

# IP4MaaS

## Deliverable D2.3 Demonstration requirements and scenarios F-REL

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## Executive Summary

The IP4MaaS project aims to plan and conduct demonstrations in Athens, Barcelona, Liberec, Osijek, Padua, and Warsaw testing technologies developed under the Innovation Programme 4 (IP4) of the Shift2Rail Joint Undertaking.

IP4MaaS adopts an iterative planning process that will enable two iterations of the **demonstration scenario definition**. The two iterations are named, respectively, C-REL (Core Release) and F-REL (Final Release). The IP4MaaS C-REL demonstration scenario definition (included in D2.2) focused only on the Barcelona, Athens, and Padua demonstration sites. The IP4MaaS F-REL demonstration scenario definition considers a new set of IP4 functionalities to be demonstrated in all the six IP4MaaS demonstration sites (including Liberec, Osijek and Warsaw).

This document provides:

- An **updated picture of the software services** that are available in each demonstration site for integration in the Shift2Rail digital ecosystem. Technical information regarding these software services has also been **uploaded on the Asset Manager** to facilitate its sharing with CFM (Calls From Members) project partners.
- An overview of **users' needs and expectations** with respect to IP4 travel experiences, as they emerged from a conversational survey administered to travellers from demonstration sites (and beyond) and an opinion mining activity run on social media
- A description of the **updated methodology** adopted by the IP4MaaS project for the definition of demonstration requirements and scenarios. Some of the steps of the methodology, described in deliverable D2.2, are updated considering the feedback and experience from C-REL.
- The results of the application of the methodology for the **demonstration scenario definition for F-REL** to the Barcelona, Athens, Liberec, Osijek, Padua, and Warsaw demonstration sites.
- As result of all the above, the list of Shift2Rail IP4 functionalities that are **candidated to be tested** by IP4MaaS for each involved demonstration site.

The C-REL and F-REL demonstration requirements and scenarios defined in this document will be further analysed within IP4MaaS WP4 to define a comprehensive roadmap toward each IP4MaaS demonstration. At the time of writing, two demonstration phases are foreseen: the first phase focusing on Athens and the second phase focusing on all other demonstration sites. This, however, may be subject to change due to the collaboration with CFM projects. Time plan, role assignments, and risks & mitigation measures for demonstrations will be provided, together with a detailed technology integration plan, in “D4.3: Demonstration Execution Plan and Technology Integration Plan, F-REL”.

## Abbreviations and acronyms

Abbreviation / Acronym	Description
AM	Asset Manager
API	Application Programming Interface
CFM	Calls for Members
CMMP	Contractual Management Market Place
C-REL	Core Release
CSV	Comma Separated Values
DoA	Description of Action
DS	Demonstration Scenario
F-REL	Final Release
GA	Grant Agreement
GTFS	General Transit Feed Specification
GTFS - RT	General Transit Feed Specification – Real Time
KPI	Key Performance Indicator
IP4	Innovation Programme 4
LBE	Location-based Experience
NeTEx	Network Timetable Exchange
OC	Open Call
POI	Point Of Interest
PP	Pain Point
PRM	Person with Reduced Mobility
PTO	Public Transport Operator
QAC	Quality Assurance Committee
S2R JU	Shift2Rail Joint Undertaking
SIRI	Service Interface for Real-time Information
TC	Travel Companion
TE	Travel Experience
TRL	Technology Readiness Level
TSP	Transport Service Provider
UC	Use Case
W/C/MM	Walking / Cycling / Micro Mobility
WP	Work Package
WPL	Work package leader

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## Background

The IP4MaaS project (S2R-OC-IP4-01-2020, GA 101015492) aims to advance the uptake of Mobility as a Service (MaaS) schemes by analysing and testing technologies developed under the Innovation Programme 4 (IP4) of the Shift2Rail Joint Undertaking by the complementary projects of IP4MaaS. IP4MaaS will conduct demonstrations in Athens, Barcelona, Liberec, Osijek, Padua, and Warsaw testing IP4 technologies in different contexts and will deliver a solid demonstration execution scheme that can be utilised by other projects.

IP4MaaS adopts an iterative planning process that will enable two iterations of the demonstration scenario definition. The two iterations are named, respectively, C-REL (Core Release) and F-REL (Final Release).

Deliverable D2.1 “Technology survey, C-REL”, in the framework of the WP2, tasks 2.1 of the IP4MaaS project, provided an initial picture of the software services available in the six demonstration sites of the project. The information included in Deliverable D2.1 was used in WP3 and WP4, in particular to plan the integration of the services in the Shift2Rail digital ecosystem for the C-REL phase.

Deliverable D2.2 “Demonstration requirements and scenarios C-REL”, in the framework of the WP2, tasks 2.2 and 2.3 of the IP4MaaS project, identified the C-REL version of demonstration requirements and scenarios to be utilized by the project. This deliverable also contributed to WP3 and WP4 activities, providing requirements and scenarios for planning the first iteration (C-REL) of the IP4MaaS demonstrations.

The present document, Deliverable D2.3 “Demonstration requirements and scenarios F-REL”, describes the outcomes of all the three tasks of WP2 for F-REL, it provides an update of D2.1 and D2.2 taking also into account feedback received from WP3 and WP4. This deliverable also contributes to WP3 and WP4 for planning the second iteration (F-REL) of the IP4MaaS demonstrations, specifically, its content contributes to Deliverable D3.3 “List of operational KPIs, analysis of the users’ satisfaction and methodology as a whole, F-REL.”, and Deliverable D4.3 “Demonstration Execution Plan and Technology Integration Plan, F-REL”.

## Objective/Aim

This document has been prepared to provide IP4MaaS WP3 and WP4 with requirements and scenarios for planning the IP4MaaS demonstrations. As agreed with the complementary CFM projects, the IP4MaaS F-REL demonstration scenario definition focuses on all the six demonstration sites: Athens, Barcelona, Liberec, Osijek, Padua and Warsaw.

This document aims to provide:

- An **updated picture of the software services** that are available in each demonstration site for integration in the Shift2Rail digital ecosystem. Technical information regarding these software services has also been **uploaded on the Asset Manager** to facilitate its sharing with CFM project partners.
- An overview of **users' needs and expectations** with respect to IP4 travel experiences, as they emerged from a conversational survey administered to travellers from demonstration sites (and beyond) and an opinion mining activity run on social media
- A description of the **updated methodology** adopted by the IP4MaaS project for the definition of demonstration requirements and scenarios. Some of the steps of the methodology, described in deliverable D2.2, are updated considering the feedback and experience from C-REL
- The results of the application of the methodology for the **demonstration scenario definition for F-REL** to the Barcelona, Athens, Liberec, Osijek, Padua, and Warsaw demonstration sites (in the case of Barcelona, Athens and Padua it represents an update and extension of what was included in deliverable D2.2; in the case of Liberec, Osijek and Warsaw it represents the full application of the updated methodology)

This document aims to provide a first step towards the definition of a comprehensive roadmap for IP4MaaS F-REL demonstrations. The defined F-REL demonstration requirements and scenarios will be further analysed within IP4MaaS WP4 to produce a technology integration plan and an execution plan for each demonstration site.

## 1. Introduction

IP4MaaS WP2 “Demonstration scenarios definition” aims to define requirements and scenarios for each IP4MaaS demonstration site. Figure 1 depicts the tasks, activities, and deliverables included in WP2. Task 2.1 aims to analyse (i) the technologies that are available in the S2R IP4 ecosystem to support door-to-door multimodal travel and (ii) the services currently offered by Transport Service Providers (TSPs) involved in the project, focusing on the technologies on which they are based. Task 2.2 aims to derive a set of requirements for the integration of services offered by IP4MaaS TSPs in the IP4 ecosystem by assessing the technological feasibility and investigating needs and expectations from TSPs and travellers in the IP4MaaS demonstration sites. Finally, Task 2.3 aims to analyse current travel experiences (the “AS-IS”) and understand how the new technologies can improve them (the “TO-BE”) with the final result of defining a set of demonstration scenarios.

A **demonstration scenario** is the intersection of a functionality provided by Shift2Rail IP4 solutions (technology innovation) and a given travel service provider (TSP) involved in the IP4MaaS project. Therefore, the demonstration scenarios must be defined for each IP4MaaS demonstration site considering the following aspects:

- the specific objectives of each demonstration site,
- the IP4MaaS TSP partners involved,
- the need of targeting a large number of potential users,
- the IP4 technologies to be demonstrated.

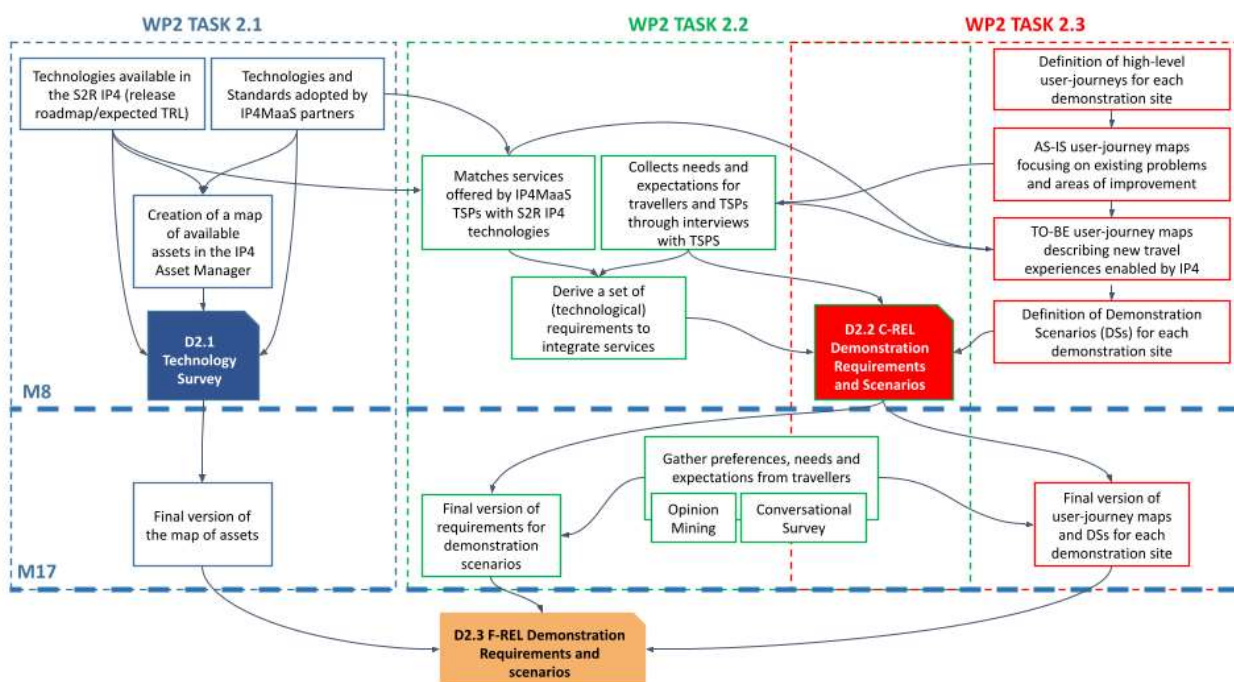


Figure 1 - Overview of WP2 activities and their dependencies.

IP4MaaS adopts an iterative planning process that enables two iterations of the demonstration scenario definition. The two iterations are named, respectively, C-REL (Core Release) and F-REL (Final Release). Task 2.1 released D2.1 “Technology Survey, C-REL” providing a first map of available assets. D2.2 “Demonstration scenarios and requirements, C-REL” described the C-REL results of Task 2.2 and Task 2.3.

This document represents D2.3 “Demonstration Scenarios and Requirements, F-REL”. It elicits demonstration scenarios and requirements for F-REL considering all the IP4MaaS demonstration sites and the new functionalities and tools developed by the CFM project. Moreover, it describes the current map of assets for transportation services in each demonstration site and it reports on the activities carried out to collect needs and expectations from travellers.

At the time of writing, two demonstration phases are foreseen: the first phase focusing on Athens and the second phase focusing on all other demonstration sites, including Athens. This, however, may be subject to change due to the collaboration with CFM projects. Time plan, role assignments, and risks & mitigation measures for demonstrations will be provided, together with a detailed technology integration plan, in “D4.3: Demonstration Execution Plan and Technology Integration Plan, F-REL”.

The deliverable is structured as follows: Section 2 discusses the outcomes of Task 2.1 “Survey of available technologies and creation of map of assets”, investigating and analysing both the technologies that are available in the IP4 ecosystem and the services offered by IP4MaaS partners. Section 3 expands on the definition of user needs and expectations and demonstration scenarios requirements. Section 4 discusses the methodology adopted for defining the demonstration scenarios and their requirements for each demonstration site, updating the ones defined in D2.1, and Section 5 reports the outcomes of applying the described methodology for the definition of demonstration scenarios for IP4MaaS F-REL demonstrators in Barcelona, Padua, Athens, Osijek, Liberec and Warsaw.

Finally, Section 6 provides conclusions, highlighting the Shift2Rail IP4 functionalities that are candidates to be tested by IP4MaaS for F-REL demonstrations.

## 2. Map of IP4 solutions and IP4MaaS TSP services

This section discusses the outcomes of Task 2.1 “Survey of available technologies and creation of map of assets”. This task aimed at investigating and analysing both (i) the technologies that are available in the IP4 ecosystem and (ii) the services offered by IP4MaaS partners that can be integrated into the IP4 ecosystem.

Section 2.1 presents the analysis performed by IP4MaaS considering the technological solutions developed within IP4 and made available by the ExtenSive project, and Section 2.2 discusses the available travel services for each IP4MaaS TSP, whose information has been made available to CFM project partners through the IP4 Asset Manager (AM).

### 2.1. Map of available IP4 solutions

This section describes the work done by IP4MaaS in collaboration with CFM partners to analyse the available IP4 solutions to be demonstrated within the IP4MaaS project. The performed activities leveraged collaboration meetings and collaborative work through shared documents, producing different valuable artifacts to describe in a structured way the technological solutions implemented within IP4 and support the definition of demonstration scenarios and requirements.

The IP4 solutions available for IP4MaaS F-REL should be considered an extension of the first set provided for C-REL and described in IP4MaaS D2.1 and D2.2.

IP4 solutions for F-REL were described by CFM partners during a collaboration meeting with IP4MaaS partners, and through a presentation reporting the following information for each of them:

- *CFM partner* responsible for the implementation,
- *description* of the solution,
- *requirements* for a TSP willing to test the solution,
- expected *TRL*,
- expected *date of availability* for the solution to be tested.

The provided solutions were also clustered in three categories by CFM partners:

- **Passive** (identifier starting with **P**): solution directly enabled by CFM projects’ developments, no technical action required from IP4MaaS partners to be demonstrated;
- **Active** (identifier starting with **A**): solution developed by ExtenSive but defining requirements for TSPs interested in demonstrating it (data and/or services to be provided);

- **Selected** TSPs (identifier starting with **S**): special solutions requiring a resource-intensive integration effort and specific data and/or services from TSPs, thus can be tested only by selected TSPs.

The list of IP4 solutions made available by CFM partners is reported in Annex I, including for each of them the identifier, the description and the requirements for demonstration. The solutions already available for C-REL have a numeric identifier (no A, P or S at the beginning of the identifier).

To better support the activities of IP4MaaS WP2 in the definition of demonstration scenarios and requirements with the involved TSPs, the complete list of IP4 solutions was analysed to better understand each proposed solution, its requirements and the user experience enabled for travellers and TSPs.

The main outcomes of this analysis are described in the following sections:

- diagram of dependencies between IP4 solutions (Section 2.1.1);
- definition of macro-categories to cluster IP4 solutions (Section 2.1.2);
- identification of the final list of IP4 solutions to be considered for demonstration in IP4MaaS F-REL (Section 2.1.3).

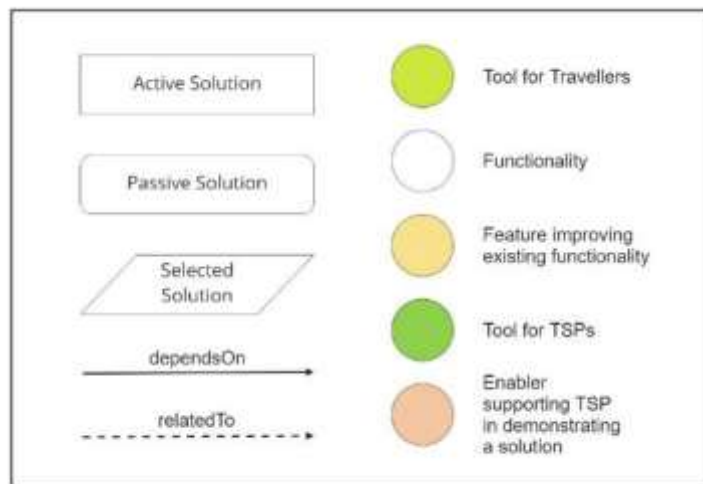
### 2.1.1. Diagram of dependencies

The first step of the performed analysis consisted in the definition of a diagram to better investigate the relations between different IP4 solutions and the connection between the IP4 solutions already considered for C-REL and the ones available for F-REL.

The first contribution of the diagram is the categorisation of IP4 solutions in:

- **Tools for Travellers:** the solution represents a tool (mobile, desktop and/or web application) that offers a (set of) functionality(ies) for travellers;
- **Tools for TSPs:** the solution represents a tool (mobile, desktop and/or web application) that offers a (set of) functionality(ies) for TSPs;
- **Functionalities:** the solution represents a service for travellers and/or TSPs implemented by one of the IP4 tools;
- **Features:** the solution represents an improvement and/or a new feature associated with an IP4 functionality;
- **Enablers:** the solution represents a technological enabler that could support a TSP in demonstrating one of the IP4 functionalities.

The proposed categorisation is orthogonal to the one distinguishing between *Active*, *Passive* and *Selected* solutions. The legenda shown in Figure 2 highlights the representation selected for the diagram.



**Figure 2 - Legenda for the diagram for IP4 solutions**

The second contribution of the diagram is related to the identification of relations between IP4 solutions. The importance of clarifying relations emerged in C-REL both within WP2, but also as feedback from WP4 in the definition of the integration and execution plans. Indeed, it is important to highlight technological dependencies between solutions to support TSPs in understanding which solutions can be demonstrated in combination. Moreover, during the planning of the integration, it is important to ensure that the set of IP4 solutions required as a dependency to enable other solutions can be integrated.

