEA PO Days 2023	Dr. Frank Werner, representing SENATOR partner Software AG, spoke at the Canadian Embassy during the ITEA PO Days 2023 event in Berlin. Addressing data complexity, his presentation, "From the Complexity of Dealing with Data in Research and AI," emphasized the importance of advanced technology for privacy preservation and machine learning in projects like SENATOR.	12-13/09/2023	Berlin, Germany.	https://itea4.org/podays2023
Project presentation	SOFTWARE AG	17th Symposium and Summer School On Service-Oriented Computing	Sustainability and IT - (how) are they related.	28/06/2023	Crete, Italy.	https://www.summersoc.eu/wp-content/uploads/SummerSOC-2023-Shoening-Sustainability-and-IT.pdf

ST 7.1.2 Communication strategy and activities

This subtask structures all the communication channels and actions used in the SENATOR project to build a dissemination and communication strategy that can reach all the identified audiences: stakeholders, the Media and the general public. The communication strategy is developed in the D.7.1 Dissemination and Communication Plan, and updated in D7.2, D7.3, and D7.4.

The SENATOR [Brand Identity Guidelines](#) have been created, as well as [templates](#) in Word and PowerPoint. It includes a detailed illustration of the chosen logos, colours, and fonts. These tools are [available for consultation and download](#) on the project website. Guidelines are consistently applied in the creation of communication materials and tools, as well as in all internal documents of consortium members and stakeholders, to ensure a cohesive representation of the SENATOR project.

The SENATOR website ([was](#) launched in December 2020 and has reached 29,092 **views** and 13,133 **visitors**. It is worth noting that the website received nominations for the “.EU Web Awards” in both 2021 and 2022 by EURid. Additional information regarding the nomination process and the subsequent voting campaign is provided in the prior report.

Table 14 Number of visits to the SENATOR website

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL
2020										166	816	461	1,443
2021	427	517	606	563	536	696	323	619	496	662	629	677	6,750

2022	731	576	731	632	1175	1017	702	568	713	743	807	640	9,193
2023	842	762	687	512	758	581	535	602	960	858	787	450	8,334
2024	673	506	741	663	644								3,369

In accordance with the Digital Marketing strategy, the "News and Events" section has been essential for enhancing the website's engagement since its launch. A monthly article is published to attract visitors, resulting in a total of 68 articles so far. These articles include updates on project developments, such as meetings, progress reports, and announcements, as well as reports on mobility and logistics trends. Additionally, news from the EU Commission, articles related to International Days, and engaging interviews are featured.

At this stage, the emphasis has been on highlighting specific articles that demonstrate the progress and key achievements of the project. These include attaining technological maturity, paving the way for the [initiation of most operational pilot phases in 2024](#) to test advanced technologies. Additionally, the [release of a mobile application tailored exclusively for affiliated agents and logistics operators](#) involved in the project, as well as the innovative approaches adopted by the project's pilots [to address urban logistics challenges that have echoed in national transportation strategy](#), have been prominently featured.

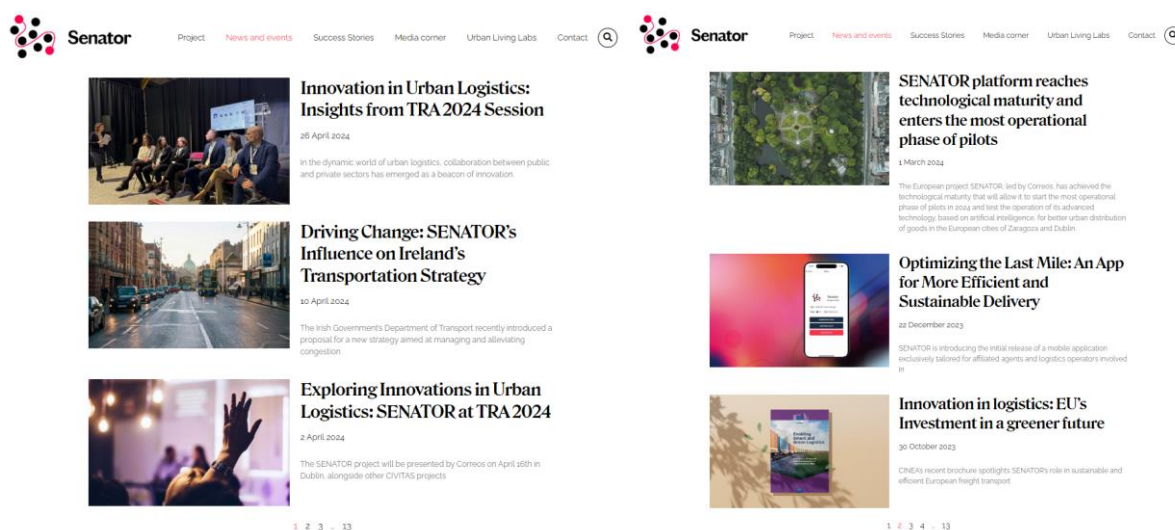


Figure 42 News on the website

The 'events' section compiles conferences, workshops, webinars, and forums attended or organized by the consortium, accompanied by brief descriptions of each.

In August 2023, the SENATOR website unveiled a new section called '[Success Stories](#),' aimed at spotlighting best practices from various initiatives and related projects to support the development of sustainable mobility and transport solutions. The core objective of the SENATOR project is to pinpoint and spotlight groundbreaking endeavors and exemplary instances within the realm of sustainable mobility and transport solutions.

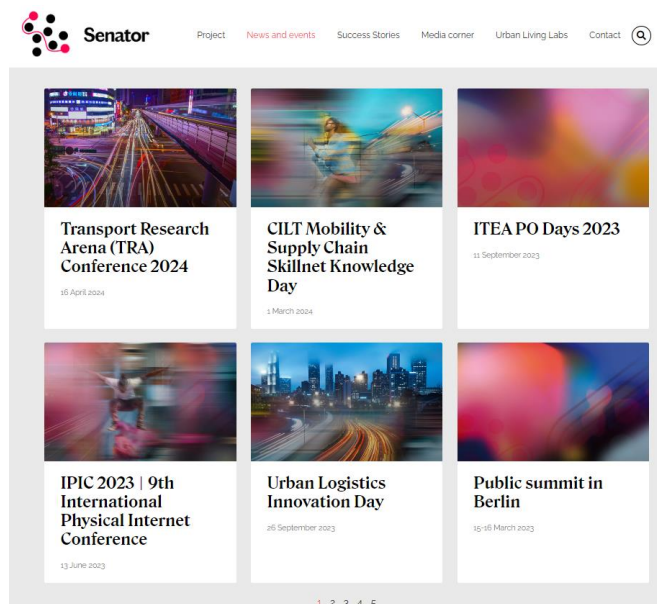


Figure 43 Events on the website

To date, 8 success stories have been published and distributed through the project's online platforms, newsletters and social media. Facilitated by productive communication channels established with similar projects, the foundation of these success stories hinges on activities conducted within their living labs, noteworthy accomplishments, and tangible outcomes. This strategic networking enhances the cohesion among projects, effectively cultivating an environment conducive to the creation of success stories. Detailed information on these Success stories initiatives can be found in D7.4 Report 3 on Dissemination and Communication activities, as well as in D7.6 Portfolio of success stories Report 1. The second report on this initiative, D7.7 Portfolio of success stories Report 2, is due M48 and will complete the series.

Through this initiative, SENATOR seeks to identify and showcase innovative activities and exemplary practices within the sustainable mobility and transport domain. These case studies serve as invaluable resources to inform and enrich future EU projects in this field. The collection of examples includes both ongoing and past EU projects, as well as collaborations with external organizations.