The diagram represents two types of relations:

- **dependsOn**: represents a strong (technological) dependency between two IP4 solutions, the solution pointed by the arrow must be demonstrated to test the solution where the arrow starts from;
- **relatedTo**: represents a logical dependency between two IP4 solutions, the solutions are associated with a similar service for the traveller and/or the TSP.

Figure 3 represents an overview of the defined diagram, refined in several iterations through a collaboration between IP4MaaS and CFM partners. Note that the IP4 solution “0. Travel Companion” is introduced to represent the personal application enabling a set of related IP4 solutions. The high-resolution diagram is provided in Annex II of this document.

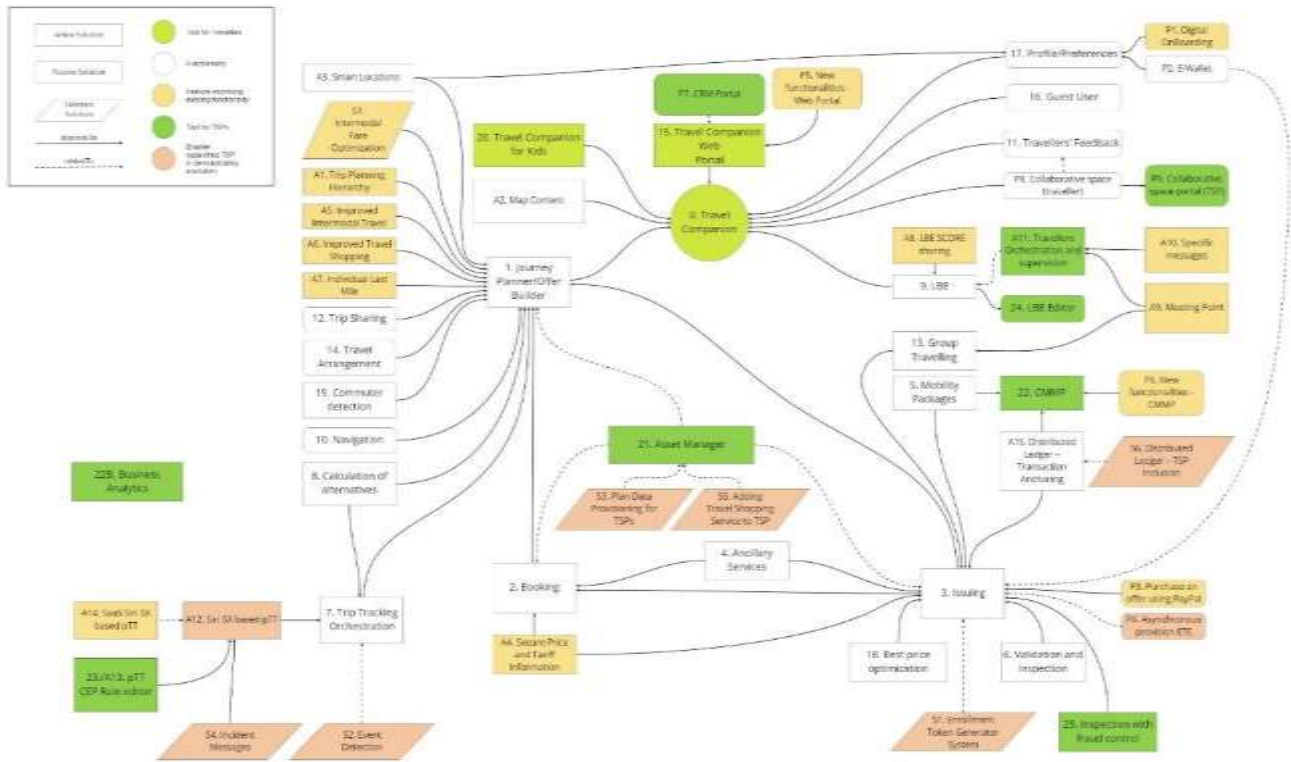


Figure 3 - Overview of the diagram of IP4 solutions (reported in Annex II)

### 2.1.2. Macro-categories

The second step of the analysis consisted of a more detailed analysis of IP4 solutions and in the definition of macro-categories to cluster them according to the dependencies identified in the diagram.

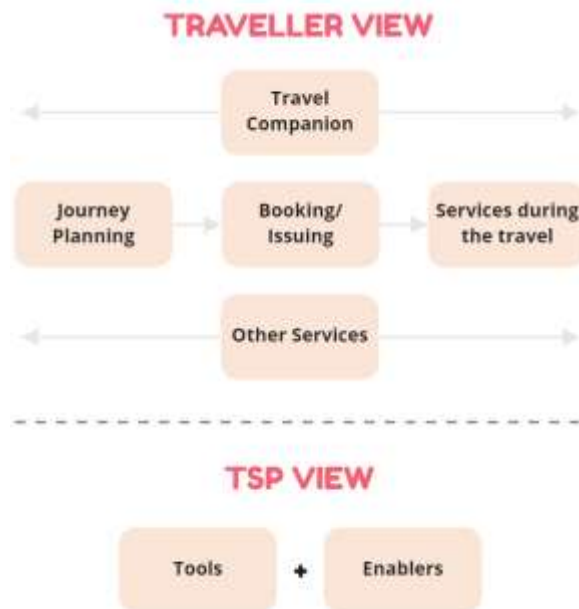
To facilitate and support the interaction between IP4MaaS and CFM partners in this activity, a shared spreadsheet was created.

Each row in the spreadsheet was associated with a single IP4 solution, and the following columns were filled collaboratively to collect further information on each solution: identifier, name of the IP4 solution, user (traveller/TSP), description, requirements, questions from IP4MaaS partners, answers from CFM partners, notes.

The collaborative completion of the spreadsheet had a twofold goal: on one hand, to clarify the



user experience enabled by each IP4 solution supporting the definition of demonstration scenarios (as described in Section 4.1), on the other hand, to investigate better the requirements for integration of each IP4 solution (described in Section 3.3). Moreover, the tabular structure facilitated a re-ordering of IP4 solutions, i.e., the shuffle of rows in the table, to identify potential macro-categories. Finally, the analysis also resulted in a revision of the final list of IP4 solutions considered for demonstration in IP4MaaS, as detailed in Section 2.1.3.



**Figure 4 - Macro-categories identified**

Figure 4 represents the macro-categories identified to cluster IP4 solutions:

- **Traveller View:** IP4 solutions targeting travellers
  - *Travel Companion:* functionalities and features associated with the general usage of the Travel Companion, i.e., the personal interface for a traveller to access integrated travel services offered by different TSPs and/or enabled by IP4
  - *Journey Planning:* functionalities and features improving the trip planning experience for a user with a mobility need
  - *Booking/Issuing:* functionalities and features improving the process of buying tickets and obtaining entitlements to travel
  - *Services during travel:* functionalities and features enabling additional services for a user during a travel
  - *Other services:* functionalities and features enabling additional services for a user
- **TSP View:** IP4 solutions targeting TSPs
  - *Tools for TSPs:* a set of tools implementing functionalities for TSPs

- *Enablers for TSPs*: enablers for a TSPs to support the technological integration and/or the implementation of specific functionalities

### 2.1.3. IP4 solutions for F-REL

This section reports the final list of IP4 solutions for F-REL agreed between CFM and IP4MaaS partners. Table 1 was compiled starting from the original list from CFM partners (cf. Annex I), which contains the final list of IP4 solutions: in this list, some functionalities have been merged (two or more identifiers for the same row), and other functionalities have been removed (strikethrough style) The resulting functionalities have then been grouped by the macro-categories defined by IP4MaaS.

The main merge/removal decisions taken can be summarized as follows:

- Improvements (features identified in the diagram) associated with IP4 solutions already considered for C-REL are merged in a single IP4 solution: Travel Companion Web Portal (15-P5), Journey Planning (1-A1-A6), Location Based Experiences (9-A8), Contractual Management Market Place (22-P6)
- IP4 solutions strictly related are merged in a single IP4 solution: Journey Planning Improved Intermodal Travel and Individual Last Mile (A5-A7), Travellers Orchestration and Supervision (A10-A11), Adding/Updating Travel Shopping Service for a TSP (S3-S5), (SaaS) Siri SX based pTT (A12-A14)
- IP4 solutions removed:
  - E-Wallet (P2) and Purchase using PayPal (P3) removed because payments won't be handled for users involved in IP4MaaS demonstrators;
  - Commuter Detection (19) removed as due to the time constraints for IP4MaaS demonstrators it is not possible to collect historical data required for the functionality;
  - Asynchronous provision ETE (P4) removed because no TSP involved in IP4MaaS requires this functionality (mainly related to air operators);
  - Secure Price and Tariff Information (A4) removed as it has been excluded from the developments by the ExtenSive project;
  - Trip Tracking CEP configuration (23) removed because integrated into the IP4 solution ptt CEP Rule editor (A13)

Solution 19 and P2 were removed from the list at a later stage, therefore, they were considered for the definition of demonstration scenarios (as reported in Section 4) but not in the final matrix (in Annex IV).

IP4 Solution	ID	User	Macro-categories
Travel Companion	0	Traveller	<b>Personal Application</b>
15 – Travel companion Web-Portal	15		
P5 – New functionalities Web Portal (Payment, Registration with Gmail and Purchase Mobility Packages)	P5		
Travel Companion for Kids	20		
Guest user	16		
Preferences and Profiles	17		
Digital OnBoarding	P1		
<del>P2 – E-Wallet</del>			
1 – Journey Planner / Offer Builder	1	Traveller	<b>Journey Planning</b>
Journey Planning improvements (A1 Trip Planning Hierarchy, A6 Improved Travel Shopping)	A1 A6		
Journey Planning - New functionalities (A5 Improved Intermodal Travel, A7 Individual Last Mile)	A5 A7		
<i>Intermodal Fare Optimization</i>	S7		
<del>19 – Commuter detection</del>			
Smart Locations	A3		
Trip sharing	12		
Travel Arrangement	14		
Booking	2		
Issuing	3		
<del>P3 – Purchase an offer using PayPal</del>		Traveller	<b>Booking/Issuing</b>
<del>P4 – Asynchronous provision ETE</del>			
<del>A4 – Secure Price and Tariff Information</del>			
Best price optimization	18		
Group travelling	13		
Ancillary service	4		
Mobility packages	5		
Validation and Inspection	6	Traveller	<b>Services during the travel</b>
Navigation	10		
9 – Location based experiences (LBE) A8 – LBE SCORE sharing	9 A8		

IP4 Solution	ID	User	Macro-categories		
Trip tracking orchestration	7				
Alternatives calculation	8				
Map Content	A2	Traveller	<b>Other Services</b>		
Traveller's feedback	11				
Collaborative space (traveller)	P8				
Asset manager	21	TSP	<b>Tools for TSPs</b>		
Collaborative space portal (TSP)	P9				
22 – Contractual Management Market Place (CMMP) P6 – New functionalities CMMP (Manual inclusion of Products and new registration process)	22 P6				
LBE editor	24				
CRM portal	P7				
A11 - Travellers Orchestration and supervision (Add and/or update LBE/POI, monitor travellers) A10 - Specific messages	A11 A10				
A9 - Meeting point	A9				
Business analytics	22B				
pTT CEP Rule editor	A13				
<del>23 – Trip Tracking CEP configuration</del>					
Inspection with fraud control	25				
<i>Enrolment Token Generator System</i>	<i>S1</i>			TSP	<b>Enablers for TSPs</b>
<i>Adding Travel Shopping Service to TSP</i>	<i>S3</i>				
<i>Update Travel Shopping Data for TSP</i>	<i>S5</i>				
Distributed Ledger – Transaction Anchoring	A15				
<i>Distributed Ledger – TSP Inclusion</i>	<i>S6</i>				
A12 – Siri SX based pTT	A12				
A14 – SaaS Siri SX based pTT	A14				
<i>Event Detection</i>	<i>S2</i>				
<i>Incident Messages</i>	<i>S4</i>				

**Table 1 - List of IP4 solutions for F-REL**

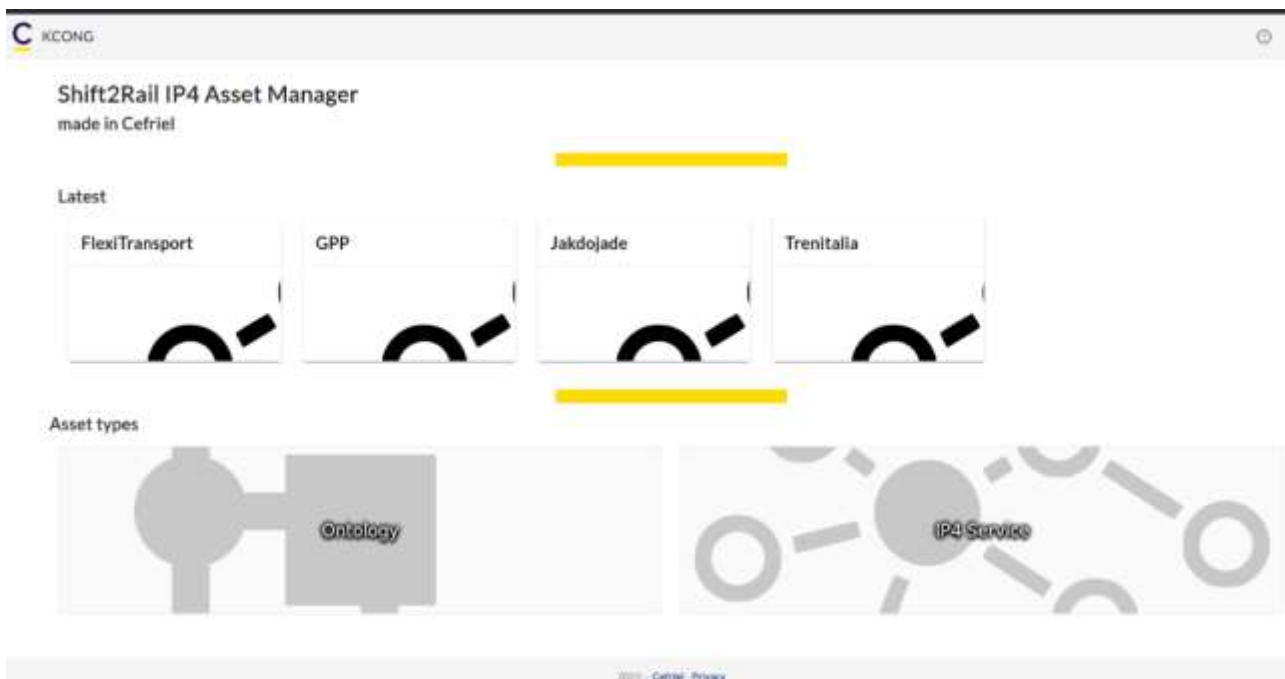
## 2.2. Assets of TSPs

This section lists the information concerning the software services that are available in each demo site. The information is shared continuously with CFM project partners through the Asset Manager (AM). The rest of this section first briefly introduces the structure of the AM (Section 2.2.1), then it provides an overview of the services available in each demo site (Section 2.2.2). Further details concerning the AM are available in Deliverable D3.3 “Crowd-based Travel Expert Service” prepared in the framework of the RIDE2RAIL Project [4].

### 2.2.1. Overview of the Asset Manager

The Asset Manager (AM) is a web-based application that works as a catalogue of digital assets. The idea behind the AM is that relevant stakeholders can provide descriptions of their assets (as asset providers) or can browse and search for relevant assets provided by other parties (as asset consumers). The AM is a tool that allows providers to share asset descriptions with the different stakeholders. In the case of the IP4MaaS (and Ride2Rail) projects, the AM constitutes the tool to share the relevant information about the TSP services (asset providers) with the CFM partners (asset consumers). All software services that are relevant for the demonstrations to be carried out in the IP4MaaS project have been described as “assets” of type “IP4 Service” in the AM.

Figure 5 shows the landing page of the AM containing all services’ descriptions, which are categorised according to their type and the projects they will be used in.




**Figure 5 – Landing page of the Asset Manager**

Whenever a new service is added to the AM, it is marked as “Submitted” for the creator and their

collaborators to review, but it is not publicly available until it is published through the appropriate function provided in the editing section. Figure 6 shows an example of this difference in the service status: When the screenshot was taken, the Korid LK service was yet to be published, while all other assets could be viewed by the users of the AM.

IP4 Service



Search

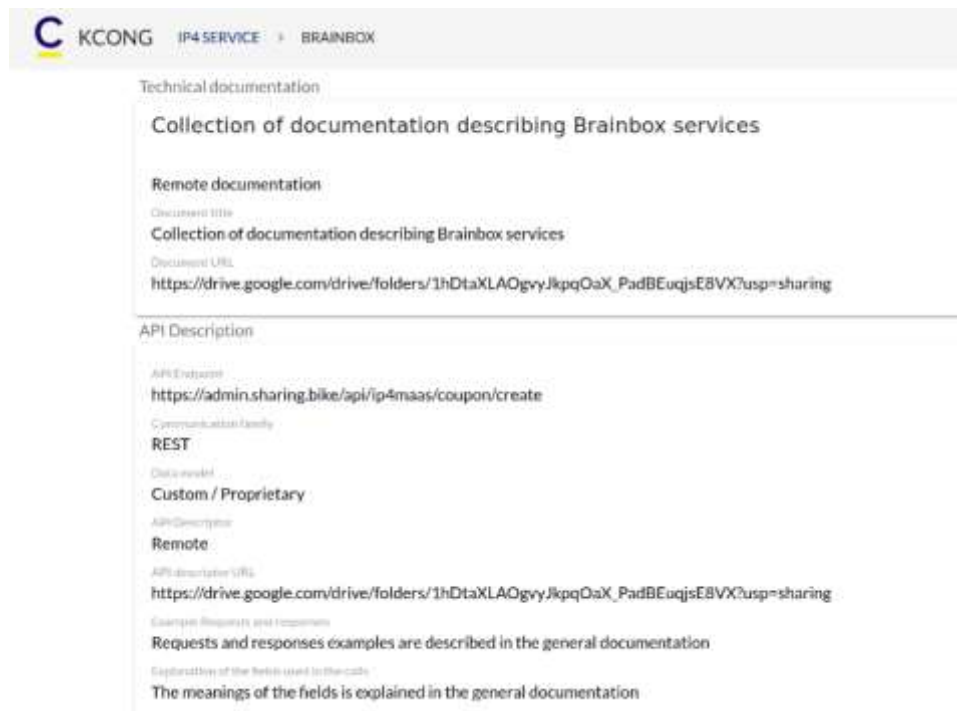
Resource name	Status	Date
GPP	Published	Apr 27, 2022, 09:36 AM
Jakdojade	Published	Apr 27, 2022, 09:35 AM
FlexiTransport	Published	Apr 29, 2022, 08:42 AM
TMB	Published	Apr 19, 2022, 12:57 PM
Brainbox	Published	Apr 22, 2022, 08:29 AM
Korid LK	Submitted	May 2, 2022, 12:17 PM
OASA	Published	Apr 22, 2022, 07:17 AM
Trenitalia	Published	Apr 22, 2022, 03:54 PM
Taxiway	Published	Apr 19, 2022, 12:58 PM
Miraklio	Published	Apr 22, 2022, 03:30 PM

**Figure 6 – Example of statuses of services described in the AM.**

Each asset has a generic section describing the asset itself and additional information regarding its provider, the demo site in which it will be used and one or more contact persons in case further explanations are needed. A separate tag identifies the development status of the service (beta version vs. “in production”).

Each IP4 Service asset is associated to a collection of documents that describe in detail the functions provided by the service and how they are supposed to be used to obtain the requested information. This documentation is sometimes provided as a link to a folder on the cloud containing the necessary set of documents.

In addition, an asset should have at least one section describing the main API provided by the service. This section is crucial to facilitate the integration of the service in the Shift2Rail digital ecosystem.



**Figure 7 – Snippet of an example of asset described in the AM.**

Figure 7 shows the snippet of a service description entered in the AM. The description includes a “Metadata” section (not shown in Figure 7) containing general information regarding the owner of the service, and the main sections labelled “Technical Documentation” and “API Description”. These sections provide information regarding how and where the endpoints corresponding to the interface of the service can be accessed, including details about the communication and data protocols that must be used to be able to implement it. This information is divided into different categories that reflect the general requirements of the demonstration scenarios. These categories are “journey planning”, “after sales”, “offer building”, “booking”, “issuing and validation”, and “trip tracking”.

While not every TSP must supply all these categories (as some might not align with a company’s business model), each service description should at least include a way to access a journey planner software API that includes timetables, availability of the service, route information, or an area in which the provider operates. This information is typically distributed as a GTFS (in case of a network-based service) or a GeoJSON archive (in case of a floating service) that are uploaded on the AM.

### 2.2.2. Assets available in each demo site

This section provides an overview of the information that is stored in the AM for each TSP available in the various IP4MaaS demo sites. The details of the services can be retrieved by the interested parties (and in particular by the CFM project members) from the AM. Information about the

services can evolve over time (for example if they are modified after their initial release), and the AM is continuously updated to keep track of the changes. For this reason, the official information regarding an available IP4 Service must always be considered the one stored in the AM. In addition, access to most services to be integrated is restricted to approved users only. For such services, the AM includes either the steps to obtain the necessary credentials, or the credentials themselves.

Athens Demo Site TSPs		
	Brainbox	Miraklio
Journey Planning	<a href="https://ip4maas-jp-api.imet.gr/plan">https://ip4maas-jp-api.imet.gr/plan</a>	<a href="https://api.transitool.com/apis/get/get-directions/3/v1.0/">https://api.transitool.com/apis/get/get-directions/3/v1.0/</a>
GTFS	GeoJSON of the covered area available in AM	Download from <a href="https://transitool.com/data-publications/miraklio">https://transitool.com/data-publications/miraklio</a>
Booking	Not available	Not available
Ticketing and validation	<a href="https://admin.sharing.bike/api/ip4maas/coupon/create">https://admin.sharing.bike/api/ip4maas/coupon/create</a>	Not available
Service status	Beta	Beta
Remote documentation	Link available on the AM	Link available on the AM

**Table 2 - Services available in the Athens demo site (part 1).**

Table 2 summarizes the information regarding the services available from two TSPs of the Athens demonstration: Brainbox and Miraklio. While journey planning is available for them, booking is not, because it depends on the business model. A GTFS, or a GeoJSON file, or a link to download them, describing the area in which the service is available are included in the contents of the AM. Since access to the API endpoints and documentation is restricted for both these entries, the documentation and the general description of the services include ways to obtain the necessary credentials.

Athens Demo Site TSPs		
	OASA	Taxiway
Journey Planning	<a href="https://ip4maas-jp-api.imet.gr/plan">https://ip4maas-jp-api.imet.gr/plan</a>	<a href="https://ip4maas-jp-api.imet.gr/plan">https://ip4maas-jp-api.imet.gr/plan</a>
GTFS	Link available on the AM	Link available on the AM
Booking	Not available	<a href="https://ip4maas-jp-api.imet.gr/booking">https://ip4maas-jp-api.imet.gr/booking</a>
Ticketing and validation	<a href="https://ip4maas-jp-api.imet.gr/issuing">https://ip4maas-jp-api.imet.gr/issuing</a>	<a href="https://ip4maas-jp-api.imet.gr/issuing">https://ip4maas-jp-api.imet.gr/issuing</a>
Service status	Beta	Beta
Remote documentation	Link available on the AM	Link available on the AM



**Table 3 - Services available in the Athens demo site (part 2).**

Table 3 shows the services available from the other TSPs in Athens, OASA and Taxiway. Like Brainbox, both are using the Journey Planner provided by CERTH, but with different credentials to access it, though with the same authentication method. Additionally, the links to the GTFS/GeoJSON files and the documentation of these TSPs are not public and can be retrieved from the AM.

Barcelona Demo Site TSPs		
	TMB	BusUp
Journey Planning	<a href="https://api.tmb.cat/v1/planner/plan">https://api.tmb.cat/v1/planner/plan</a> additional info <a href="https://api.tmb.cat/v1/transit/">https://api.tmb.cat/v1/transit/</a>	<a href="https://api.sandbox.busup.com/beta/">https://api.sandbox.busup.com/beta/</a>
GTFS	Download from <a href="https://api.tmb.cat/v1/static/datasets/gtfs.zip">https://api.tmb.cat/v1/static/datasets/gtfs.zip</a>	Link available on the AM
Booking	Not available	<a href="https://api.sandbox.busup.com/beta/">https://api.sandbox.busup.com/beta/</a>
Ticketing and validation	Not available	<a href="https://api.sandbox.busup.com/beta/">https://api.sandbox.busup.com/beta/</a>
Service status	In Production	Beta
Remote documentation	<a href="https://developer.tmb.cat/api-docs/v1">https://developer.tmb.cat/api-docs/v1</a>	Link available on the AM

**Table 4 – Services available in the Barcelona demo site (part1).**

Table 4 summarizes the services available from the TMB and BusUp TSPs of the Barcelona demo site. TMB is an urban transport provider for Barcelona, thus no booking is possible due to the nature of its business model. The Journey planning service for TMB has been divided into two different entries: one service provides the planning mechanism available to use, the second deals with static information about this TSP transport modes (routes, stops, lines etc). Documentation for all these services is available in Catalan (understandable by non-Catalan speakers through Google translate) following the links added to the entry. As the service is publicly available, authentication credentials must be created separately. Steps to obtain them are described in the general section of the documentation.

Barcelona Demo Site TSPs	
	FlexiTransport
Journey Planning	<a href="https://virtserver.swaggerhub.com/pmrazovic/FlexiTransport_2_VariableStops/0.0.1/algorithm">https://virtserver.swaggerhub.com/pmrazovic/FlexiTransport_2_VariableStops/0.0.1/algorithm</a>
GTFS	GeoJson available from the AM
Booking	Not available
Ticketing and validation	Not available
Service status	Beta
Remote documentation	<a href="https://app.swaggerhub.com/apis-docs/pmrazovic/FlexiTransport_1/0.5.0">https://app.swaggerhub.com/apis-docs/pmrazovic/FlexiTransport_1/0.5.0</a> <a href="https://app.swaggerhub.com/apis-docs/pmrazovic/FlexiTransport_2_FixedStops/0.0.1">https://app.swaggerhub.com/apis-docs/pmrazovic/FlexiTransport_2_FixedStops/0.0.1</a> <a href="https://app.swaggerhub.com/apis-docs/pmrazovic/FlexiTransport_2_VariableStops/0.0.1">https://app.swaggerhub.com/apis-docs/pmrazovic/FlexiTransport_2_VariableStops/0.0.1</a>

**Table 5 - Services available in the Barcelona demo site (part2)**

FlexiTransport is the most recent addition to the Barcelona demo site list of TSPs and is shown in Table 5. As of the time of writing, the only service provided by this entry is Journey Planning: an API endpoint has been published with two separate variants also available to use within the same coverage area describer in the GeoJSON uploaded on the AM. Each of these has its own documentation link provided through Swagger UI. No authentication mechanism description has been provided for FlexiTransport services.

Warsaw Demo Site TSP	
	Jakdojade
Journey Planning	<a href="http://jakdojade.pl/api/rest/v2/routes">http://jakdojade.pl/api/rest/v2/routes</a>
GTFS	Available from AM
Booking	Not available
Ticketing and validation	Not available
Service status	In production
Remote documentation	<a href="https://jakdojade.pl/public/pages/api/routes.html">https://jakdojade.pl/public/pages/api/routes.html</a> <a href="https://jakdojade.pl/public/pages/api/tables.html">https://jakdojade.pl/public/pages/api/tables.html</a> <a href="https://jakdojade.pl/public/pages/api/locations.html">https://jakdojade.pl/public/pages/api/locations.html</a>

**Table 6 – Services available in the Warsaw demo site.**

Table 6 displays the situation regarding the situation of the services available in the Warsaw demo site. Jakdojade is a third-party company that developed a Journey Planner that can be integrated for this demonstration site. Although its documentation is in Polish, as mentioned in the AM, it can be read easily using a quick automatic translation with the translator of choice (e.g., Google Translate).

As the TSP are mostly dealing with urban transport, no booking or issuing is available for them. The authentication mechanisms are discussed in the general documentation provided at the links included in the entry. A GTFS file covering all of Warsaw public transport is available from the AM. Though the GTFS file is not officially provided by the Warsaw municipality, but from a third party, the municipality confirms that it is of good quality, and it is reliable.

Osijek Demo Site TSP	
	GPP
Journey Planning	<a href="https://ext.crws.cz/">https://ext.crws.cz/</a>
GTFS	<a href="https://gtfs.gpp-osijek.com:3010/api/">https://gtfs.gpp-osijek.com:3010/api/</a> also available from AM
Booking	Not available
Ticketing and validation	Not available
Service status	Beta
Remote documentation	<a href="https://gtfs.gpp-osijek.com:3010/swagger/index.html">https://gtfs.gpp-osijek.com:3010/swagger/index.html</a> Journey planner documentation available on demand

**Table 7 – Services available in the Osijek demo site.**

Table 7 shows the information related to the GPP TSP of the Osijek demo site. A Journey Planner is available, based on the same technology that is used for the Liberec demonstration site (see later). Documentation for the journey planner is available, but only on request. GTFS information about the network is available from a service, but also directly downloadable from the AM. As for the previous entries, the mechanisms and credentials to access the remote API services are described in the related Asset manager entry.

Padua Demo Site TSP	
	Trenitalia
Journey Planning	<a href="https://api.lefrece.it/pico/olta">https://api.lefrece.it/pico/olta</a>
GTFS	Downloadable from AM
Booking	Available
Ticketing and validation	PDF ticket document. Validation only through proprietary hardware/software
Service status	In production
Remote	Link available on the AM

**Table 8 - Services available in the Padua demo site.**

Table 8 summarizes the services available from the Trenitalia TSP of the Padua demo site. Trenitalia has all the services required for the demonstration, except for ticket validation, which is only possible through proprietary assets (hardware and software). The downloading of tickets (in PDF format) is also available. A link to a cloud repository that allows users to download a collection of documents describing these services and the steps to use them is available on the AM. A reading guide of these documents is also present to simplify the process. Credentials to access these services are issued by FST directly, thus requiring a separate query through the communication channels provided within the asset’s description.

In addition, it is planned to also integrate in the Padua demo site a Journey Planner for the the Busitalia TSP, based on technology provided by the Shift2Rail ecosystem. Do initialize this Journey Planner GTFS data regarding the Busitalia network is necessary, so a suitable GTFS file has been upload for this on the AM.

Liberec Demo Site TSPs	
	KORID/OLTIS
Journey Planning	<a href="https://ext.crws.cz/">https://ext.crws.cz/</a>
GTFS	Available on demand
Booking	Available if deemed interesting
Ticketing and validation	<a href="https://brnord.oltisgroup.cz/korid/api/ticket">https://brnord.oltisgroup.cz/korid/api/ticket</a>
Trip Tracking	<a href="https://brnord.oltisgroup.cz/crws-wrapper/actuator/info">https://brnord.oltisgroup.cz/crws-wrapper/actuator/info</a>
Service status	In Production
Remote documentation	Available on demand only for the Journey Planner Available on the AM for the other services

**Table 9 – Services available in the Liberec demo site.**

The services available in the Liberec demonstration site are provided by KORID/OLTIS, some of them based on technology provided by CRWS. They are summarized in Table 9. In Liberec there is good coverage of the typical travellers’ services (journey planning, booking, ticketing, trip tracking). GTFS files describing the covered network and the detailed documentation are available on demand. To access this information a separate demand must be issued using the communication channels mentioned in the AM. Other services are subject to individual TSP business models. Booking, for instance, is possible if the bus services provided by AMS are be integrated (whether to integrate the AMS service or not is still a pending decision, to be taken in consultation with the CFM project partners). A ticketing service and a trip tracking service are also available, and their related information is available from the AM.

### 3. Definition of user needs & expectations and demonstration requirements

For C-REL (reported in D2.2), the collection of needs and expectations for travellers and TSPs was done through interviews with the TSPs, and via the AS-IS template, which presented a section aimed to collect needs driven by any specific characteristic of the travellers.

For F-REL, the collection of said needs and expectations is done through the administration of a conversational survey to travellers in all the different demonstration sites (cf. Section 3.1), and an opinion mining activity (cf. Section 3.2).

This section also summarizes the technical requirements for the integration of the services in the Shift2Rail digital ecosystem.

#### 3.1. Conversational Survey

The goal of this survey is to gather information related to the IP4 functionalities directly from potential final users. Specifically, the conversational survey was administered to travellers of each demonstration site, with the purpose of gathering their interest and their expectations with respect to specific functionalities. The goal of the survey is to run a sort of “market research” analysis, investigating needs and requirements coming from travellers with respect to the solutions offered by IP4 to travellers. **The idea is that the insights derived from the survey data can be of help in providing feedback to IP4 solution providers, as well as informing the actual IP4MaaS experimentation** (for example providing hints for the re-design and adaptation of the USI survey cf. deliverable D3.2).

##### 3.1.1. Survey design

The list of IP4 solutions already presented in Table 1 was used as starting point to investigate the user needs and expectations. Since the survey respondents were not expected to have any background information about IP4 or the main topics of the project and the survey must be easy to fill in, IP4 solutions were selected to be investigated based on their ease of understanding and use by general travellers (e.g. companion app, trip planning), while the most complex and advanced ones were disregarded (e.g. best price optimization, location-based experiences). As a result, for each macro-category, 2-3 questions spanning the selected IP4 solutions were created.

Each question is defined to investigate the importance and the perceived usefulness of the set of IP4 solutions from the travellers’ point of view ; therefore, each question was formulated as a statement with a closed set of 5 answers representing the level of interest, preference or perceived usefulness (e.g. “not at all”, “not really”, “indifferent”, “a little”, “a lot”) which were coded with a numerical value from 1 to 5.

The following Table 10 details the set of the IP4 solutions (the list of identifiers) selected to define

the questions for each macro-category.

Macro Category	Question 1	Question 2	Question 3
Travel companion	[0,15,P5] <i>Mobile or web application for travelers to access integrated travel service</i>	[16] <i>App usage without a registered account (i.e., guest user)</i>	
Journey planning	[1,A1,A6,A5,A7] <i>Multimodal travel solution calculation including private transports</i>	[S7] <i>Fares optimization considering different means of transport</i>	[A2] <i>Outdoor map that displays travel-related content</i>
Booking/Issuing	[2] <i>Online booking and ticket issuing</i>	[5] <i>Mobility packages</i>	
Services during the travel	[10] <i>Navigation helper to provide the traveller additional information (e.g., arrival times)</i>	[11,P8] <i>Ability to report situations like crowded stations and view others' reports</i>	[7,8] <i>Real-time information to notify about disruptions and provide alternative solutions</i>

**Table 10 - Question's definition**

In addition to the specific questions for each macro category, a few other demographic questions were included to profile the respondents, related to age, gender and employment status. The response options set for these specific questions are homogeneous and consistent with those of the USI questionnaire (cf. deliverable D3.2).

The survey was designed and implemented using Coney, a conversational survey tool developed by Cefriel (<https://coneytoolkit.cefriel.it/>) for administering questionnaires in a chat form, so that the respondent can experience it as it was a conversation with another person rather than a pure list of questions [2]. Therefore, the list of questions related to the IP4 solutions and macro-categories were formulated in a colloquial form and connected in a conversational flow to improve the compilation experience.

In this storytelling flow, users are asked to imagine themselves travelling on a journey with the following characteristics:

- Different transport modes must be used, with separate ticket necessary for each one of them

- Each journey must also include the use of a private vehicle, to reach the first station from the departure point, or the arrival point from the last station
- The user has access to an application that guides him/her through this journey; this app allows the user to perform a number of different activities during the journey (e.g., planning the trip, making reservations, buying different tickets, etc.)

Setting this travel context also facilitates the description of functionalities that would otherwise be difficult for a user to understand.

The survey (as well as its information sheet) was translated from the original English version into other 6 different languages (Italian, Spanish, Polish, Croatian, Czech and Greek) in order to increase its acceptance and response rate in the demonstration sites. The projects partners undertook the translations.

The full survey (in its English version) is fully reported in Annex VI.