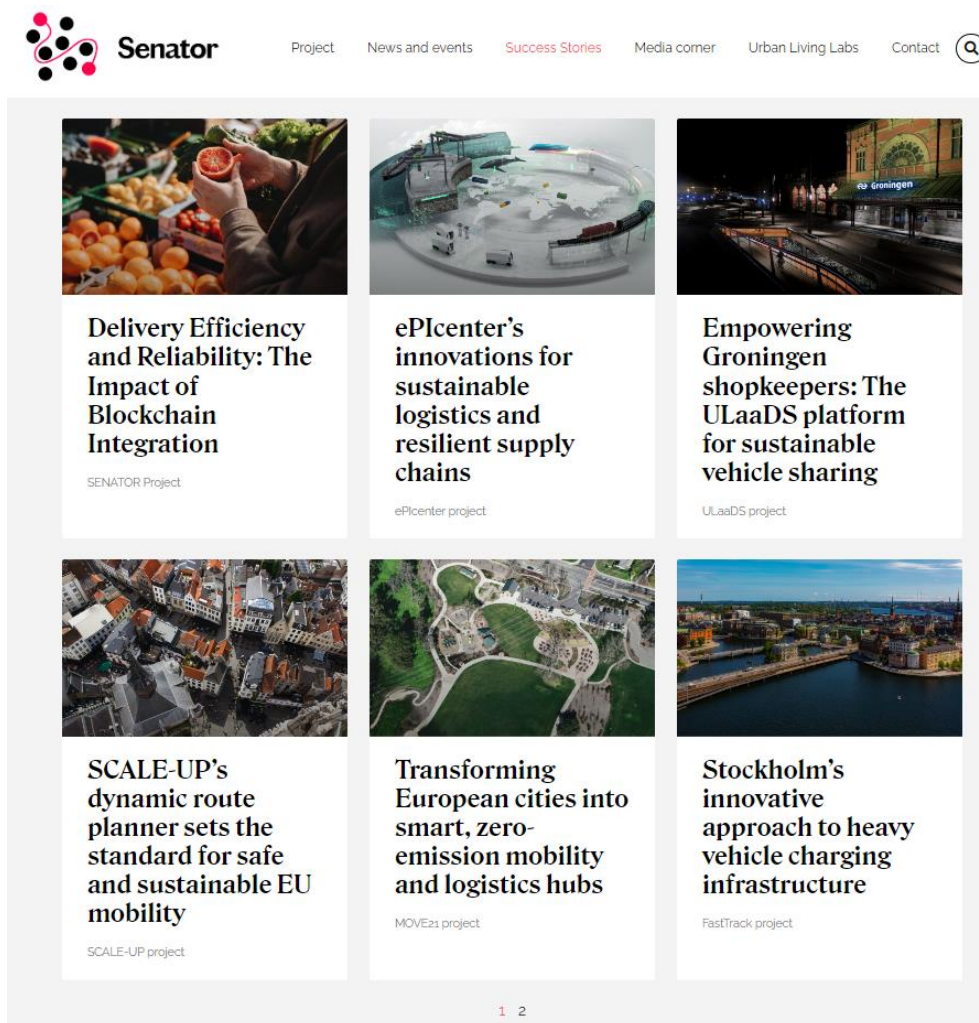


Figure 44. SENATOR's new Success Stories site

The project's web portal strategically connects with social media channels, newsletters, and related initiatives to amplify its online presence and raise awareness. Notable examples include **collaborative articles with CIVITAS 'sister' projects**, alongside features showcasing SENATOR on these partners' websites. Additionally, SENATOR is prominently presented on the CIVITAS website and **actively promoted by project partners** such as [Software AG](#), [MDS TRANSMODAL](#), [RINA](#), and [ZABALA](#).

The **social media accounts** for the SENATOR project were established to enhance project visibility and amplify the impact of its outcomes. These platforms serve as key channels for informing audiences about project updates, sharing refreshed website content, and promoting various initiatives. These include participation in key events like Transport Research Arena (TRA) 2024, unveiling new project developments such as a SENATOR mobile app for affiliated agents and logistics operators, highlighting recently published success stories, showcasing the impact of project's pilots on policymaking, and promoting newsletter

subscriptions, to mention some of the most prominent recent content shared on the project's social media channels.

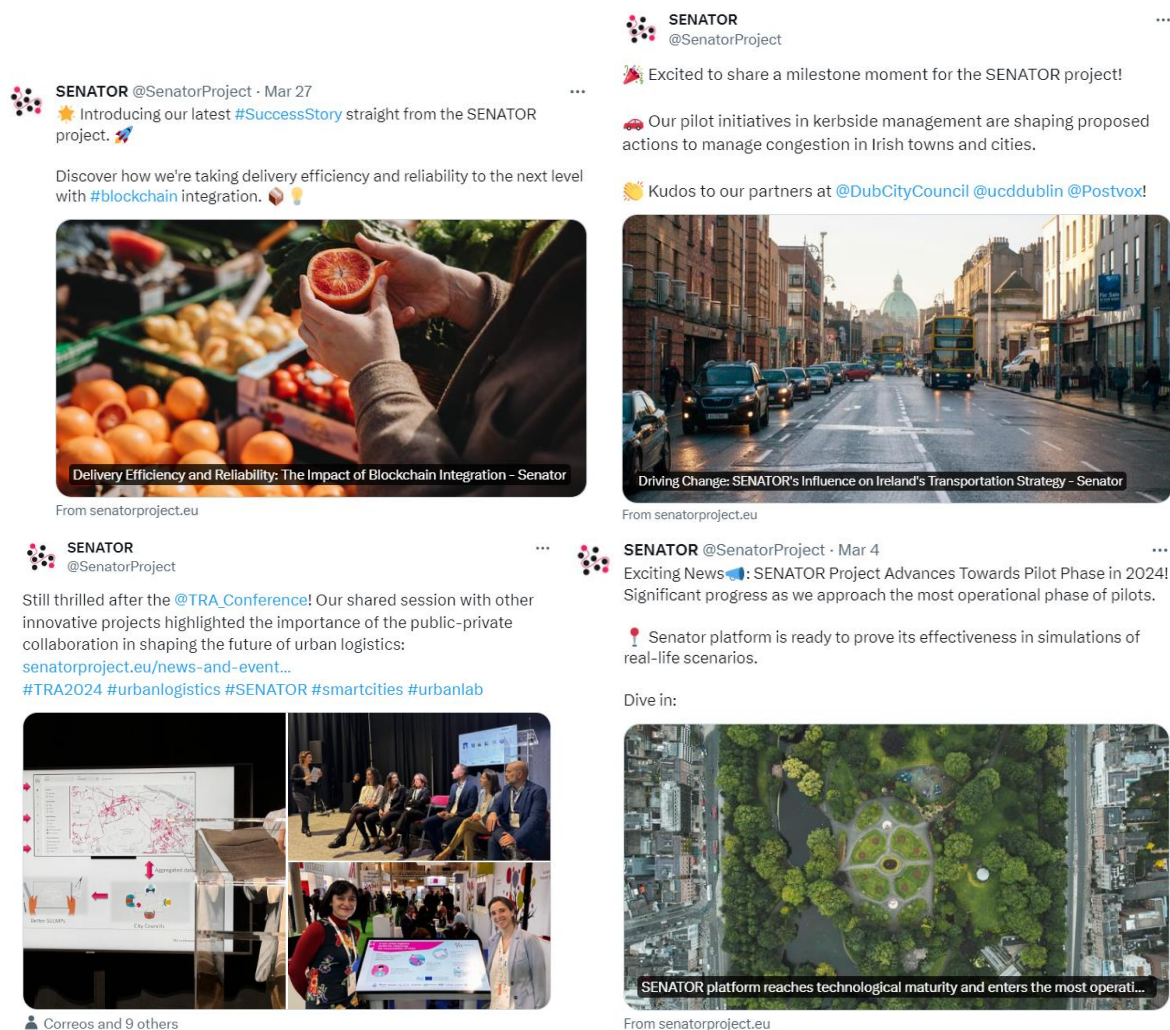


Figure 45. Latest from SENATOR on social media

SENATOR project maintains active profiles on [X \(former Twitter\)](#) and [LinkedIn](#), which were established shortly after the project's inception in month 1. These channels are regularly updated, boasting a substantial following to date:

- **X:** 436 followers with 433 posts
- **LinkedIn:** 524 followers

The **main analytics regarding social media performance** can be found in the D7.2 Report 1 on Dissemination and Communication Activities, D7.3 Report 2 on Dissemination and Communication Activities, and D7.4 Report 3 on Dissemination and Communication Activities.