### 3.1.2. Survey distribution

The survey was distributed by the project partners through their dissemination channels: each partner was asked to fill a shared online table, indicating all the potential dissemination channels (e.g., mailing lists, social media pages, CRM, etc), the target audience, and the person in charge of managing the dissemination through each channel.

While the survey (with all its translations) is unique, it was necessary to track where the compilations came from, in terms of demonstration sites. Therefore personalized links were created for each distribution channel listed in the table mentioned above (as Coney provides this feature). Each survey compilation remains completely anonymous, except from the tracking of the dissemination channel.

These survey links were distributed on the 1st of March to the partners responsible for dissemination and the survey remained open for compilations until the end of April, when the links were disabled and the survey was no longer fillable.

During the compilation period, a weekly update was sent to all the people in charge of the dissemination, reporting some aggregated statistics, in order to monitor and in case push for further dissemination actions.

### 3.1.3. Result analysis

#### *General statistics*

1414 travellers started completing the survey and 1027 of them finalized it (72% completion rate) from the 1<sup>st</sup> March 2022 to the 14<sup>th</sup> April 2022. The average compilation time was 3 minutes and 36 seconds. In this chapter contains the analysis of the answers gathered from only the completed surveys.

Regarding the provenance of compilations, Table 11 shows the number of answers collected from each demo site.

Demo Site	N° of respondents
Warsaw	435
Padua	36
Osijek	41
Liberec	69
Barcelona	44
Athens	162
Other	240

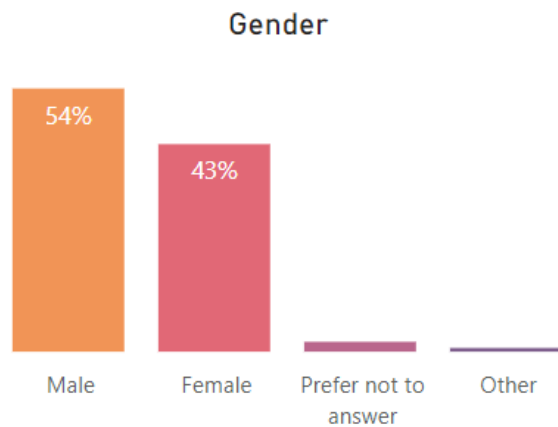
**Table 11 - Number of respondents for each demo site**

The statistics used in the following sections are computed on the entire dataset without making distinction based on demo site, due to the strong different in numerosity between the demo sites.

#### *Respondents' profiling*

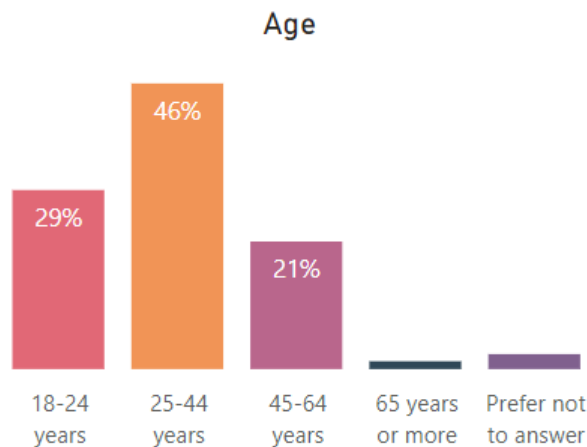
In regards to gender;, the 54% of the respondents were are and 43% female, as shown in Figure 8.





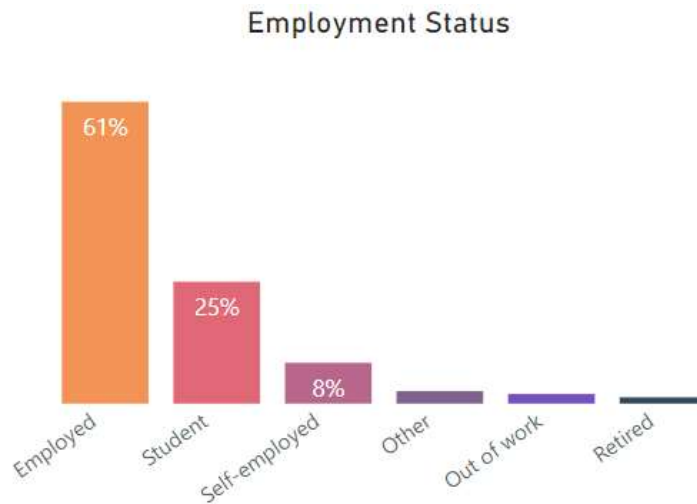
**Figure 8 - With which gender do you most identify with?**

Most of the participants (46%) are between 25-44 years old, 29% in the range 18-24 and 22% older than 45 years old (cf. Figure 9).



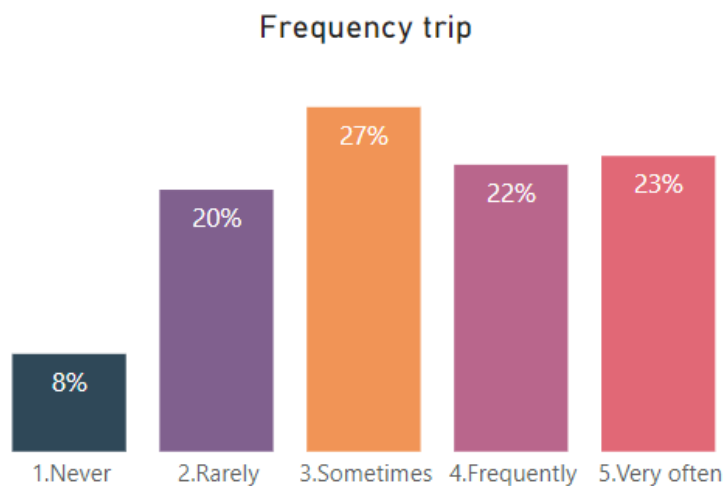
**Figure 9 - How old are you?**

Regarding the employment status, most of them (69%) are employed or self-employed, 25% are students and the remaining 6% are retired or out of work.



**Figure 10 - What is your employment status?**

Almost all participants (92%) made a trip like the one described in the introduction of the survey at least once: 45% of respondents do such a trip very often or frequently and 47% sometimes or rarely (cf. Figure 11).



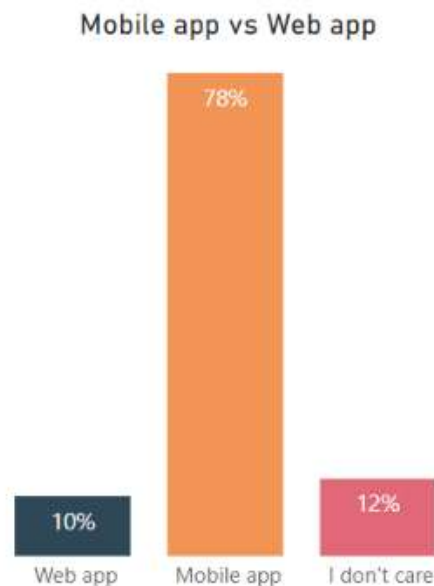
**Figure 11 - How often do you happen to make such a trip?**

#### *Macro-categories questions*

This section reports the answers collected for each of the four macro-categories analysed: travel companion, journey planning, booking/issuing and services during the travel. All IP4 solutions, as presented in the survey, recorded a high interest and relevance in the high majority of respondents. This confirms that indeed those features can provide an added value to travellers and that the research and innovation direction of IP4 is indeed touching upon a clearly perceived need of European people.

## Travel companion

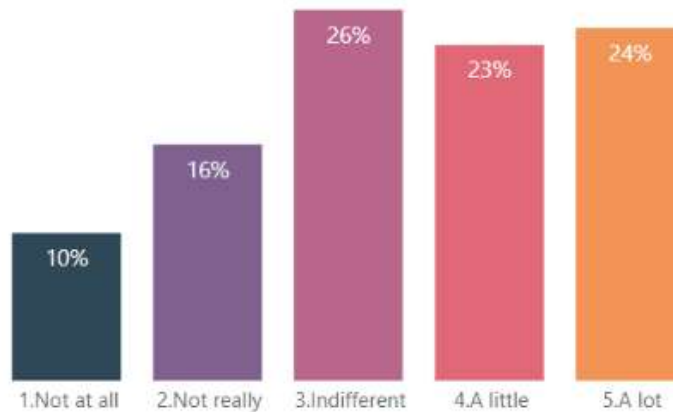
The proposed app lets travellers plan their journey, book and buy tickets and access a variety of other services during the trip, all in one place. Users were asked if they prefer to have a mobile app for their phone or a web application accessible via the browser. Most of them (78%) prefer the mobile app, as shown in Figure 12.



**Figure 12 - Which of these options would you prefer?**

Users are asked to create an account within the app, in order to access personalized features like scrolling through their old trip's history or their personal travel preferences. Users were then asked if they would prefer to use the app without creating an account, so giving up on the personalized features. 47% of respondents appreciate the possibility of using the app without registration, 26% is indifferent and the 26% will use the app only with an account (cf. Figure 13).

Using the app without creating an account

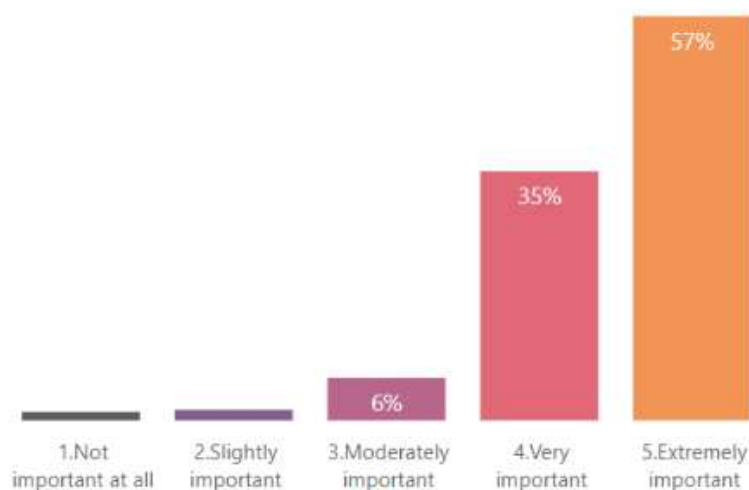


**Figure 13 - Would you prefer instead to use the app WITHOUT creating an account, so giving up on the personalized features?**

### Journey planning

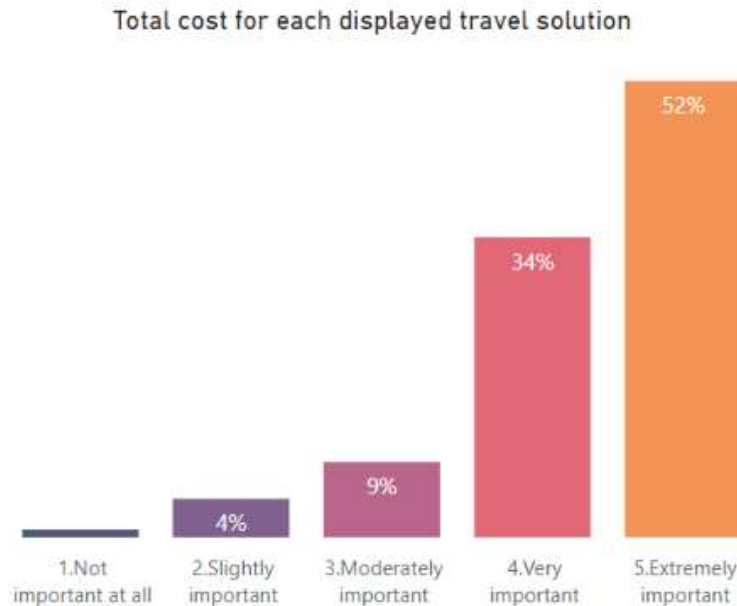
As for the journey planning phase, travellers appreciate a lot the possibility of having an app which includes all possible means of transports and all different service providers in the same place (cf. Figure 14).

All means of transport and service providers in the same app



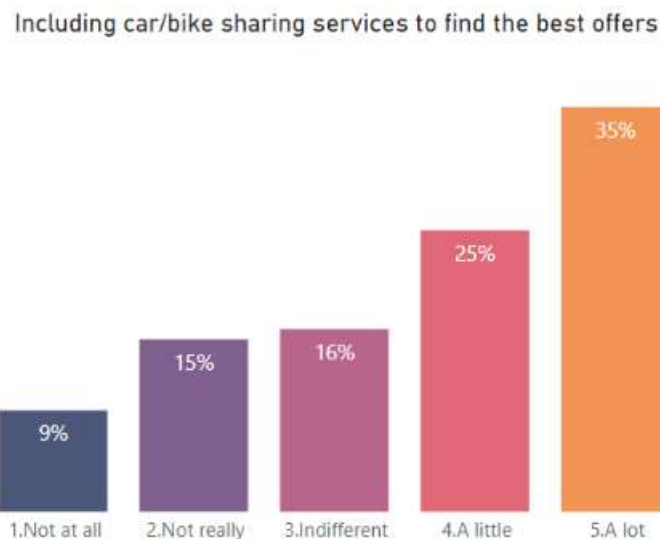
**Figure 14 - First off, how important is it for you that this app already includes all possible means of transport and all different service providers in the same place (instead of using different applications)?**

Moreover, 86% of respondents considers very important the functionality that can display in the app the total costs of all the suggested travel solutions (cf. Figure 15).



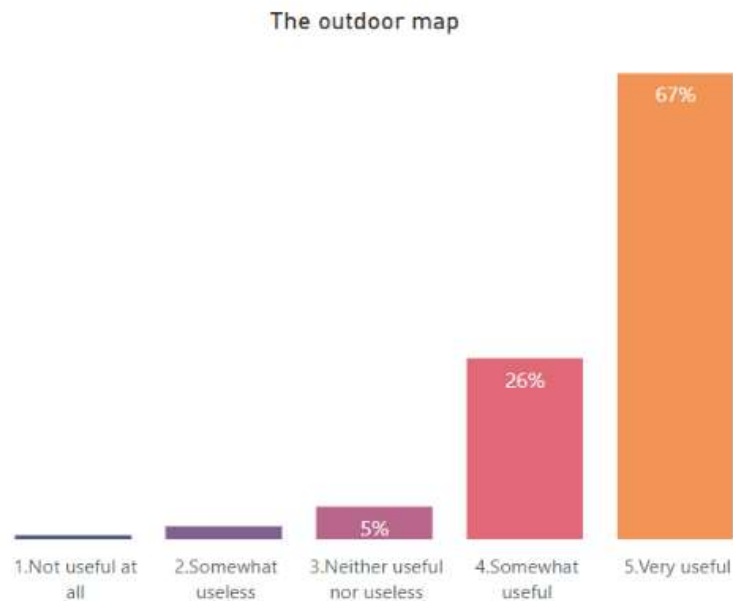
**Figure 15 - And how important is it for you to have the total cost for each displayed travel solution?**

60% of respondents are in favour of including in the app also the possibility to consider car/bike-sharing for finding the best travel offer, as shown in Figure 16.



**Figure 16 - Would you like the app to also consider car/bike-sharing services to find the best offers considering both the public transport tariffs and the sharing services time-based cost?**

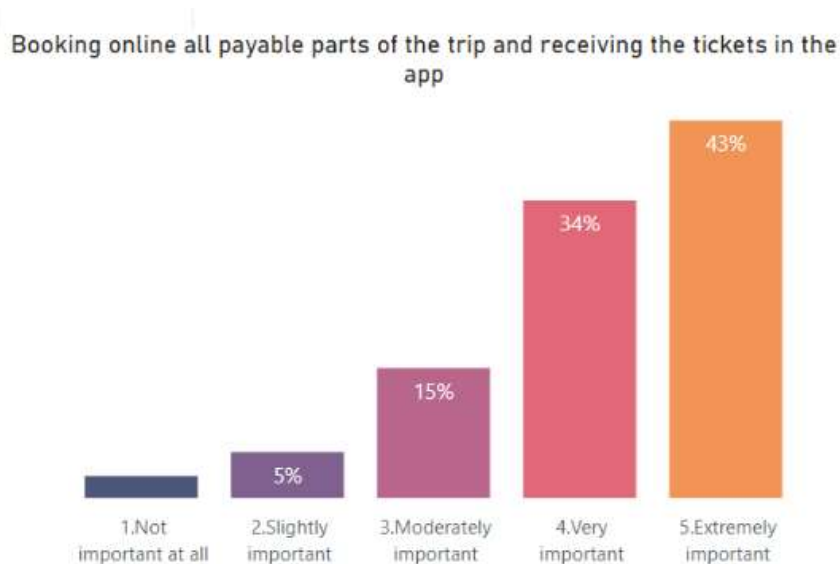
The integration of a zoomable and interactive map, which lets users navigate all the computed travel solutions and displays all the travel-related relevant content (name of roads, bus stops, stations, etc), is perceived useful by almost all respondents (93%), as shown in Figure 17.



**Figure 17 - How useful would you find the outdoor map?**

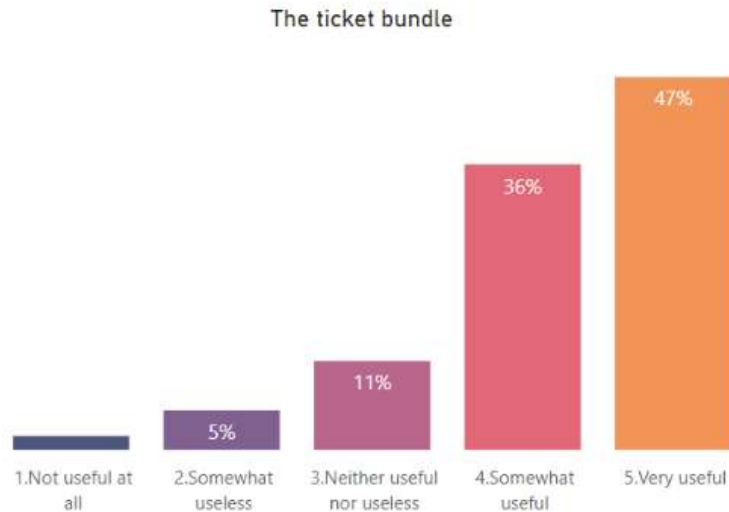
### Booking/Issuing

Regarding the booking of the trip, users find it useful to have the opportunity to book online all the payable parts of the trip and receive the tickets right within the app (cf. Figure 18).