In order to promote the project and direct traffic to specific sections of the website, certain **social media campaigns** like #SenatorProject or #SENATOR have been consistently active.

These campaigns have been prioritized at this stage of the project over others that may be premature or focused on early project stages. Furthermore, several campaigns are likely to be developed before the project is completed to enhance the visibility of the results.

The SENATOR community on social media remains strong and engaged over time. This active community plays a pivotal role in increasing project visibility through content sharing. Continued implementation of best practices on social media includes regular tagging of partner organizations in posts to encourage interaction and foster collaboration. Additionally, **active promotion of the project by consortium members** extends its reach to new audiences across various countries, initiating meaningful conversations.

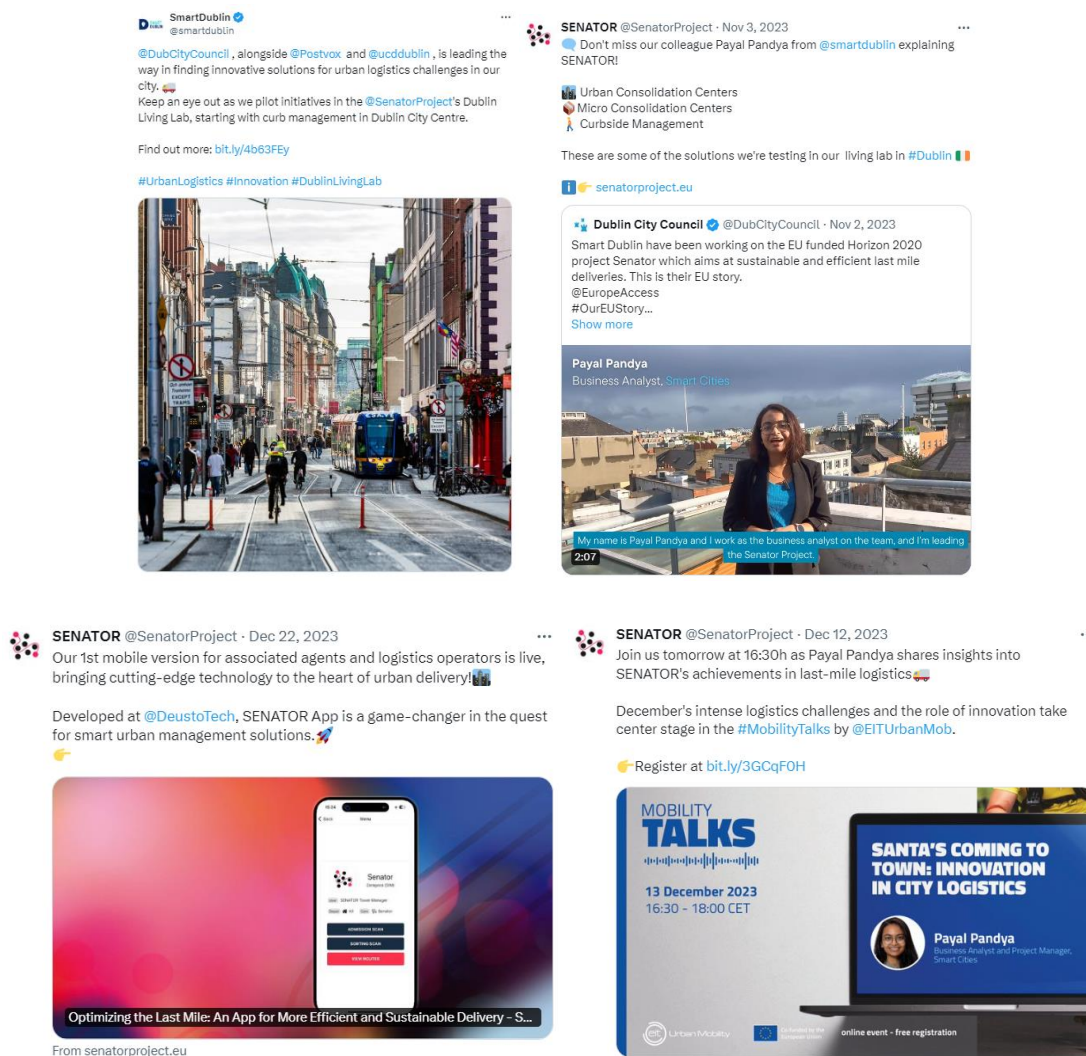




Figure 46. Recognizing project partners in social media posts.

SENATOR continues to **engage with other projects or initiatives** to maximize its impact:

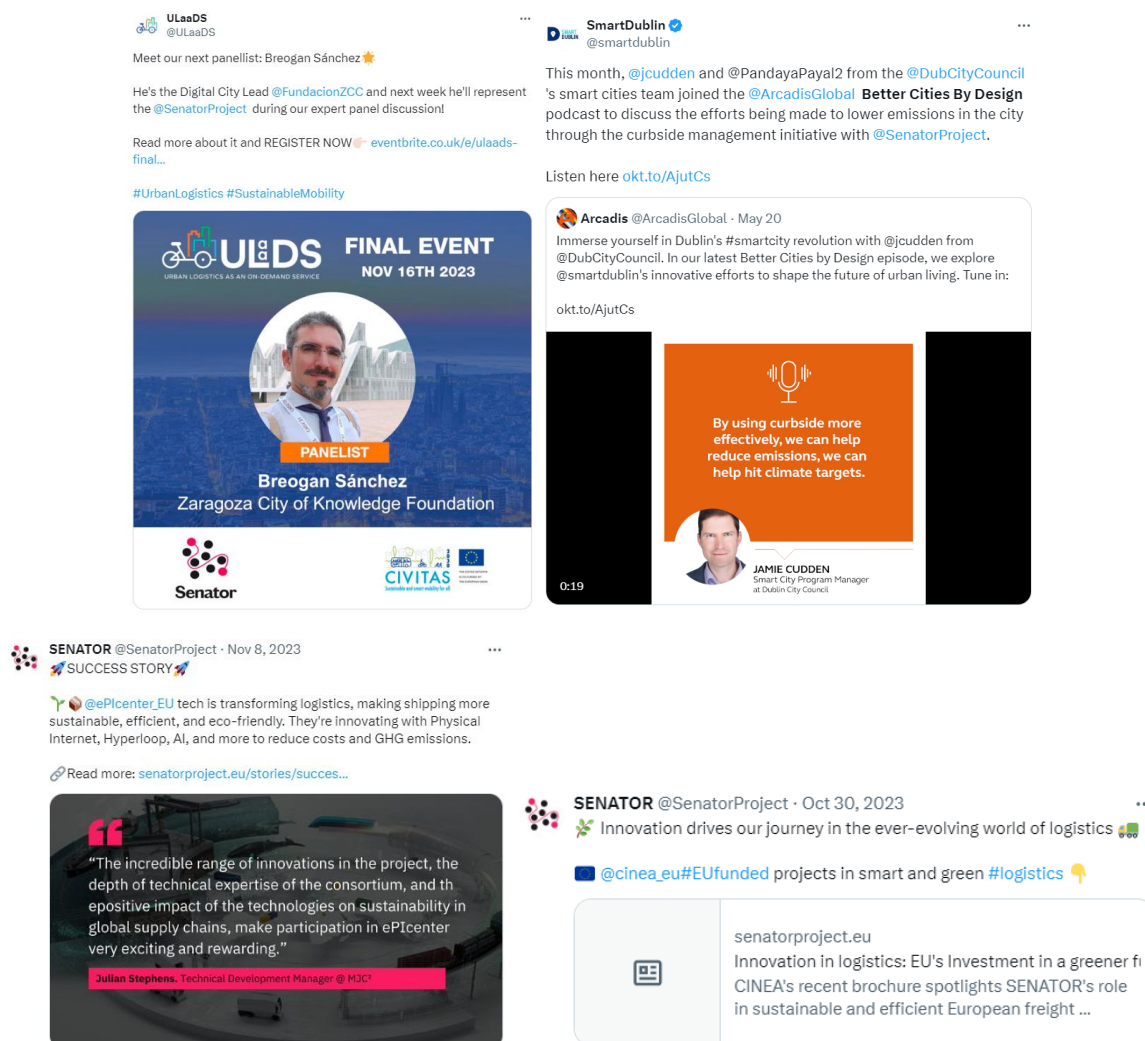


Figure 47 Interaction with other initiatives on social media

Attendance and participation in key sector events consistently draw stakeholders' attention to SENATOR's project website and social media channels, fostering interaction with other projects and initiatives:

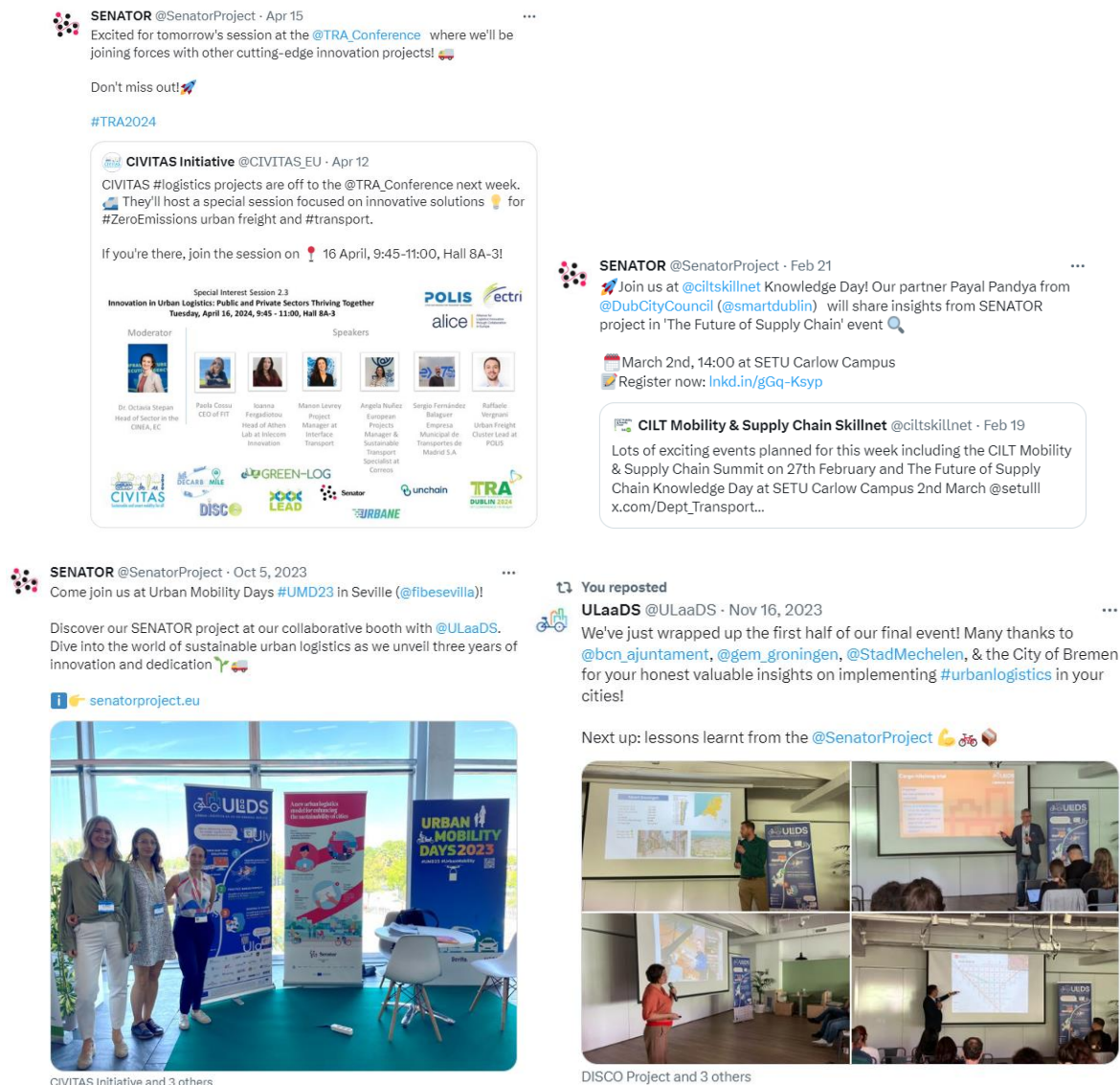


Figure 48. SENATOR Events on social media

The project has sustained its quarterly **newsletter initiative**, which commenced following the the completion of the sixth month. These newsletters are designed to furnish subscribers with timely updates on the project's advancements, outcomes, notable events attended, and other pertinent developments related to the Zaragoza and Dublin Urban Living Labs. Those interested can easily access the registration form on the project's website, along with an archive of past newsletters for reference.

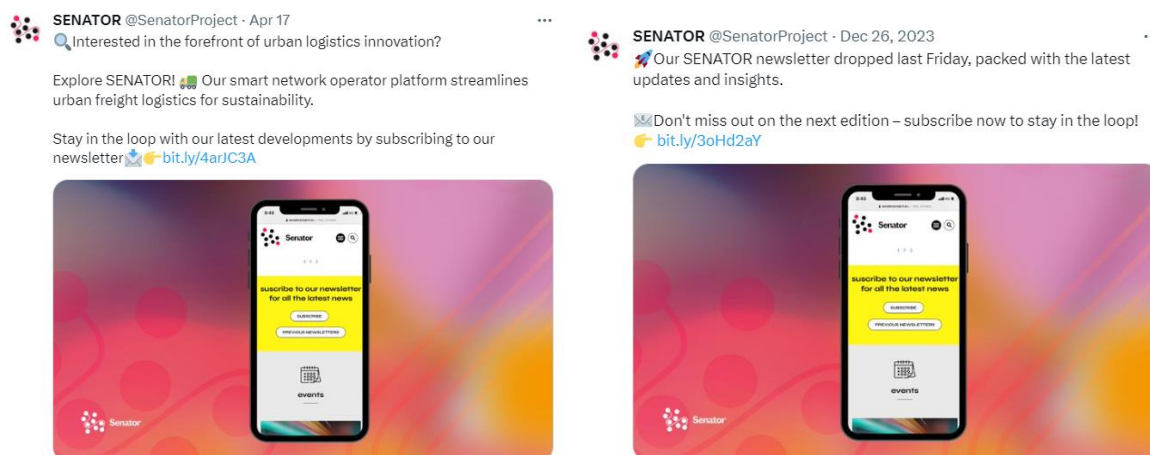


Figure 49. Boosting newsletter subscriptions via social media outreach.

To date, 9 newsletters have been delivered, and the current subscriber count stands at 115 contacts. These newsletters are conveniently accessible to the public through a link on the project website under the section labelled “[Previous newsletters](#)”.

Communication support materials.

Communication supporting materials designed to enhance the project's visual impact have been appropriately utilized and promoted at all stages. These materials effectively provide stakeholders with visually engaging information, simplifying the project's concepts, and serving as valuable tools for partners at events and conferences. SENATOR's primary communication materials, such as the project **poster** and **leaflet**, are prominently featured on social media and readily available on the website.

In terms of video content, in addition to two **introductory project videos** with over 1,000 views combined, available on the [SENATOR YouTube channel](#), two new videos are being produced to showcase the project's pilots in Dublin and Zaragoza, along with their outcomes. These videos will be essential for communicating and generating further impact in the project's final phase.

Regarding collaboration with other H2020 projects, ongoing support and collaboration have been maintained by SENATOR with “sister project” initiatives such as LEAD and UlaaDS, actively promoting their progress until their completion, including participation in their final events.

SENATOR actively participated in a session during the Urban Logistics Innovation Day held on September 26, 2023, focusing on urban space and that served as the final conference for the LEAD project. This engagement provided an exceptional opportunity for SENATOR to share successful practices from the Dublin living lab and to gain valuable insights from more advanced projects like LEAD.



Figure 50. Insights on SENATOR during the Urban Logistics Innovation Day's Urban Space discussion.

Additionally, membership in the CIVITAS network ensures continuous connections and collaborations with other European projects. Noteworthy is the regular participation in coordination sessions organized by CIVITAS, gathering project coordinators, evaluation managers, and dissemination managers from various projects within the cluster.

In 2023, the **annual CIVITAS coordination meeting** took place during the **Urban Mobility Days** in Sevilla, Spain. This significant event brought together project coordinators, evaluation managers, and dissemination managers from ongoing CIVITAS projects. The primary objective of this cluster meeting was to identify areas of collaboration between projects, address common topics of interest, and tackle thematic challenges faced by the projects.

During the meeting, the logistics cluster was officially launched, comprising various CIVITAS projects. This cluster unites eight projects co-funded by the European Union, all dedicated to improving, innovating, digitalizing, and decarbonizing urban logistics. The included projects are LEAD, DISCO, UNCHAIN, DECARBOMILE, GREEN-LOG, URBANE, and SENATOR.

The in-person CIVITAS meeting highlighted potential collaboration opportunities in dissemination and communication, including joint initiatives such as success stories and coordinated participation in events. Moreover, during the Urban Mobility Days, the SENATOR project hosted a stand, facilitating interactions with a diverse range of stakeholders, including policymakers, representatives from the European Commission, local authorities, academics, NGOs, industry professionals, and urban transport practitioners.

This collaborative effort underscores the commitment to advancing urban mobility through shared knowledge and innovative solutions, fostering a more integrated and sustainable urban transport system across Europe.



Aligned with upcoming cluster events, SENATOR has already expressed interest in participating as speakers at the next annual CIVITAS Forum event in Parma, Italy, scheduled for October 2024.

T7.1.3 Public Communication and Media Relations

The SENATOR project remains **actively engaged with media outlets** spanning different levels of specialization and geographic areas. To ensure success in achieving impacts across specialized and general platforms, the project has consistently pursued various established actions:

- **Creation of press releases (PR)** taking advantage of the milestones of the project. The PR are produced in English and sent to the partners. Every organization can adapt the content to their own corporative style and translate it into the local language.
- **Materials** to facilitate the contact of the partners with their own Media contacts have been created: brochures, press releases, press kits, etc.

SENATOR has accumulated **60 media impacts** since the project's inception until the current period (M46). The main recent impacts of SENATOR in local, regional, and international media are outlined below. Previous overall media impacts were detailed in D8.6 RAR - Regular Activity Public Report, Year 3.

Table 15 Media clipping

	Title	Media	Link	Date	Country
60	Driving Change: SENATOR's Influence on Ireland's Moving Together Strategy	Smart Dublin	Link	23/04/2024	UK
59	How transport leaders are tackling the challenges of urban freight	Cities Today	Link	28/03/2024	International
58	SENATOR logistics platform reaches technological maturity	CIVITAS	Link	12/03/2024	International

57	Zaragoza testará la tecnología que permitirá optimizar las rutas de reparto	El Periódico de Aragón	Link	14/01/2024	Spain
56	SENATOR Taps Ardor Blockchain To Establish Modern Urban Planning Policies	Cryptela	Link	22/07/2023	International
55	SENATOR Utilizes Ardor Blockchain to Revolutionize Urban Planning Policies	The News Crypto	Link	20/07/2023	International
54	European SENATOR Project Employs Blockchain, Pushes Urban Freight Logistics Revolution	U Today	Link	20/07/2023	International
53	SENATOR Taps Ardor Blockchain To Establish Modern Urban Planning Policies	Analytics Insight	Link	20/07/2023	International
52	SENATOR, the EU-funded SENATOR project, taps Ardor blockchain to develop new urban planning policies	Tech STARTUPS	Link	20/07/2023	International

Added to the list of actions outlined in the previous report, these **additional activities** further enhance SENATOR project's visibility:

- The Irish Government's Department of Transport proposed a new strategy to address congestion in towns and cities. Named "[Moving Together – A Strategic Approach to Enhancing Transport System Efficiency in Ireland](#)," this strategy incorporates insights from the SENATOR project pilot in Dublin. SENATOR influenced the strategy in two key areas: demand generation (movement of goods) and public space utilization. Retail and freight transportation are critical in these areas. Lessons from SENATOR emphasize smart loading bay solutions and comprehensive kerbside management strategies. 27/03/2024
- SENATOR partner Dublin City Council was invited to join a well-known podcast program —Better Cities By Design — to discuss the efforts being made to lower emissions in the city through the Dublin Living Lab's kerbside management initiative within the project. 20/05/2024
- SENATOR partner Dublin City Council participated in the Mobility Talks organised by EIT Urban Mobility to share insights into SENATOR's achievements in last-mile logistics. 12/12/2023
- A video introduction to the SENATOR project created by Dublin City Council and disseminated through social media and online platforms significantly boosted visibility, deepened project comprehension, and expanded our reach to broader audiences. 03/11/2023
- Thanks to ongoing engagement and relationships from SENATOR with other projects, similar initiatives have extended the reach of SENATOR's content and information by sharing it through their newsletters and communication channels.

Task 7.2 Co-creation processes and citizens awareness

Status: Ongoing. The work started at M3 (November 2020) and it is foreseen to be finished at M48 (August 2024). Within task 7.2 **D7.8 “Co-creation and engagement methodologies”** context was submitted, a methodology for co-creation adapted to the pilot's as a way of

structuring the public participation in an effective manner, supported by the partners leading the participatory activities. The deliverable compiles the SENATOR citizen engagement strategies on which the co-creation processes has been based. It provides a detailed description of the steps and the tools to set up and carry out the Urban Living Labs (ULLs).

After the work done for deliverable D7.8, ZABALA worked on its update, **D7.9 “Co-creation methodology and stakeholders engagement plan update”**, which was submitted on month 25. The update of the co-creation and stakeholder engagement strategy was done in collaboration with project partners that are directly involved in the ULLs: the deliverable presented a tailor-made co-creation strategy for each of the ULLs following the overall co-creation strategy that was presented in D7.8. The work of this deliverable fed in the next steps of Task 7.3, laying the groundwork of the Social Impact Assessment and Social Risk Analysis.

The co-creation processes have been essential for validating the indicators for the Social Impact Assessment with both pilots, as explained in the following (task 7.3). Validating them with stakeholders and the actors that will measure them ensures that the indicators are not only relevant, but also measurable for each specific context. Thus, the engagement and co-creation methodology developed point out the main tools to conduct the analysis.