**Figure 18 - Is it important for you to book online all payable parts of the trip that you are planning, and receive the tickets right within the app?**

Instead of buying separate tickets, users would appreciate the option of buying a ticket bundle that allows them to use different transport modes, possibly for a few consecutive days (cf. Figure 19).

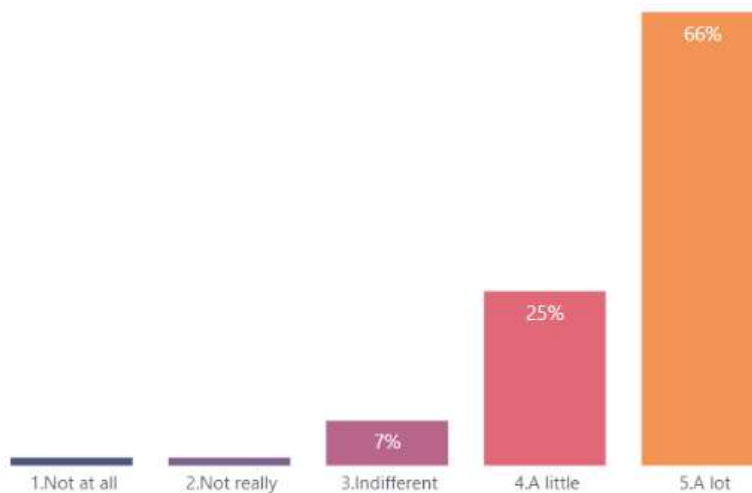


**Figure 19 - Would you find the ticket bundle useful?**

### Services during the travel

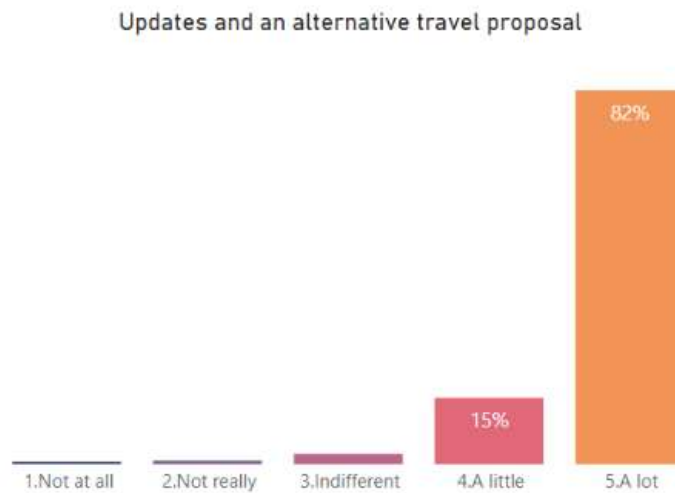
The app allows users to receive up-to-date information on the journey. Almost all the users would like to be informed in real time on the different stops, transport mode changes, departure and arrival times while they are travelling, as shown in Figure 20.

Live updates about stops, transport mode changes and departure and arrival time



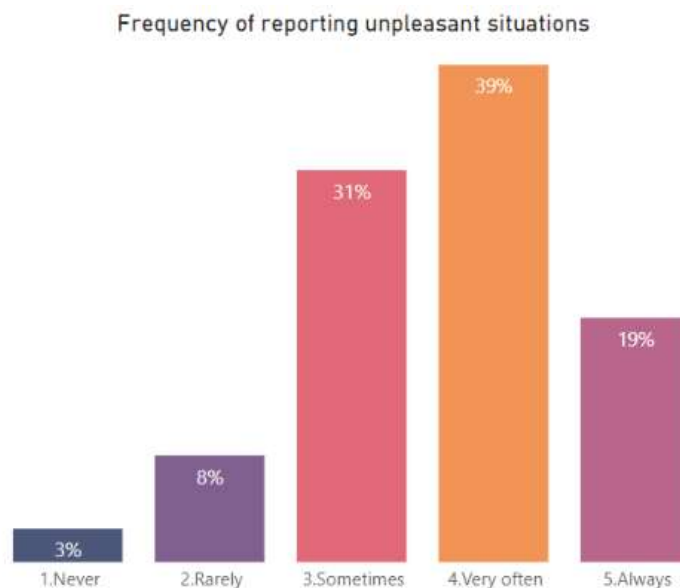
**Figure 20 - Would you like to be informed live about the different stops, transport mode changes, departure and arrival times while you travel?**

Users would also like to receive updates from the app in case of delays or disruptions (e.g. part of the trip has been cancelled) while on the road. They would expect the app to send updates and an alternative trip suggestion (cf. Figure 21).



**Figure 21 - Would you like the app to send you updates and an alternative travel proposal?**

In case of unpleasant situations such as delays, crowded stations or broken equipment, the app would allow users to report about these kinds of situations and to check other people’s reports. Travellers are already used to report these kinds of situations, as reported in Figure 22: 58% of travellers reports these situations always or very often and only the 11% reports them rarely or never.



**Figure 22 - How often would you report those situations?**



### *Differences between different users' profiles*

The difference in mean between age groups was also tested for each macro-category, gender categories and types of employment to verify if any demographic parameters could influence the perceived usefulness of the functionalities analyzed. Due to the uneven numbers of answers for each of the different groups, no test was done on combined profiles (e.g. self-employed women under 45 years old). The dimensions of age, gender and employment status were considered separately.

The Wilcoxon non-parametric statistical test (a test similar to the Student's t-test, but applicable in case of non-normal distributions) was used to verify if the existing differences in mean are statistically significant.

In the high majority of cases there was no statistically-significant difference (at 5% significance level) meaning that, in general, there is no difference in user interest/preference based on age, gender or employment status. However, there are a few cases in which this difference is indeed statistically significant ( $p\text{-value} < 0.05$ ) but the difference between the mean values is very limited (between 3% and 8%), thus there is only some evidence of very light effect of profiling characteristics on results.

To provide some examples, in the case of the question analysed in Figure 15 "How important is it for you to have the total cost for each displayed travel solution?" people under 45 years old are slightly more interested w.r.t. people over 45 (mean of 4.37 vs. 4.17 on a 1:5 scale), but both groups rated over 4, so the feature is very important for everybody. A similar behaviour is observed between women and men where the former are slightly more interested (mean 4.49) than the latter (mean 4.20).

Similarly, for the question in Figure 17, women find the outdoor map slightly more useful than men (mean of 4.66 vs. 4.5). In addition, women consider it a bit more important to be informed live during the travel about different stops, transport mode changes, departure and arrival times than men, as depicted by the mean of 4.63 for women and 4.43 for men (question in Figure 20).

As for question in Figure 22, people younger than 25 years old are a bit more used than people over 25 to report in an app unpleasant situations that may occur during the travel such as delays, crowded stations or broken equipment (mean of 3.77 vs. 3.58).

There is another difference related to age in question in Figure 13: people older than 25 years old are slightly more inclined to use the Travel Companion app without creating an account, as proved by the mean of 3.40 for over-25 and 3.22 for under-25. This trend is confirmed by looking at the employment status, where students (generally younger than 25) are less interested in using the app without an account rather than self-employed workers (mean of 3.2 vs. 3.6).

In addition, referring to question in Figure 12, younger people prefer to install the Travel Companion on their smartphones instead of accessing it via browser. Actually, the percentage of people that prefer to have it as a mobile app decrease with increasing age, from the 85% of preferences for people aged between 18-24 to the 62% for people over 65 years old.

### 3.2. Opinion Mining

The opinion mining activity carried out in the IP4MaaS Project complements the survey analysed in Section 3.1 by performing a sentiment analysis of the topics of public transport and shared mobility in the Barcelona and Veneto regions. More precisely, whereas the survey presented in Section 3.1 was conducted in a top-down manner, by asking responders specific questions on matters of interest for the Shift2Rail ecosystem, the opinion mining activity follows a bottom-up approach, in that it analyses the opinions expressed by users in a spontaneous way, without prompting. This was achieved through the analysis of the tweets published by common people of the above-mentioned regions concerning public transport. More precisely, as many tweets as possible were collected containing a keyword that could be related to the two topics (public transport and shared mobility), which were then analyzed to identify other related topics that could be related to them; finally the emerging sentiment was analysed to see what was the opinion in the regions that were relevant for the pilot. The analysis was carried out only in areas related in two demonstration sites, the Barcelona and Veneto regions. Indeed, the opinion mining activity requires, on the one hand, a large enough corpus of messages (tweets) to analyse and, on the other hand, mechanisms that are tailored to the specific language (hence also possibly the alphabet) in which the tweets are expressed. This made the analysis sustainable only in the two selected regions.

The methodology can be split into 4 phases, which are summarized in Figure 23. During the first phase, the query format is designed in order to maximize the retrieved data and minimize the number of irrelevant tweets, while at the same time fulfilling Twitter’s API restrictions in terms of query complexity. In the second phase, labelled as “Corpus Cleaning”, the data is submitted to an additional filtering step to avoid irrelevant tweets, standardize and lemmatize each word in each tweet, and remove punctuation symbols, among others. The third phase consists of an in-depth analysis, both at a quantitative and at a conceptual level, to find the topics that are being mentioned in the corpus, as well as the interactions between them. The fourth and final phase consists of analyzing the emotion – positivity, neutrality or negativity – of the tweets, as well as the sentiment – anger, fear, joy, etc. However, in order to make the results more interpretable, the emotions and sentiments are linked to the topics found in the topic extraction phase.



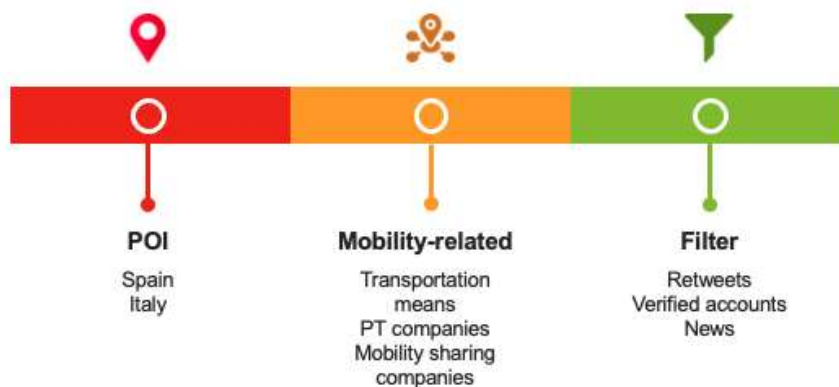
**Figure 23 – Sentiment analysis methodology**

The phases are run in an iterative manner, in the sense that it is possible that some irrelevant tweets are found during the corpus cleaning, which then helps improve the filters in the first phase. Analogously, if unrelated topics or threads are found during the topic extraction phase, they are filtered out in the initial two phases, thus leading to an increasingly robust and reliable corpus at each iteration of the 3 initial steps.

The rest of this section briefly presents the outcomes of each of the steps depicted in Figure 23. Additional details can be found in Annex VIII.

### 3.2.1. Raw Corpus Creation

As a first step, the data retrieval is performed using Twitter’s API (Application Programming Interface), collecting the relevant data using the query dictionary that is described below. The data retrieval is performed weekly due to the 7-day window restriction of Twitter API to access and collect tweets. The query dictionaries per pilot are created using the three blocks shown in Figure 24.



**Figure 24 - Query structure**

The first part of query involves the choice of a territory – Italy or Spain. Once the territory has been specified, the exact POIs – Points Of Interest – are obtained from Table 12.

Country	Point of interest
Spain	Barcelona, Mataró, Sant Cugat, Sabadell, Campus Nord
Italy	Padova, Venezia, Vicenza, Treviso, Ca’Foscari, Camposampiero, Castelfranco Veneto, Torri Quartesolo, Montegalda, Arcella, Trebaseleghe, Piombino Dese, Mestre, Veneto, Loreggia, Laguna, Rovigo, Triveneto, Resana

**Table 12 - Relevant POIs per country**

Clearly, the choice of a POI conditions the possible mobility keywords. For instance, the city of Venice in Italy has a transport means called *vaporetto*, which does not exist anywhere in Spain. Thus, in order to select the mobility-related search-word, Table 13 is defined.

Country	Transportation Means	Shared Mobility Companies	Public Transportation Companies
Spain	metro, tren, train, bus, autobús	Amovens, AvanCar, BlaBlaCar, GetAround, ShareNow, SocialCar, SomMobilitat, Ubeeqo, DriiveMe, DedoCarApp, CompartirCoches, Journify, HoopCarpool, Carpoolworld, BusUp.	TMB, AMB
Italy	Tram, tranvia, bus, autobus, treno/treni, monopattino/monopattini, pullman	MoBike, RideMovi, CarSharing Padova, BitMobility, Dott	Trenitalia, Busitalia, Busitalia Veneto, Atvo, Arriva Veneto, ACTV/AVM

**Table 13 – Relevant mobility keywords per country**

Finally, a filter is added because verified accounts and news are not entirely representative of the sentiments and emotions of the general public. Moreover, these sources tend to aim at neutrality and at informing, rather than providing opinions, and thus tweets and retweets coming from them are removed. This completes the third block.

The results of the data retrieval step are shown in Annex VIII.

### 3.2.2. Corpus cleaning

In this phase, various activities were carried out, and in particular tweets that concerned topics unrelated to urban transport and shared mobility were removed. This led to a reduction in the number of tweets to be analysed.

As expected, although the initial volume of English tweets collected for the Barcelona pilot is remarkably larger than the volume of Spanish and Catalan tweets, the data munging process returns a dataset in which the languages follow a more reasonable distribution – the most spoken languages at the POIs are Spanish and Catalan, so the size of the datasets for the two languages should be larger than the size of English tweets. Table 14 shows the number of tweets left after the cleaning step in the Barcelona demo site.

Status	ca	en	es
before_cleaning	25,210	59,761	8,652
after_cleaning	12,038	7,457	5,676

**Table 14 - Tweet counts per language in Spanish pilot**

The final numbers for the Padua demo site, instead, can be found in Table 15.

status	en	it
before_cleaning	129	1214
after_cleaning	41	975

**Table 15 - Tweet counts per language in Italian pilot**

### 3.2.3. Topic extraction

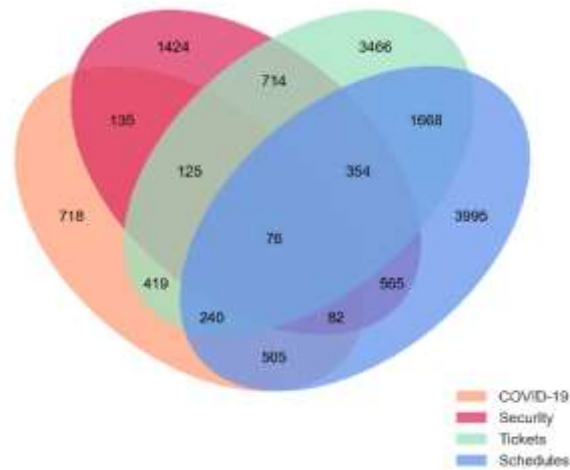
One of the main difficulties of topic mining is that, unlike in sentiment analysis, there are no standardized dictionaries for topics. For this reason, the following iterative method is proposed: First, the most frequently used words observed in a process known as *n-gram analysis* are grouped into distinct topics that can be related to shared mobility and public transport. Afterwards, the number of tweets in each group is computed and, finally, depending on the amount of tweets that fall in each group, the topic is removed or kept – if the number is too low with respect to the total amount of data, that means not enough people are talking about it and therefore it should be removed. The details of the results of the topic extraction phase are shown in Annex VIII. They can be summarized as follows.

The n-gram analysis leads to the identification of the 4 following topics for the Barcelona demo site:

- COVID19
- Security
- Tickets
- Schedules

For each topic, a set of corresponding n-grams was identified, so that each tweet can be assigned one or more topics depending on the terms that appear in it.

Figure 25 shows the number of tweets related to each topic, as well as the intersections of these sets of topics. The numbers correspond to the distinct tweets that make reference to the topic, which is specified by the color. For instance, the number 76 in the middle of Figure 25 represents that there are 76 tweets in the processed data that make reference to the 4 topics.



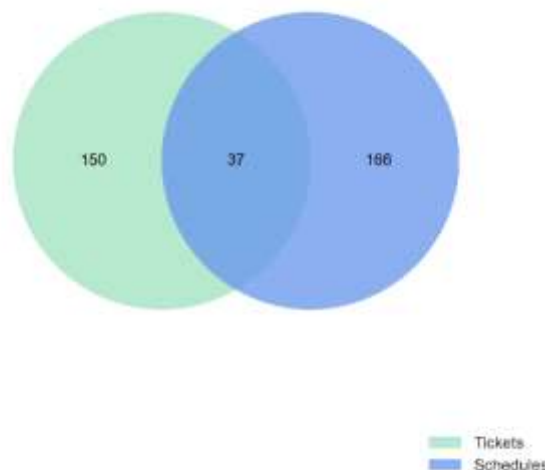
**Figure 25 - Venn diagram of topics for Spain**

The largest intersection between two topics occurs between tickets and payment methods, and waiting times and schedules, which is reasonable given the queries used in order to retrieve the data. On the other hand, there are only 135 tweets in the intersection between covid and security, which means that the topics have not been referenced together as often as other pairs of topics.

The n-gram analysis concerning the Padua demo site led to the identification of the 2 following topics:

- Tickets
- Schedules

As shown in Figure 26, for the Italian pilot there is a good balance between the tweets that reference tickets and payment methods and waiting times and schedules. In addition, the intersection of both topics contains 36 tweets, which suggests that in the Italian pilot, the two topics are referenced separately more often.



**Figure 26 - Venn diagram of topics of Italy**

### 3.2.4. Sentiment Analysis

There are several approaches to analyze sentiment. Given the amount of data available, a lexicon-based approach is chosen. More specifically, the chosen lexicon is EmoLex, also known as NRC Word-Emotion association lexicon. It is a list of more than 14,000 words for each language together with an association with eight basic emotions – anger, fear, anticipation, trust, surprise, sadness, joy and disgust – and two sentiments – negative and positive. The algorithm then consists on counting the number of times a word corresponding to each sentiment has appeared in the processed text, and the results are then appended to the processed dataframe, under a column whose name is given by the possible emotions and sentiments. For the negative and positive emotions, however, it is considered that since a “neutral” emotion should also be available, it is best to use the *polarity* ratio: Given a tweet with  $p$  positive words and  $n$  negative words, its polarity is defined as

$$Polarity = \frac{p - n}{p + n}$$

**Equation 1 - Definition of polarity**

Clearly, the polarity of a tweet is well-defined whenever  $p + n$  is non-zero, and it varies between  $-1$  and  $+1$ . If  $p + n$  is zero, that means that no positive or negative words were found in the tweet, so those tweets are disregarded. In addition to this, a polarity close to  $+1$  can be regarded as the tweet being “positive”, of  $-1$  being “negative”, and around  $0$  meaning that there was a balance between negative and positive words, thus it can be regarded as “neutral”.