For the Dublin pilot, the validation process was conducted with the Dublin City Council and An Post. These sessions focused on assessing the general and specific indicators for their applicability and relevance to Dublin's unique urban and logistical environment. Discussions centred around the availability and accessibility of the required data to ensure that the selected indicators could be effectively measured.

In Zaragoza, the validation sessions were held with the Zaragoza City Council and Correos. Similar to the Dublin pilot, these sessions aimed to evaluate the suitability of the general and specific indicators for Zaragoza. The practical aspects of data collection and the specific challenges they might face in accessing necessary information were discussed.

Furthermore, an upcoming co-creation session is planned with market agents in Zaragoza to further refine and validate the indicators. This session will involve engaging local stakeholders who play a crucial role in the urban logistics and delivery ecosystem, ensuring that all relevant perspectives are considered.

These co-creation sessions have been instrumental in tailoring the indicators to the specific needs and contexts of both Dublin and Zaragoza, and the insights gained from them will be integral to the development of a robust methodology for measuring social impact.

Task 7.3 Social Impact Assessment and Social Risk analysis

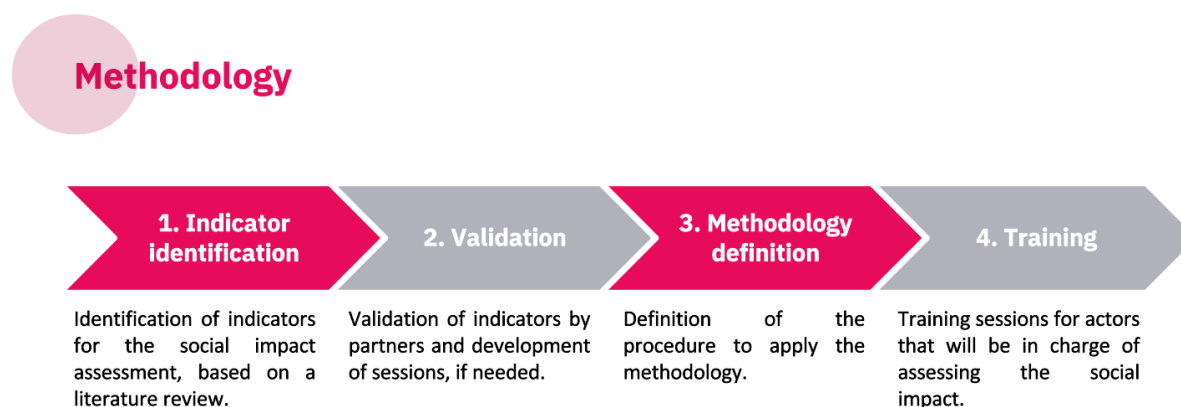


Status: Ongoing. The work started at M1 (September 2020) and it is foreseen to be finished at M48 (August 2024).

Within this task, the ZABALA team is creating a methodology to monitor the social impact of the project for the different categories of stakeholders identified in **D7.8 "Co-creation and engagement methodologies"** and its update in D7.9.

It is important to note that, given the development of the project, the measurement of the Social Impact Assessment cannot be completed within its duration as planned originally. Therefore, as agreed, the methodology will be developed to measure the Social Impact of SENATOR once the project is finished, and the actors who will carry out the assessment will be trained to implement it after the project has ended. This will allow for the measurement of the social impact post-project completion and ensure that these assessments can continue into the future.

The methodology for measuring the social impact of the project is being developed by ZABALA as follows:



To create the methodology for the social impact assessment, the first step has been to conduct a thorough process for identifying the needed indicators to measure. This process began with a desk review of the state of the art in Social Impact Assessment for projects with a similar background to SENATOR in terms of sector and scope. The selection of these comparable projects was guided by the D4.1 “SULP guidelines” developed by RINA.

The primary focus of this desk research has been on reviewing relevant documents, including project proposals, reports, and studies, to identify these indicators. Furthermore, particular attention has been given to projects within the CIVITAS network—a coalition of over 370 cities and local authorities dedicated to sustainable urban mobility. This includes reviewing EU-funded urban mobility projects and the results they have achieved, thereby ensuring a comprehensive understanding of the indicators used and their effectiveness. By leveraging

these sources, we have identified the most relevant indicators for assessing the social impact of the SENATOR project.

Following the initial review, the next step has been to validate these indicators with the project partners and relevant stakeholders through co-creation sessions. These collaborative sessions will ensure that the indicators are both relevant and practical for all parties involved. For the co-creation sessions, the specific contexts of Zaragoza and Dublin have been considered separately. General indicators have been selected for both pilot cases, along with specific indicators tailored to each city's unique circumstances. During these sessions, discussions were held about the feasibility of obtaining the required data, taking into account the accessibility of such data for the stakeholders involved. Consequently, these indicators will be presented and explained in the methodology, ensuring that they are both relevant and attainable for assessing the social impact effectively in each pilot case. This is the step we are currently at in this stage of the project.

With the selected and validated indicators, the next step will be to develop the detailed methodology for measuring the social impact. This methodology will outline the procedures and tools needed to accurately assess the social impact based on the chosen indicators, ensuring a systematic and reliable evaluation process. The document will include the desk review, the explanation for the selected indicators and how to measure them, and the overall methodology for measuring social impact.

Finally, as the last step for this task, ZABALA will train the actors responsible for assessing the social impact in each pilot. This training will ensure they are proficient in using the methodology, enabling them to effectively measure social impact beyond the project's completion.

Task 7.4 Training based on new logistics operators' skills

Status: Ongoing. The work has started with some delay, at M42 (initially scheduled at M37, September 2023) and it is foreseen to be finished at M42 (February 2024), but it is still ongoing, and will be finished by October 2024.

This task will define the new profiles, skills and capabilities to be developed by the logistics operators to which a tailored training strategy and procedures (profile definition and training adaptation) will be developed about the concepts, results and implementation of the SENATOR platform tested at the ULLs and the Sulp developed within the project.

The main effort made has been by the Correos training team, in meetings at the beginning of the task together with the coordination team of the Senator project.

The information available about the roles defined within the Senator platform has been analyzed, analysis of the roles, knowledge and skills currently existing in the Operations profiles of logistics operators with the aim of identifying both synergies and gaps with respect

to needs. defined in the new platform roles. As next steps, this information will be addressed with the rest of the partners involved in this task.

3.7.3 Risks and deviations

The following table lists the possible risks for WP7 identified in Annex 1 of the GA, as well as the proposed risk-management measures. In addition, information on if the risks were materialised and if the proposed risk-management measures were applied is provided.

Table 16. List of possible risks for WP7 identified in Annex 1 of the GA.

Risk No	Description of Risk	Proposed risk-mitigation measures	Was the risk-mitigation measures applied?	Was the risk materialised ?
24	Local stakeholders are reluctant to participate	The consortium will count on the collaboration of local partners to make an accurate mapping of the local groups and understand their needs and expectation in order to propose the participatory activities that better fit them.	NO	NO
25	Dissemination activities don't reach the targeted groups. Results don't have the identity visibility	The consortium will devise a comprehensive Communication and Dissemination plan in WP7. With the main goal of identifying further stakeholders and potential end user and defining clear strategies to reach each target group. Moreover, the IAB and stakeholder involved in project will provide new target groups with their contact network and stakeholder panels.	NO	NO

3.7.4 Deliverable and Milestones status

The following tables summarise the deliverables submitted and milestones reached within WP7.

Table 17. Deliverables submitted for WP3.

Del. No	Deliverable name	Lead Beneficiary	Type	Diss. level	Due date in Annex I (month)	Submission Date
D7.1	Dissemination and Communication plan	ZABALA	R	CO	4	30/12/2020

D7.2	Report on Dissemination and Communication activities Report 1	ZABALA	Other	PU	13	06/10/2021
D7.3	Report on Dissemination and Communication activities Report 2	ZABALA	Other	PU	25	30/09/2022
D7.8	Co-creation methodology and stakeholders engagement plan definition	ZABALA	R	CO	6	26/02/2021
D7.9	Co-creation methodology and stakeholders engagement plan update	ZABALA	R	CO	25	30/09/2022

Table 18. Milestones reached in WP7.

MS. No	Milestone name	Lead Beneficiary	Due date in Annex I (month)	Means of verification
MS13	Co-creation processes and engagement strategy ready	ZABALA	6	Milestone achieved with the submission of D7.8 (Co-creation methodology and stakeholders engagement plan definition).

3.7.5 Planning until the end of the project

Task 7.1 Stakeholder management, dissemination & communication strategies

The dissemination and communication strategy is now in its final phase (M25-48), during which dissemination activities have been significantly intensified. Notable developments include a substantial increase in the publication of papers in esteemed scientific journals, alongside active participation in conferences. SENATOR has also collaborated with other Civitas projects to coordinate strategic panel sessions at major events like TRA 2024.

In recent months, numerous articles, news updates, and documents highlighting the progress of the SENATOR platform and its testing in the Zaragoza and Dublin living labs have been made publicly available. This has also increased engagement with local media. By September 2023, the project had produced its first success stories through collaborations with other Civitas projects. These achievements were documented in M37 within the D7.6 Success Stories report and will be further detailed in the upcoming D7.7 Portfolio of Success Stories Report 2.

Additionally, a comprehensive report titled D7.4 "Report on Dissemination and Communication Activities Report 3" was completed in M37, with one final report, D7.5 "Report on Dissemination and Communication Activities Report 4," forthcoming. Both

reports detail the latest impacts and analyze key performance indicators (KPIs) to guide updates and refinements to the dissemination and communication plan.

As the project enters its final stage, efforts will focus on promoting and raising awareness of the project's outcomes. Final reports and documentation will be prepared to capture the lessons learned and best practices developed. Additionally, the team will work on strengthening the networks and collaborations established during the project to ensure that the benefits of SENATOR's innovations continue to be realized beyond its conclusion.

Task 7.2 Co-creation processes and citizens awareness

During the next months, ZABALA will conduct the last validation sessions for the indicator needed to develop the methodology for the social impact assessment (Task 7.3). An upcoming co-creation session is planned with market agents in Zaragoza to further refine and validate the indicators. This session will involve engaging local stakeholders who play a crucial role in the urban logistics and delivery ecosystem, ensuring that all relevant perspectives are considered.

The ZABALA team will also continue to engage with relevant stakeholders to validate and refine the impact areas. In order to do this, ZABALA will seek feedback from project partners and other relevant external stakeholders. This participatory approach will enhance credibility and effectiveness of the social impact assessment.

Task 7.3 Social Impact Assessment and Social Risk analysis

During the next months, ZABALA will conduct the last validation sessions for the indicator needed to develop the methodology for the social impact assessment (Task 7.3). An upcoming co-creation session is planned with market agents in Zaragoza to further refine and validate the indicators. This session will involve engaging local stakeholders who play a crucial role in the urban logistics and delivery ecosystem, ensuring that all relevant perspectives are considered.

The ZABALA team will also continue to engage with relevant stakeholders to validate and refine the impact areas. In order to do this, ZABALA will seek feedback from project partners and other relevant external stakeholders. This participatory approach will enhance credibility and effectiveness of the social impact assessment.

Task 7.4 Training based on new logistics operators' skills

Share the analyses carried out by the Correos training team with the rest of the partners involved, and prepare the deliverable jointly to meet the objectives of the task. For this, the platform's user manual will be of great help, which will be updated with the latest developments (especially pilot 2 in Zaragoza) at the end of September.

3.8 WP8 - Project management

3.8.1 WP objectives

WP8 entails the technical, administrative and financial follow-up of the SENATOR project. In this way, WP8 aims to:

1. Coordinate the actions of participants and progress monitoring for achievements of project goals to ensure the delivery of results in a timely, cost-effective way with scientific and technical excellence;
2. Manage all financial and administrative aspects;
3. Be a reliable interface to the EC, the external stakeholders and the public at large; and
4. Manage the project data.

3.8.2 Work progress and achievements during the period covered

During the first 45 months, CORREOS (as Project Coordinator - PC) has organized and coordinated the project on a strategic level, ensuring: (i) project follow-up (project progress control and planning); (ii) continuous update of the project status to the commission; (iii) decision making procedures and suitable project administration.

Task 8.1 Management Project Office

Status: **Ongoing.** The work started at M1 (September 2020) and it is foreseen to be finished at M48 (August 2024).

ST 8.1.1 Quality Management

The second planned update of the Project Management Handbook through the production of deliverable **D8.3 “Project Management Handbook: Quality Plan - second update”** has been carried out with the collaboration of all partners and it has been submitted simultaneously to deliverable **D8.6 “RAR. Regular Activity Public Report - year 3”**, at the end of M34. Management structures were updated according to the current composition of members of the SENATOR partners. Workplan and project structure were reviewed to ensure the procedures in place were still valid and suitable.

ST 8.1.2 Administrative assistance to project Partners

CORREOS, as PC, has constantly been in touch with the PO to inform about the progress of the project, and other external issues affecting the project.

After the conclusion of the Reporting Period 2 (RP2), the Project Office coordinated efforts from all partners in the production of the required Technical and Financial Reports,

establishing a constant communication and consulting channel with all partners to receive, merge, evaluate and review all contributions, ensuring the quality and diligence on the submission of all requested information and reports to the EC. In addition, the Project Office coordinated the arrangement and preparation of the RP2 Review Meeting with the PO, that took place in Brussels on October 22nd 2023.

The period between the submission of **D8.4 “RAR. Regular Activity Public Report - year 3”** and this document D8.7 falls under Reporting Period 3 (RP3). The following actions have been carried out regarding the management of SENATOR:

- Maintenance and updating of the SENATOR’s OneDrive repository where partners can access relevant information, documents, templates, etc., within the scope of the project;
- Day-to-day managerial, administrative and financial tasks;
- Review and quality control of documentations corresponding to project progress (*i.e.* internal progress reports) and deliverables;
- Arrangement and setup of project meetings (*e.g.* Annual Progress Meeting, Synchronizations TelCo meetings, follow-up meetings, etc.);
- Preparation of templates (*e.g.* payment management, deliverables and milestones dashboards, contact list and timesheets) for the proper management and control of the project and delivery of requested documents on time. For instance, 48 Deliverables have been submitted to EC (*i.e.* after a detailed internal review process);
- Production and distribution of written Minutes of Meeting (MoM) of each meeting carried out in the context of the project;
- Transference of the interim payment following Reporting Period 2 (RP2) proportionally (*i.e.* according to the GA) among all project partners.

In addition, as part of the activities coordinated by the Management Project Office, several of the problems that have materialised in other Work Packages have needed the put in place of mitigation measures. Since the project beginning, the Covid-19 pandemic hampered essential meetings between 2020 and 2022, affecting WP5 pilots' requirement definitions. In Dublin, local delivery companies failed to agree on operating a consolidation centre due to contractual and commercial constraints. Consequently, the Dublin team needed more time to simulate the centre's operations. In Zaragoza, new data privacy regulations and a high workload at Correos caused delays, requiring updates to data collection and the need for anonymization plans. These issues, along with delays in the pilots' implementation, have hindered the progress of the SENATOR platform in WP3 and business model development in WP6. These issues are being addressed to redefine the planning for the following months. The effect on other WPs such as WP4 and WP6, and cross-cutting WPs, are also being assessed.