In addition to this, it has been considered that, in order to make the results more interpretable, the best approach is to evaluate the sentiment and emotion for each of the topics. This provides a context when a tweet is assigned any of the previous sentiments and polarity. However, this comes at the cost that the only tweets that can be used are those for which both a sentiment/emotion and a topic has been found, which reduces the amount of data that is usable for this interpretation.

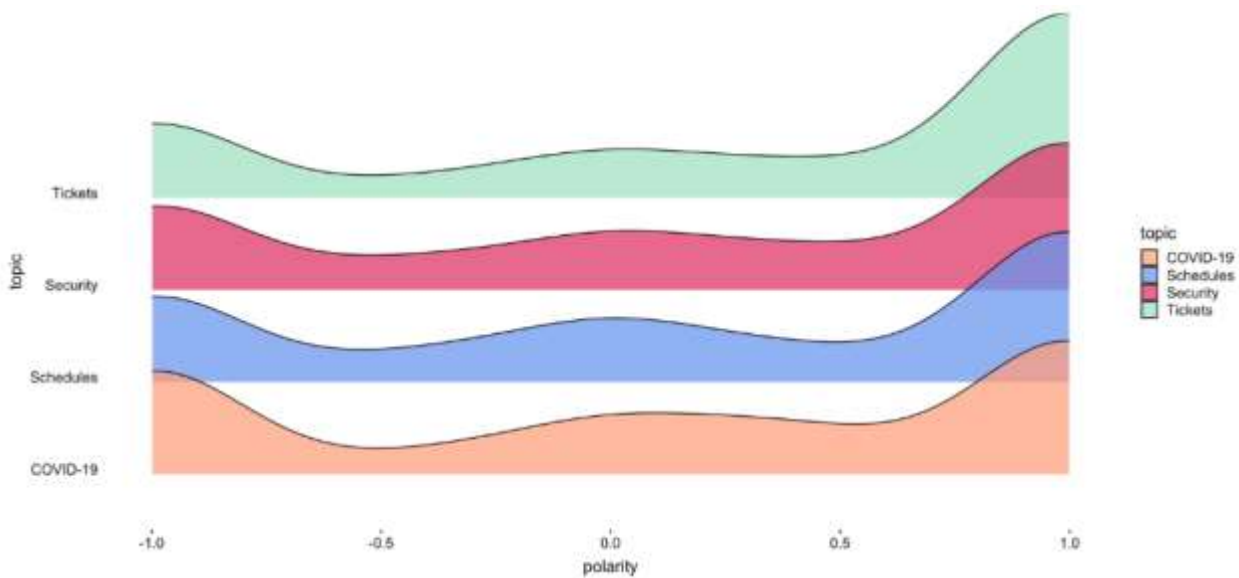
Pilot	Dataset	Number of entries
Spain	Processed	25171
	Sentiment	16472
	Topic	14574
	Sentiment and topic	10185
Italy	Processed	1016
	Sentiment	742
	Topic	380
	Sentiment and topic	303

**Table 16 - Dataset sizes after topic and sentiment extraction**

Table 16 shows that there is a significant loss of data after the sentiment and topic extraction – only 40.46% of the processed data (10,185 entries out of 25,171) can be assigned a topic *and* a sentiment in the case of the Spanish pilot, and only 29.82% (303 entries out of 1,016) in the case of the Italian pilot.

*Sentiment and Polarity: Barcelona*

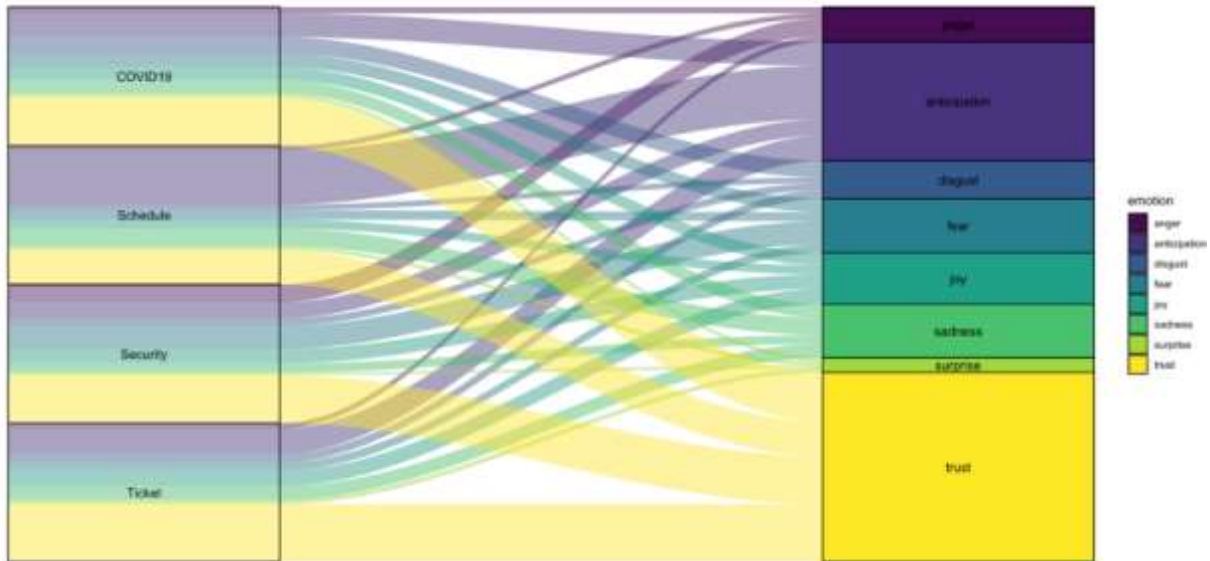
In order to present the polarity, it was concluded that the best possible approach was to plot the overall density – note that a kernel density estimation approach has been used to estimate the actual density –, as this was going to provide an idea of which positions were the most frequent ones.



**Figure 27 - Polarity density in Spain by topic**

As shown in Figure 27, the sample seems to regard positively most of the topics, except for COVID19, for which the positive and negative poles seem to be balanced. Note that this does not contradict what is expected – tweets mentioning COVID-19 are either going to do it in a positive manner – hopeful that things are going to get better – or in a negative one – things are getting worse. On the other hand, the positivity seems to reach a maximum regarding the tickets, which suggests that the sample have a positive inclination towards the recent changes in terms of ticket purchasing possibilities. Note that the second most polarized subject is the schedules, which is also reasonable – depending on the location where people are using the train, it is possible that there is a higher or lower frequency of public transportation vehicles, and thus a positive or a negative inclination towards the topic.

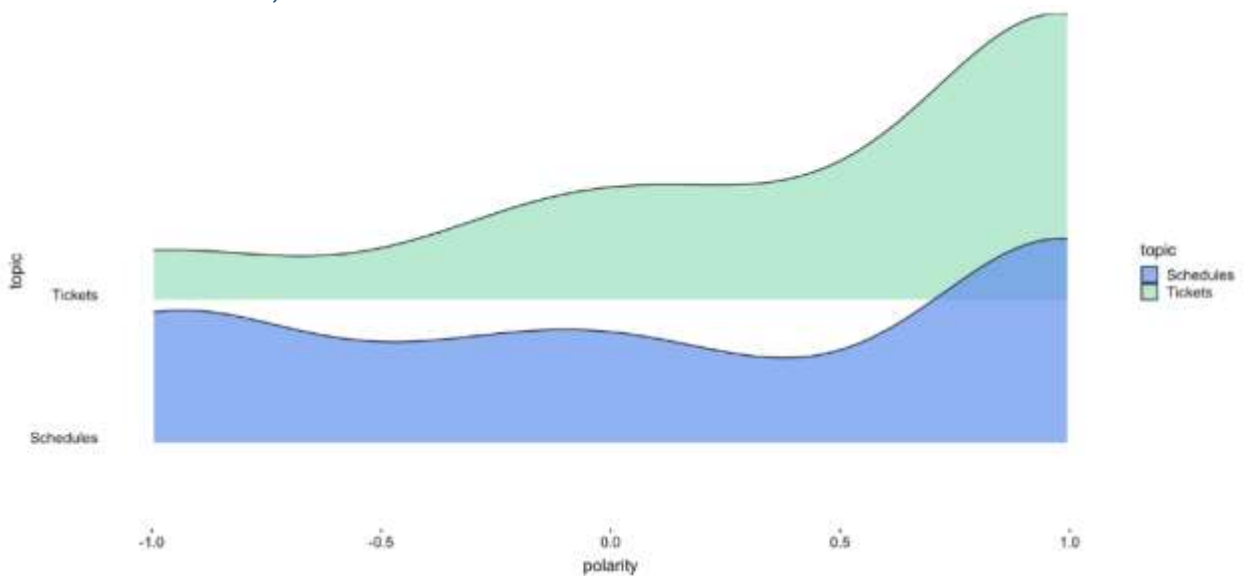




**Figure 28 - Topic-Sentiment distribution for Spanish pilot**

Figure 28 shows that the most predominant sentiment for the sample is trust, which can be interpreted as a trust in the transportation systems for the topics “Schedule”, “Security” and “Ticket”, and in the case of COVID-19, as trust in an improvement regarding the pandemic. There is a good balance for the rest of emotions except for surprise and anger, which are the least represented.

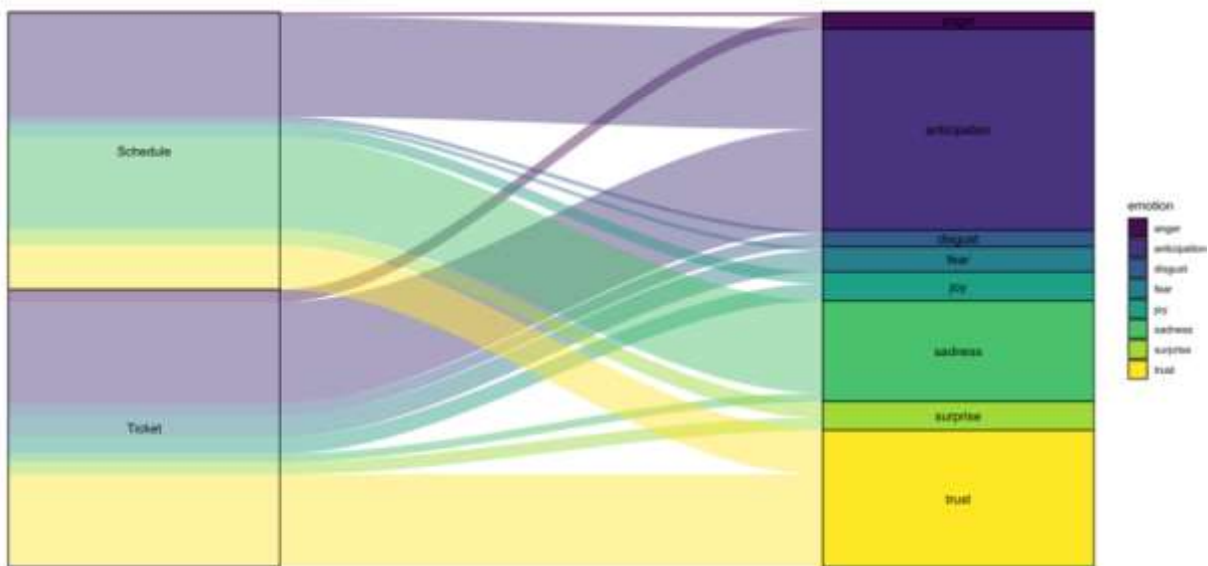
*Sentiment and Polarity: Padua*



**Figure 29 - Polarity density in Italy by topic**

Regarding the Italian pilot, it is observed that the topic of ticketing is regarded positively in most

of the tweets (see Figure 29), with very few cases of negative polarity. On the other hand, the topic of schedules is quite polarized, with both positive and negative extremes being balanced in terms of frequency. This can be justified by both the scarcity of the data, or by the explanation suggested in the Spanish pilot – the public transportation frequency and connections depend greatly depending on the area where it is used.



**Figure 30 - Topic-Sentiment distribution for Italian pilot**

Figure 30 shows that trust and anticipation are the most frequent sentiments for the sample, regarding the topics. Trust is again explained in terms of the public transport system, and anticipation can be justified by the knowledge of the service by the users. Additionally, sadness is the third most frequent sentiment, possible due to lost trains and expensive ticketing, and the rest of emotions are quite balanced, so no conclusions are drawn from them.

### 3.2.5. Discussion

The Wordcloud and n-gram graph analyses show that, in the Spanish pilot, the topics COVID-19, Security, Tickets and Schedules covered 57.89% (14,574 out of 25,171 entries) of the data, and no other topic was extracted with as much confidence. It was concluded that the sample regarded these topics in a positive and trustful manner, except for COVID-19, for which the opinion was more polarized – some tweets were hopeful about the pandemic coming to an end, whereas some others held a more negative vision on the subject.

As for the Italian pilot, and considering the low volume of data, the only mobility-related topics that were found were Tickets and Schedules – encompassing 37.40% of the data (380 out of 1,016 entries). In addition to this, the opinion towards the ticketing system was concluded to be positive, whereas in the case of schedules, the opinion was more polarized, that is, the amount of positive

and negative tweets was more balanced.

Finally, we can conclude from the opinion mining activity that the topics that travellers seem to care more about are related to security, scheduling and ticketing. Hence, a digital ecosystem such as the one developed within the Shift2Rail initiative should focus on providing passengers support and reliable information especially regarding the scheduling of trips and the acquisition of tickets. These results have helped shape the User Satisfaction Index survey developed within WP3 and presented in D3.2 – “List of operational KPIs, analysis of the users’ satisfaction and methodology as a whole, F-REL”. In particular, the topics of interest determined through the opinion mining activity have been used to identify specific questions for user profiles that are most sensitive to these topics (e.g., women with respect to security, unemployed people regarding ticket prices, or people with disabilities for schedules, and in particular their reliability).

### 3.3. Demonstration Requirements

The demonstration of some of the functions provided by the Shift2Rail ecosystem is possible only if a certain set of requirements is fulfilled. For example, some functions can be demonstrated only if suitable software services are available to be integrated in the ecosystem. Others require the provision of suitable information to initialize the demonstrated function. The identification of these requirements was carried out through various meetings and interactions with the developers of the components of the Shift2Rail ecosystem, i.e., with CFM project partners. The outcome of the requirements’ gathering activity is shown in the table in Annex VII<sup>1</sup>. This section highlights the main findings of the activity, listed by function to be demonstrated.

The following functions require, to be demonstrated, the availability of suitable software services to be integrated in the Shift2Rail digital ecosystem.

**Journey Planning/Offer Building.** The demonstration of this function requires the availability of a few technical elements:

- A web service exposing an API that allows clients to request trips from an origin to a destination.
- For network-based transport services, a GTFS file describing the transportation network served.
- For transport services based on floating vehicles (e.g., taxis, shared mobility services), a GeoJSON file describing the area served by the service.
- Information about trip fares, better if included in the trip information returned by the journey planner.

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<sup>1</sup> Please note that Annex VII represents the snapshot of the requirement gathering activity as of beginning of May 2022. This activity will continue under the aegis of WP4 with the actual demonstration planning.

**Booking.** This function requires the availability of a web service allowing clients to book offers previously created through the journey planner/offer builder.

**Issuing.** This function requires the availability of a web service through which one can retrieve the issued entitlements in digital form, for example as QR codes.

**Validation.** To demonstrate this function, digital mechanisms to validate issued entitlements are necessary, based for example on software applications, or suitable hardware validators.

**Trip Tracking.** To demonstrate this function, a suitable software service providing information related to notable transportation-related events (e.g., delays, trip cancellations) must be available. In addition, this service must satisfy specific technical requirements, and in particular it should support the publish/subscribe paradigm to allow the Shift2Rail digital ecosystem (and in particular the so-called Trip-Tracking Orchestrator) to subscribe to events of interest and then asynchronously receive notifications. Also, the service should support the TRIAS<sup>2</sup> standard for what concerns both the communication protocol and the data format. Availability of a Trip Tracking function is also a pre-requisite for the demonstration of the **Alternatives Calculation** function.

The following functions, instead, require, to be demonstrated, the provision of suitable information (possibly in precise formats), rather than software services.

**Mobility Packages.** To demonstrate the use of mobility packages in a demonstration site TSPs need to provide information about their products through the Shift2Rail operator portal. Whereas in a previous version of the Shift2Rail digital ecosystem this information had to be provided using the NetEx<sup>3</sup> standard, this is no longer the case, and the information can be provided in less structured ways (though still through the operator portal).

**Location Based Experiences.** The demonstration of this function requires TSPs to provide information about locations and Points Of Interest (POIs). This information is to be provided in a semi-structured way to CFM project partners through suitable templates.

**Business Analytics.** To demonstrate the business analytics capabilities of the Shift2Rail ecosystem, TSPs need to provide data, in CSV (Comma Separated Value) format, spanning at least a couple of years of activity (several millions records), and the KPIs (Key Performance Indicators) to be computed.

**Adding Travel Shopping Service to TSP.** This function allows TSPs that do not have a journey planner available to create one using the Shift2Rail infrastructure. To demonstrate this function, it is enough to provide the ecosystem developers with a GTFS file describing the network and the services that are available from the TSP.

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<sup>2</sup> <https://www.vdv.de/431-2sdes-v-1-3.pdf>

<sup>3</sup> <https://netex-cen.eu>

## 4. Definition of demonstration scenarios

This section discusses the methodology adopted for defining the demonstration scenarios and their requirements for each demonstration site, updating the ones defined in C-REL (cf. D2.1) and developing the ones for F-REL.

The requirements for the updated list of demonstration scenarios are:

- Most of the IP4 solutions, all of them if possible, have to be tested in at least one demonstration site.
- The IP4 solutions marked as *special* can be tested by only one demonstration site

### 4.1. Methodology for the update and definition of demonstration requirements and scenarios

The F-REL list of the demonstration scenarios was developed starting from the inputs gathered for C-REL, which were revised and adapted to better fit the new requirements and functionalities.

This adaptation was achieved through the following steps:

- **Description of enabled user experiences:** a new list of all the available IP4 solutions was developed, describing each solution according to the user experience they enable, and dividing all of them into their respective macro-category.
- **TO-BE scenarios update:** in this phase, the TO-BE scenarios of the demonstration sites selected for C-REL have been revised and updated using the new *Description of enabled user experiences template*.
- **TO-BE scenarios design workshops:** a workshop was organized to analyse the interest and impact of IP4 solutions on the demonstration sites that were selected for F-REL, necessary to then develop the demonstration scenarios.
- **Demonstration scenarios and requirements definition:** in this phase, the *demonstration requirements and scenarios* are defined as the input to IP4MaaS WP4 and WP5, dealing with the planning and execution of the IP4MaaS demonstrations. A set of demonstration scenarios is defined for each demonstration site by selecting from the TO-BE user journey maps specific travel experiences enabled by IP4 solutions.

To enable the application of the aforementioned methodology, the demonstration site leaders have been involved in coordinating the dialogue with the involved TSPs and for the collection of contributions. The demonstration scenarios defined in this document will be further discussed in the following months within WP4 as well as with the CFM partners to address potential integration issues and to define the actual execution plan.

## 4.2. Description of enabled user experiences

Following the work done by IP4MaaS in collaboration with the CFM partners to analyse the available IP4 solutions to be demonstrated within the IP4MaaS project described in Section 2, an updated list of the IP4 solutions to be considered for IP4MaaS F-REL was produced.

To better understand and present this output to the different demonstration sites, a list of all the solutions sorted into their respective macro-category was developed, hence dividing them into:

- Travel companion
- Journey planning
- Booking & Issuing
- Services during the travel
- Other services
- Tools for TSPs
- Enablers for TSPs

Furthermore, to improve the readability of the output, each solution was analysed and described through the user experience they enable. Building on the categorization of all the available solutions described in Section 2.1, some features have been merged to their related functionality in a single “user experience”. This revised description of the solutions aims to highlight the user needs (for both TSPs and Travellers) that they can solve.

**Table 17 - Description of enabled user experiences for IP4 solutions**

ID	Enabled user experience
<b><i>Travel Companion</i></b>	
0	Mobile application for travellers to access integrated travel services
15 P5	Web application for travellers to access integrated travel services (planning, booking, and issuing) and filing claims
20	Mobile application for kids with limited access to travel services and offering a simplified interface
16	Possibility of accessing a limited set of travel services without the need of creating an account
17	Possibility to set different travel preferences according to different travel profiles for the same account (e.g., when travelling for work, or travelling with the family I want to apply different preferences even if same profile).
P1	Register/access a personal account using biometrics (fingerprint, face, etc.)
P2	<del>Set up a personal e-wallet to easily manage payments and refunds through the app</del>
<b><i>Journey Planning</i></b>	

ID	Enabled user experience
1 A1 A6	Calculate multimodal travel solutions from an origin to a destination integrating different TSPs, including offers price calculation
A5 A7	Calculate door-to-door multimodal travel solutions covering also the first and last mile of a trip, and considering private transport to cover a leg of the trip
S7	Optimize fares considering the availability of multimodal trips with different combination of distance/time-based tariffs and classic public transportation tariff products.
19	<del>Commuters being suggested recurring travel solutions based on their trip history</del>
A3	Utilize the user preferences about locations (stations, POI, etc.) to suggest specific travel solutions
12	Share a planned travel solution with another user
14	Have a travel arranger prepare the trip for a different user
<b>Booking &amp; Issuing</b>	
2	Book online all the payable parts of a planned journey.
3	Pay for and get the digital tickets for the booked trip
18	Pay for each ticket but get partially refunded at the end of a period if a cheaper alternative existed.
13	Set up a group inviting users and issue the purchased group tickets
4	After booking a travel offer, buy additional services such as meals or on-board Wi-Fi
5	Instead of buying single tickets, buy a mobility package that includes all the needed means of transports and TSPs
<b>Services during the travel</b>	
6	Have the app visualise the ticket in a QR Code format to ease the validation and inspection process
10	Have the app provide navigation information such as where to get on or off, departure and arrival times, etc.
9 A8	Be provided with quiz games, commercial offers and other entertainment services based on your location directly
7	Integrate real-time information for different TSPs and receive notification for a planned multimodal trip
8	If a disruption happens, be provided with alternative solutions
<b>Other services</b>	
A2	Navigate an outdoor map that displays travel-related relevant content according to the user filters and the zoom level
11	Report situations around the traveller such as delays, crowded stations, broken equipment, etc.
P8	View reports made by either TSPs or other travellers, comment, validate or add media to them

ID	Enabled user experience
<b>Tools for TSPs</b>	
21	Join the Shift2Rail ecosystem by describing in a shared web catalogue the available web-services for a TSP that can be integrated
p9	Manage travellers' reports, create new ones, modify and delete them. Filter active reports and check statistics regarding time and type of active reports.
22 P6	Describe the products that can be used for a mobility package for travellers and/or propose the creation of new mobility packages for other stakeholders (e.g., TSPs)
24	Build quiz games, commercial offers and other location-based experiences for the travellers to use
P7	Check customers' data and manage claims
A10 A11	Send messages to travellers in specific zones
A9	Define meeting points based on location to groups of travellers
22B	Perform descriptive, predictive, and prescriptive analysis on ticketing and/or validation datasets and visualize the results
A13	Add, delete or adjust rules to process real-time events and detect complex event patterns
25	Block the travellers' ability to buy and receive tickets while the inspection is in progress
<b>Enablers for TSPs</b>	
S1	Enable the possibility of generating digital entitlements
S3 S5	Generate and update a journey planning service for the integration with other TSPs from timetable data
A15	Register the financial transactions associated with a TSP in a distributed ledger.
S6	Host a node of the distributed ledger to directly handle a copy of registered transactions.
A12 A14	Enable a trip tracking service (notifying disruptions over the transportation network) for a TSP from an available event source
S2	Setup the fleet with devices sending real-time information about the vehicle status and position to then notify the travellers whenever the trip is affected
S4	Have the travellers notified about disruptions by automatically-created messages that both inform the users and may also suggest alternatives

Table 17 served as a starting point to (i) develop a template to update the outputs of C-REL, which was distributed to the demonstration site leader of Athens, Padua, and Barcelona, and (ii) to develop the workshops for the partners from Osijek, Liberec, and Warsaw. In both cases, the produced lists allowed for a discussion about the selected IP4 solutions and how they can fit specific issues, (as opposed to the outputs of the C-REL round that had been developed starting from the pain points of the demonstration sites). It is important to note that both the updated TO-BE maps and the workshop outputs produced by WP2 define a first set of demonstration scenarios



that will be further discussed within WP4 to address potential issues and determine the final execution plan.

### 4.3. TO-BE scenarios update

Starting with the Athens, Padua, and Barcelona update of the demonstration scenarios, the first step was to produce a new template, created to update the information provided during the C-REL iteration. As previously mentioned, the goal of this template was to start from the available IP4 solution, and map the site’s pain points or desiderata while gathering information about the interest the TSPs have for the different “IP4-enabled travel experiences”.

The template contains a table with one row per each travel experience, structured as follows:

- Description of the Travel Experience corresponding to one or more IP4 functionalities;
- Level of interest [low, medium, high] of the demonstration site for the travel experience;
- Motivation for the interest expressed in the functionality or lack thereof (e.g., pain point that can be solved by this IP4 functionality/reasons why the functionality is not interesting).

**IP4 Macro Category**  
A general description of the Travel Experiences enabled by IP4 macro category

IP4-enabled Travel Experience	Interest			Motivation for the interest score selected
	low	medium	high	
<i>Description of the Travel Experience corresponding to one or more IP4 solution(s)</i>	Level of interest for the demonstration site (X in the box)			Motivation of the interest score provided (e.g., pain point that can be solved by this IP4 solution/reasons why the solution is not interesting).

To be filled

**Figure 31 - Extract of the updated TO-BE template structure**

This template was sent to all the partners of the Athens, Padua, and Barcelona demonstration sites, to be filled ahead of a meeting scheduled to discuss the information gathered and plan the final demonstration description.

#### 4.4. TO-BE scenarios design workshops

For each of the Osijek, Liberec and Warsaw demonstration sites, a TO-BE workshop was executed. The workshop aimed at extending the methodology described in the previous section, gathering information about the interest level and motivation of the sites for each Travel Experience, while also discussing the impact these IP4 solutions may have on the TSPs.

Each workshop was organised by Task 2.3 leader (Cefriel) as a 2-hour telco with all the partners involved in the demonstration site. The agenda of each workshop was the following:

- (15') Introduction and agenda of the workshop
- (60') Description of the Travel Experiences enabled by IP4 solutions and collaborative exercise using the MIRO board<sup>4</sup>. The workshop organizer (Cefriel) described the Travel Experiences and asked the stakeholders to reply to the following questions by writing the responses on post-its and moving them on the board (Figure 32):
  - *How interesting would you rate testing this functionality and why?*
  - *Are there any pain points that this functionality could address?*
  - *What kind of impact would you expect from such travel experience?*
- (25') Discussion of doubts to complete the exercise and next steps
- (20') Discussion on user engagement for WP2 Surveys and pilot execution



**Figure 32 - TO-BE Workshop Miro Template**

Since during the workshop there was time to address only a subset of Travel Experiences, the involved stakeholders were asked to complete the exercise off-line, providing detailed information about the motivation of the reported interest and the expected impact.

<sup>4</sup> [www.miro.com](http://www.miro.com)

## 5. Definition of demonstration scenarios

This section reports the outcomes of applying the described methodology for the definition of demonstration scenarios for IP4MaaS F-REL demonstrators in Barcelona, Padua, Athens, Osijek, Liberec and Warsaw. This is the result of the TO-BE updates and workshops, paired with the feedback received from WP4 following the development of the execution and integration plan.

For each demonstration site, a brief description of the demonstration site and the involved stakeholders is provided. The main content is reported in a table containing the information collected through the templates and during the TO-BE workshops. The table reports an interest score for each IP4-enabled user experience and the related motivation considering current pain points, expected impact, etc.

Demonstration scenarios are identified by rows expressing *high* interest for a (set of) TSP(s) for a given IP4 solution. Demonstration scenarios already identified for C-REL are reported with a *high* interest, except if a TSP decided to motivate a different interest score.

### 5.1. Barcelona

The Barcelona demonstration site covers both the urban and suburban areas of Barcelona. In particular, it focuses on travels having as origin or destination the residential areas of Barcelona (e.g., Vilassar de Mar or Arenys de Mar) and the medium-sized cities in the metropolitan area of Barcelona, such as Mataró, Sabadell, Terrassa, Sant Cugat del Vallès. The main objective of the demonstrator is to incentivise multi-modal travel and shared modes of transport targeting: (i) users travelling from the same starting point to different destinations in Barcelona, and (ii) users travelling from different starting points to the same destination in the suburban/rural area of Barcelona. On one hand, people going to the same destination in Barcelona could benefit, in the first mile, from sharing rides together with other passengers having a similar starting point and going to different destinations in Barcelona. On the other hand, people working in the same area outside Barcelona could reach, through public transport, a shared transfer point in Barcelona and then benefit from shared rides to reach their destination.

The PTO and TSP involved in the IP4MaaS Barcelona demonstration site are:

- **TMB** (*Transports Metropolitans de Barcelona*) is the main public transport operator operating the metro and several bus lines in the urban metropolitan area of Barcelona.
- **BusUp** is a company providing bus ride-sharing services and on-demand services for commuting in large metropolitan areas. BusUp provides corporates located in suburban/rural areas, usually lacking a suitable public transport offer, with a sustainable and economic means of transport for their employees.
- **SocialCar**: a car-sharing and car renting company operating in Spain. SocialCar allows also private users to share their vehicles as car-sharing vehicles.
- **AMTU** (*Associació de municipis per la Mobilitat i el Transport Urbà*): an association of 128 associated municipalities, working to assist them with the managing of Mobility or their

Urban Transport. It helps technically and economically to improve the public transport services of its municipalities, manages transport services on demand, with taxis in the municipalities of El Masnou, Palafolls, Alella, Sant Pere de Ribes, Santa Susanna, Sant Antoni and Sant Pere de Vilamajor, Santa Maria de Palautordera and Pineda de Mar, with busses on request in Terrassa (L12 Flex). It is also managing the first public platform for Mobility as a Service (MaaS), known as FlexiTransport Catalunya.

AMTU (subcontractor of SPA) was included later in the project with the service of FlexiTransport to substitute partially the services of Social Car

The additional IP4MaaS partners involved in the Barcelona demonstration site are SPARSITY (demonstration site leader) and MOSAIC.

Initially, the project planned to integrate, in the Barcelona demo site, the services offered by the SocialCar TSP. However, the business model of the SocialCar service (and the ensuing mobility management model) does not fit very well the philosophy with which the components of the Shift2Rail IP4 ecosystem have been developed.

In particular, SocialCar allows private users to lend their cars to other private users; borrowers, once they have the car at their disposal, can drive wherever they want, provided that they take the car back at the origin point. This clashes with the very basic approach taken by the Shift2Rail ecosystem, where trips are always between a different origin and destination (round trips are simply made of two separate trips). The analysis of the services offered by SocialCar revealed that it was not possible to overcome this clash.

Hence, a new TSP (AMTU) was involved in the Barcelona demo site, to fill the gap that was created by the clash of transportation paradigms. SocialCar will only participate to the demo activities by assisting the users' engagement processes and dissemination.

For the above reasons, this deliverable includes the analysis of the interest and motivations also for SocialCar, which still appears in the following tables, as well as in Annex IV. However, the technical analysis presented in Section 3.3, as well as Annex VII, do not include SocialCar.

Table 18 reports the interest and motivation toward IP4 solutions for the Barcelona demonstration site. The table considers the results obtained in applying the full methodology for the definition of demonstration scenarios in C-REL and the information gathered through the template for F-REL.

**Table 18 – Barcelona: Interest and motivation towards IP4 functionalities**

ID	Enabled user experience	Interest score	Motivation for interest (current pain points, expected impact, etc.)
<b>Travel Companion</b>			
0	Mobile application for travellers to access integrated travel services	High	Already selected in 1 <sup>st</sup> phase demonstration scenarios.
15 P5	Web application for travellers to access integrated travel services (planning, booking, and issuing) and filing claims	Medium (TMB, Social Car) High (BusUp, AMTU)	TMB and Social Car already provide this functionality, but it would be interested in testing it considering integration with third-party travel services. BusUp is highly interested in a web app to access integrated travel services (a lot of users of BusUp like to plan their trips and combine different transport means for a multimodal solution). AMTU is interested to have booking services in 3 <sup>rd</sup> parties web applications as it can offer more visibility to transport on-demand services.
20	Mobile application for kids with limited access to travel services and offering a simplified interface	High (BusUp), Medium (TMB, AMTU), Social Car (Low)	TMB expresses medium interest because the usefulness of the functionality depends on the city (e.g., usually the kids' age should be at least 12 years to travel) and the parents' confidence. Such functionality would be of high interest for BUSUP as it might help in expanding its clientele. Semi-private and private schools in Barcelona (around Sarrià/St Gervasi/Pedralbe) use bus services to accommodate their students' transport to/from schools and in many cases the bus is shared among 2 schools. Having a travel companion for kids could be a nice solution for both kids and parents. The clients of SocialCar cannot be kids so such a service is out of the scope for SocialCar. It is interesting for AMTU to have services for kids, however, the implications of GDPR as well as the payment method might be an obstacle.
16	Possibility of accessing a limited set of travel services without the need of creating an account	High	Already selected in 1 <sup>st</sup> phase demonstration scenarios.

ID	Enabled user experience	Interest score	Motivation for interest (current pain points, expected impact, etc.)
17	Possibility to set different travel preferences according to different travel profiles for the same account.	High	Already selected in 1 <sup>st</sup> phase demonstration scenarios.
P1	Register/access a personal account using biometrics (fingerprint, face, etc.)	High	<p>TMB is interested in testing this functionality because it is useful for users and can bring more customers. The only concern is about potential GDPR issues.</p> <p>BusUp is interested in this functionality and would be interested in also enabling access to buses through biometrics instead that with QR codes.</p> <p>SocialCar already uses the app as a key and would be interested in testing more advanced technologies such as biometrics.</p> <p>AMTU is also highly interested as it will provide new possibilities and more clients.</p>
P2	<del>Set up a personal e-wallet to easily manage payments and refunds through the app</del>	-	<p>TMB has its app but tickets are directly sold by ATM (Barcelona's transport authority).</p> <p>BusUp users can purchase different products so a kind of wallet might be interesting to allow them to manage their door-to-door travels.</p> <p>It can be interesting for SocialCar and AMTU to test a different way of managing payments or manage the payments out of the integrated system sold by ATM.</p>
<b>Journey Planning</b>			
1 A1 A6	Calculate multimodal travel solutions from an origin to a destination integrating different TSPs, including offers price calculation.	High	Already selected in 1 <sup>st</sup> phase demonstration scenarios.