Task 8.2 Governing Bodies meetings

Status: Ongoing. The work started at M1 (September 2020) and it is foreseen to be finished at M48 (August 2024).

This task is divided in two subtasks, which include two different sets of meetings: (i) Project Management Board (PMB) Meetings; and (ii) Technical Committee Meetings. The Table below summarizes the meetings organised within WP8 (particularly within Task 8.2) between M35 and M46 of the SENATOR project.

Table 19. Meetings within WP8.

Meeting	Date	Venue	Objective
Project Management Board (PMB) meeting II	27/09/2023	Face to face, Dublin (Ireland)	To review the planning, organise, and monitor the integrated effort to achieve the project objectives within the Consortium
Annual Progress meeting III	26-27/09/2023	Face to face, Dublin (Ireland)	Review the project progress with regards to time schedule
Consortium Synchronizations TelCo meetings	Once every two months	Teleconference	To follow up the technical progress of the project on a monthly basis
WP Leaders Synchronizations TelCo meetings	Once every two months (alternating months with Consotium Synchro meeting)	Teleconference	To follow up the technical progress of the project on a monthly basis
Project Technical Committee (PTC) meeting III	27/09/2023	Face to face, Dublin (Ireland)	To review the overall progress of each WP with regards to time schedule, deliverables or performance of any party.
Project Technical Committee (PTC) meeting IV	24/06/2024	Teleconference	To review the overall progress of each WP with regards to time schedule, deliverables or performance of any party.
Exploitation Board (EB) meeting III	4/07/2023	Teleconference	Discuss the potential ways that the consortium could exploit the results of the project
Exploitation Board (EB) meeting IV	27/09/2023	Face to face, Dublin (Ireland)	Discuss the potential ways that the consortium could exploit the results of the project

Synchronizations TelCo meetings have been held virtually on a monthly base. In these meetings, all WP leaders have participated to follow up regularly the technical progress of the project. It was also decided to include, once every other month, all the consortium to these virtual meetings to keep all the partners informed and involved in the project progress.

Task 8.3 Interaction with Advisory Board, cooperation with other H2020 and European initiatives

Status: Ongoing. The work started at M1 (September 2020) and it is foreseen to be finished at M48 (August 2024).

An international advisory board (IAB) has been set up as a consulting body to ensure an external and independent view of the project results, replicability and scalability. IAB members have formalised their commitment via an Adhesion and Non-Disclosure-Agreement Form. The SENATOR's IAB is constituted by University of Westminster, SERPOST, T-ZIR and IDENCITY. First meeting with all of them was held on June 30th 2022, counting with the participation of all SENATOR partners.

Next IAB meeting is planned for autumn 2024.

According to other H2020 projects and European Initiatives, periodical meetings have been kept with our other sister projects (ULAADS and LEAD), and also with CIVITAS coordination team for coordination and with CIVITAS ELEVATE to receive support for Evaluation Activities.

Task 8.4 Project Data Management plan

Status: Ongoing. The work started at M1 (September 2020) and it is foreseen to be finished at M48 (August 2024).

On the scope of this task, following the procedures defined in **D8.8 “Data Management Plan”**, the PC and all partners have dedicated efforts on gathering, maintaining and elaborating all the information related to the data collection, processing, protection and retention. This includes (i) types of data collected and processed in the project and how will be processed, (ii) data subjects concerned, (iii) retention periods and protection measures and (iv) plans for data sharing and preservation. SENATOR's Data management Plan has been/will be complied during the project lifetime and beyond.

3.8.3 Risks and deviations

The following table lists the possible risks for WP8 identified in Annex 1 of the GA, as well as the proposed risk-management measures. In addition, information on if the risks were materialised and if the proposed risk-management measures were applied is provided.

Table 20. List of possible risks for WP8 identified in Annex 1 of the GA.

Risk No	Description of Risk	Proposed risk-mitigation measures	Was the risk-mitigation measures applied?	Was the risk materialised ?
26	Partner leaves the project or underperforms either technically or financially	Two options will be considered: a) substitution of the Partner with a similar profile; b) reallocation of resources and tasks among the Partners in order to assume the leaving Partner responsibilities and objectives.	IN PROGRESS	YES
27	Delay on progress performance, resulting in poor delivery and project outcome	Further PM methods, tool and techniques will be included. Continuous and systematic processes for monitor & control project performance: requirements, changes, schedule, costs, risks, stakeholders, quality, decisions and acceptance.	YES	YES
28	Critical changes on the project's planned execution	Work plan, consortium structure and management bodies have been carefully designed to be able to dynamically adapt to penitential scheduling and technical mishaps without endangering the project's scope and its expected outputs	IN PROGRESS	YES
29	Evaluation results for each WP don't meet plausibility and acceptance criteria.	Quality Assurance Plan will be planned to detect losses of quality and implement corrective measures. In addition, Involvement of external stakeholders and target group representatives with Cross-checking feedback rounds will be done	NO	NO
30	MDST's forced withdrawal due to no Brexit contingencies	MDST has a strong commitment to the project, but technical contingencies will be considered as Management Risk #1 describes it above. There are other consultancy firms within project with solid background in Business Plan development: RINAC participates in 4 EU projects with this role & ZABALA also collaborates in 13 EU projects with this role. Funding	NO	NO

contingencies provided by Gov.uk
(June 2019)

3.8.4 Deliverable and Milestones status

The following tables summarise the deliverables submitted within WP8 during the third year of the project. No milestones are pending to be reached in WP8.

Table 21. Deliverables submitted for WP8.

Del. No	Deliverable name	Lead Beneficiary	Type	Diss. level	Due date in Annex I (month)	Submission Date
D8.3	Project Management Handbook: Quality – second update	CORREOS	R	CO	34	30/06/2023
D8.6	Regular Activity Public Report - year 3	CORREOS	R	CO	34	30/06/2023

3.8.5 Planning until the end of the project

- Follow-up on managerial activities and administrative assistance to project partners.
- Arrangement and setup of project meetings:
 - Follow-up on the organisation of the third annual progress meeting with the entire consortium.
 - To allow a more efficient communication and cooperation among all partners, Synchronizations TelCo meetings will be rearranged. Starting from July 2023, Synchronizations TelCo meetings among WP Leaders will continue to be held as usual every third Wednesday of each month. However, once each two months, representatives of all partners of the consortium will be requested to join these meetings to guarantee that all partners are informed and updated of the project status and progress, and foster further constructive discussions on open matters.
- Starting from September 2023, preparation and organization of the second Reporting Period (closing August 2023, M36), and review meeting with the Project Officer.
- Review and quality control of documentations corresponding to project and deliverables.
- As a key activity in WP8 for the following months, a planning will be defined to put in place any contingency measures needed to mitigate all issues detected in project progress, involving WPs 3-8. The Project Officer will be contacted in due time to discuss and agree on further actions to be taken.

3.9 WP9 - Ethics requirements

3.9.1 WP objectives

The objective is to ensure compliance with the 'ethics requirements' set out in this WP.

3.9.2 Work progress and achievements during the period covered

N/A.

3.9.3 Deliverable and Milestones status

No deliverable have been submitted during the third year of SENATOR project within WP9.

4 Conclusion

The SENATOR project is currently in its fourth year of development and on its way to the end. Several risks have emerged during the last year in key areas, specifically within WP3 and WP5, which could lead to deviations from the planned schedule and affect the expected progress in the upcoming months. To address this, corrective and preventive mitigation measures have been implemented to ensure proper cooperation and communication among the project partners, aiming to prevent any negative impact on the project's implementation. At present, a plan is being developed together with the EU Commission to establish contingency measures to address all identified issues in the project's progress.