ID	Enabled user experience	Interest score	Motivation for interest (current pain points, expected impact, etc.)
A5 A7	Calculate door-to-door multimodal travel solutions covering also the first and last mile of a trip, and considering private transport to cover a leg of the trip	Medium (BusUp, TMB, SocialCar) High (AMTU)	<p>Travellers in Barcelona usually use TMB services for the main leg of their trip. However, TMB would be interested in testing a solution that includes more TSPs to promote seamless door-to-door transport involving public transport.</p> <p>BusUp is highly interested in having a service for multimodal travel solutions as it would help users in reaching the BusUp bus stops and using its services. Indeed, BusUp users should almost always use another mode such as the metro or a soft mobility solution (walk, bike, etc.) to reach the bus stop.</p> <p>SocialCar is interested since car-hiring is often part of a trip chain, e.g., car -&gt; train, car -&gt; aeroplane, etc.</p> <p>AMTU has a high interest as it has a limited coverage area and it would like to be connected with PT for longer distance trips.</p>
S7	Optimize fares considering the availability of multimodal trips with different combination of distance/time-based tariffs and classic public transportation tariff products.	Medium	<p>TMB believes the functionality is interesting for users. However, it should be considered that prices for transport products are fixed by ATM (Barcelona transport authority) and not managed directly by TMB.</p> <p>BusUp is highly interested since this functionality can allow BusUp customers to access more appealing multimodal tariffs.</p> <p>SocialCar is interested because such functionality would complement the services offered.</p> <p>AMTU is highly interested in optimizing fares considering different options of multimodality.</p>
19	<del>Commuters being suggested recurring travel solutions based on their trip history</del>	-	<p>TMB would be interested in the functionality to offer a more personalized experience.</p> <p>BusUp is not interested because their service already provides transportation service covering the commuting needs of the employees working in customer companies. The users of SocialCar do not have recurring itineraries. However, SocialCar would be interested in identifying patterns by analysing the trip history of users.</p>
A3	Utilize the user preferences about locations (stations, POI, etc.) to suggest specific travel solutions	Medium (TMB, SocialCar) Low (BusUp, AMTU)	<p>TMB already offers in its app the ability to store user-preferred locations, but it would be interested in testing the functionality to offer a more personalized experience.</p> <p>The majority of BusUp and AMTU users are commuters using the bus to reach their work location in a suburban area, hence the POIs would not have such an interest for them.</p> <p>SocialCar is moderately interested since this functionality may provide extra information to its users.</p>

ID	Enabled user experience	Interest score	Motivation for interest (current pain points, expected impact, etc.)
12	Share a planned travel solution with another user	High	Already selected in 1 <sup>st</sup> phase demonstration scenarios. AMTU wants to be able to share a planned trip with another user to allow different combinations and synchronization of group travelling.
14	Have a travel arranger prepare the trip for a different user	Low	TMB is interested in the Trip Sharing (12) functionality because it facilitates the sharing of a trip plan with a different user, but not interested in this functionality because public transport tickets can be already bought for another person without any means of verification (e.g., ID, passport number etc.). It is in a way implemented for BUSUP services. SocialCar is not interested since the driver is usually directly planning and using the service. AMTU's app already provides this possibility hence would like to see it in a 3 <sup>rd</sup> party's app.
<b>Booking &amp; Issuing</b>			
2	Book online all the payable parts of a planned journey.	N/A (BusUp), High AMTU	Already selected in 1 <sup>st</sup> phase demonstration scenarios.
3	Pay for and get the digital tickets for the booked trip	Medium (BusUp) Low (TMB, SocialCar)	Selected in D2.2. as a demonstration scenario. TMB expressed low interest because transport products are handled by ATM. BusUp would be interested to test how its service can be integrated into 3rd parties' apps. SocialCar is not interested since users only reserve (book) the car online and the process is different from the booking/issuing adopted in IP4. AMTU is interesting in switching to a fully digital ticketing system.
18	Pay for each ticket but get partially refunded at the end of a period if a cheaper alternative existed.	Low	TMB has a low interest because transport products are managed by ATM. BusUp is not interested because such a functionality is not aligned with their business plan. SocialCar is not interested because there are no different transport products available for their services. AMTU has no interest in such a policy.



ID	Enabled user experience	Interest score	Motivation for interest (current pain points, expected impact, etc.)
13	Set up a group inviting users and issue the purchased group tickets	Medium	<p>TMB would be interested in particular considering the Montjuïc Cable Car or the tourist bus.</p> <p>BusUp sells tickets to companies considering employees as the group of people that can access the service. However, having the possibility to invite specific users in a group would be interesting.</p> <p>SocialCar would be interested to support carsharing scenarios, however, due to the COVID situation and other issues in enabling rent for multiple users the interest is limited.</p> <p>AMTU is interested in properly integrating group travelling as it is one of the core aspects of FlexiTransport</p>
4	After booking a travel offer, buy additional services such as meals or on-board Wi-Fi	Low (BusUP), N/A (SocialCar, TMB, AMTU)	<p>TMB services are urban services, so meals and other similar ancillary services are not provided. Moreover, board Wi-Fi is not made available since the majority of travellers have their internet services. Could be interesting to support specific touristic services but currently, no ancillary services are available.</p> <p>BusUp has already onboard Wi-Fi that should not be booked separately. BusUp is interested in offering light meals (such as coffee), however, this should be evaluated with bus providers and considering the cleaning costs that are generated.</p> <p>Social car is not interested because a car user needs to be concentrated during the travel (no ancillary services are currently available).</p> <p>AMTU is not currently interested as it mainly focuses on short or medium distances. However, if the transport demand grows in the future and FlexiTransport will serve long distances, it might be a good addition.</p>
5	Instead of buying single tickets, buy a mobility package that includes all the needed means of transport and TSPs	Medium (TMB) High (BusUp, SocialCar, AMTU)	<p>Selected in D2.2. as a demonstration scenario.</p> <p>TMB would be interested in the definition of mobility packages, but they can not directly test this functionality since transport products are handled by ATM.</p> <p>BusUp is interested in defining and testing mobility packages involving other TSPs, indeed often its users use other means of transport to reach the bus stop.</p> <p>SocialCar is interested in testing mobility packages, especially if this package is a combination with public transport solutions. Moreover, the combination of products for “park and ride” is an appealing use case to be investigated.</p> <p>Since AMTU is interested in combining its services with a single ticket for the Barcelona metropolitan area, mobility packages are an interesting service.</p>

ID	Enabled user experience	Interest score	Motivation for interest (current pain points, expected impact, etc.)
<b>Services during the travel</b>			
6	Have the app visualise the ticket in QR Code format to ease the validation and inspection process	High (TMB, BusUp, AMTU) N/A (SocialCar)	Already selected in 1 <sup>st</sup> phase demonstration scenarios.
10	Have the app provide navigation information such as where to get on or off, departure and arrival times, etc.	High (TMB, BusUp) Low (AMTU, SocialCar)	Already selected in 1 <sup>st</sup> phase demonstration scenarios. For AMTU, as the driver knows where to drop off the passenger it is not necessary to have navigation info.
9 A8	Be provided with quiz games, commercial offers and other entertainment services based on your location directly	Medium	TMB is interested in testing this functionality to entertain the travellers at stops/stations when users are waiting for their transport, especially if a delay occurs. BusUp is interested in testing this functionality also while users are using their services. SocialCar is not interested because its users are drivers and quiz/commercial offers are not in the core business logic of the company. Social would be interested in testing entertainment services that can be offered while driving, e.g. different kinds of music. AMTU is interested since it can be used to promote local trade and convenience stores.
7	Integrate real-time information for different TSPs and receive notification for a planned multimodal trip	High	Already selected in 1 <sup>st</sup> phase demonstration scenarios.
8	If a disruption happens, be provided with alternative solutions	High	Already selected in 1 <sup>st</sup> phase demonstration scenarios.

ID	Enabled user experience	Interest score	Motivation for interest (current pain points, expected impact, etc.)
<b>Other services</b>			
A2	Navigate an outdoor map that displays travel-related relevant content according to the user filters and the zoom level	Medium (TMB, BusUp, SocialCar) Low (AMTU)	TMB and BusUp are quite interested because, although most of their users are commuters, it may be interesting to offer this kind of information to the rest of the users, e.g. tourists. SocialCar believes it might be useful to explore the surroundings where the driver is looking for the car or if someone is a tourist. AMTU has a low interest as it mostly addresses commuters.
11	Report situations around the traveller such as delays, crowded stations, broken equipment, etc.	High	Already selected in 1 <sup>st</sup> phase demonstration scenarios.
P8	View reports made by either TSPs or other travellers, comment, validate or add media to them	High	TMB, AMTU and BusUp are interested in testing this functionality to know the comments of travellers for their services. They already have a complaint centre but this functionality can offer broader and timely reports. SocialCar is interested to have a global view of the system.
<b>Tools for TSPs</b>			
21	Join the Shift2Rail ecosystem by describing in a shared web catalogue the available web services for a TSP that can be integrated	High	TMB already has public APIs and is interested in describing its services and joining the S2R ecosystem. BusUp and SocialCar would be interested in joining the catalogue allowing different TSPs (especially of public transport) to access their services. The potential impact is the definition of new collaborations between them and public transport operators, offering complimentary services. AMTU is interested in joining the S2R ecosystem as its services can be complementary to PT. Additionally having FlexiTransport as an option in a 3 <sup>rd</sup> parties app is a new nice feature
P9	Manage travellers' reports, create new ones, and modify and delete them. Filter active reports and check statistics regarding time and type of active reports.	Medium	TSPs are willing to test this functionality but their interest may vary considering the type of reports handled and the relevance of statistics provided.

ID	Enabled user experience	Interest score	Motivation for interest (current pain points, expected impact, etc.)
22 P6	Describe the products that can be used for a mobility package for travellers and/or propose the creation of new mobility packages for other stakeholders (e.g., TSPs)	High	Already selected in 1 <sup>st</sup> phase demonstration scenarios.
24	Build quiz games, commercial offers and other location-based experiences for the travellers to use	Medium (TMB) Low (BusUp, SocialCar, AMTU)	TSPs are interested in providing Location-Based Experiences to users (cf. 9-A8) but not directly in building the experiences.
P7	Check customers' data and manage claims	Medium (TMB, AMTU) Low (BusUp, SocialCar)	TMB, AMTU is interested in testing this functionality to be able to manage its relationship with the customers. Potential aspects to be taken into account are: (i) in some cases, claims may involve also the transport authority ATM, (ii) TMB manages customer data using its tools, so this could require some integration. BusUp and Social Car are not interested because they already have a complete solution to handle customers' data.
A10 A11	Send messages to travellers in specific zones	Low	TMB is not interested because this functionality is already enabled for app users registered in JoTMBé. Similarly, also BUSUP already can send information to its users. SocialCar is not interested in the functionality.
A9	Define meeting points based on location to groups of travellers	Medium (TMB, Social Car) Low (BusUp, AMTU)	TMB is interested in this functionality, in particular, to test meeting points as a way to enable park&ride scenarios. The stops of BusUp are pre-determined and defining meeting points does not make sense for the services of BusUp. The concept of car-sharing is an expansion of the services offered by SocialCar. SocialCar is interested in testing this functionality to enable park&ride scenarios but it should be evaluated if possible given the currently available services. Since the stops are determined by the passengers and the service AMTU has low interest in the functionality.

ID	Enabled user experience	Interest score	Motivation for interest (current pain points, expected impact, etc.)
22B	Perform descriptive, predictive, and prescriptive analysis on ticketing and/or validation datasets and visualize the results	High (TMB), Medium (SocialCar), Low (BusUp)	<p>For TMB and AMTU would be interesting to predict the service demand to adjust their offer. A potential impact of analysing data about ticketing and validation is also related to a better distribution of incomes from ticket products sold by ATMs.</p> <p>BUSUP is not interested because it already performs these analyses.</p> <p>SocialCar can be interested but, not having ticketing/validation processes, could only provide data about bookings made (car, time, etc.).</p>
A13	Add, delete or adjust rules to process real-time events and detect complex event patterns	Medium (BusUp, SocialCar, AMTU), Low (TMB)	<p>TMB is not interested because it already implements a policy to tackle real-time events and detect patterns of occurrence.</p> <p>Although BusUp already has a system to detect and analyse real-time events, they would be interested in testing an advanced system to handle them.</p> <p>SocialCar does not have a solution to process real-time events. SocialCar would be interested in such a tool but it may be too costly in terms of effort for the TSP. AMTU would like to have a tool to track real-time events apart from the drivers' app.</p>
25	Block the travellers' ability to buy and receive tickets while the inspection is in progress	Low	<p>Ticket selling is managed by ATM, therefore TMB is not interested in this functionality.</p> <p>BusUp is not interested in this functionality because its business logic is not based on selling "tickets" to allow access to buses.</p> <p>Not applicable for SocialCar and AMTU not having an inspection process.</p>
<b>Enablers for TSPs</b>			
S1	Enable the possibility of generating digital entitlements	Low	<p>ATM manages ticket selling. It could be a possibility for TMB considering touristic entitlements.</p> <p>BusUp already generates digital entitlements.</p> <p>SocialCar uses an online booking process different from the booking/issuing adopted in IP4.</p>

ID	Enabled user experience	Interest score	Motivation for interest (current pain points, expected impact, etc.)
S3 S5	Generate and update a journey planning service for the integration with other TSPs from timetable data	Low (TMB) Medium (BusUp, SocialCar, AMTU)	<p>TMB already provides a journey planning service. BusUp has a journey planning service but is a closed system. BusUp would be interested in testing a journey planning service for the integration with other TSPs from timetable data.</p> <p>SocialCar is interested in testing this functionality to define a journey planning service that can be integrated with other TSPs. Peculiarities of free-ride transportation should be considered (not the same with the fixed timetables of the public transport). AMTU would like such a feature as transport on demand and area of operations aims to be complementary to PT.</p>
A15	Register the financial transactions associated with a TSP in a distributed ledger.	Low	<p>Ticket selling is managed by ATM, therefore TMB is not interested in this functionality. BusUp is not interested given the business logic of their service.</p> <p>SocialCar already uses a secure financial transaction system to identify transactions. AMTU could be interested in local ticketing but is limited in ticket selling and transaction system choice by ATM.</p>
S6	Host a node of the distributed ledger to directly handle a copy of registered transactions.	Low	<p>Ticket selling is managed by ATM, therefore TMB is not interested in this functionality. BusUp is not interested given the business logic of their service.</p> <p>SocialCar already uses a secure financial transaction system to identify transactions. AMTU could be interested in local ticketing but is limited in ticket selling and transaction system choice by ATM.</p>
A12 A14	Enable a trip tracking service (notifying disruptions over the transportation network) for a TSP from an available event source	Medium	<p>TMB and BusUP already have similar services but are interested in receiving real-time events from additional sources (e.g., other TSPs) and other integrated TSPs disruptions.</p> <p>SocialCar may be interested in testing this functionality to provide additional information to users, however, the availability of suitable event sources should be checked. AMTU has a high interest in this functionality as its services can be used as an alternative if an event occurs.</p>

ID	Enabled user experience	Interest score	Motivation for interest (current pain points, expected impact, etc.)
S2	Setup the fleet with devices sending real-time information about the vehicle status and position to then notify the travellers whenever the trip is affected	Low	TMB and BusUp already have similar services and are not interested. SocialCar believes that, since vehicles are directly rented to a user, GDPR might be a huge barrier. AMTU has an interest in implementing such a feature since, for the time being, it is using the mobile app of the drivers.
S4	Have the travellers notified about disruptions by automatically created messages that both inform the users and may also suggest alternatives	Medium	TMB and BusUp already have similar services, but they are interested in this functionality, e.g. to provide suggestions on alternative solutions and/or to inform about disruptions of other TSPs. SocialCar is interested in this functionality to notify users about disruptions or traffic jams. Interest is limited because often users rely on a navigation application with real-time information. AMTU would like to have such a channel of communication for the passengers but primarily would like to arrange the service by providing another car.

## 5.2. Athens

The demo site is located within the Athens agglomeration and focuses on the main terminal positions of the metro and suburban rail where multiple modes are available. Although multiple transport modes are operating in the area, serving everyday travellers in the agglomeration, there is limited connectivity at the level of the networks and the services to support both tourists and commuters.

The main objective of this demonstration scenario is to enhance multimodality by providing integrated services, including all the different TSPs, through a single application that can be used by tourists and commuters. The services should cover (i) trips from central Athens to metro stations outside the city centre for day-to-day work commuters, (ii) trips from touristic hubs such as Port Piraeus or El. Venizelos airport to any other station for tourists, and (iii) trips from rural areas to any other central metro station to cover commercial points for shopping or leisure commuters.

The PTO and TSP involved in the IP4MaaS Athens demonstration site are:

- **OASA:** is the responsible authority for planning, coordinating, and financing the public transport system in the Athens metropolitan area, covering buses, trams, trolleys and metro (3 lines).
- **MIRAKLIO:** is the public transport operator responsible for the buses operating within the Municipality of Heraklion, Attica.
- **BRAINBOX:** is a company offering bike and car-sharing services.

- **TAXIWAY:** is a company providing taxi services.

The additional IP4MaaS partners involved in the Athens demonstration site are CERTH (demostration leader) and AETHON.

Table 19 reports the interest and motivation towards IP4 solutions for the Athens demonstration site. The table considers the results obtained in applying the full methodology for the definition of demonstration scenarios in C-REL and the information gathered through the template for F-REL. The functionalities chosen for the 1<sup>st</sup> phase may be subject to changes since this list refers to the first selection.

**Table 19 - Athens: Interest and motivation towards IP4 functionalities**

ID	Enabled user experience	Interest score	Motivation for interest (current pain points, expected impact, etc.)
<b>Travel Companion</b>			
0	Mobile application for travellers to access integrated travel services	High	Already selected in 1 <sup>st</sup> phase demonstration scenarios.
15 P5	Web application for travellers to access integrated travel services (planning, booking, and issuing) and filing claims	High	This functionality is of high interest to the TSPs since no solution integrates all the services. A web application would allow all end-users to take advantage of MaaS, whereas mobile apps require a mobile device.
20	Mobile application for kids with limited access to travel services and offering a simplified interface	Low	The usefulness of the functionality depends on the number of kids using the service and, for what concerns Athens, this is rarely the case.
16	Possibility of accessing a limited set of travel services without the need of creating an account	High	Already selected in 1 <sup>st</sup> phase demonstration scenarios.
17	Possibility to set different travel preferences according to different travel profiles for the same account.	High	Already selected in 1 <sup>st</sup> phase demonstration scenarios.
P1	Register/access a personal account using biometrics (fingerprint, face, etc.)	Medium	This functionality is of medium interest. It might help some users in adding a protection layer to their trip patterns and other personal information.



ID	Enabled user experience	Interest score	Motivation for interest (current pain points, expected impact, etc.)
P2	Set up a personal e-wallet to easily manage payments and refunds through the app	Medium	E-payments and refunds can be materialised by credit/cash card or even through e-banking. However, an e-wallet is an additional security factor and might be necessary for some TSPs
<b>Journey Planning</b>			
1 A1 A6	Calculate multimodal travel solutions from an origin to a destination integrating different TSPs, including offers price calculation.	High	A travel planning tool integrating all possible solutions, regarding different modes, trip durations and trip costs is valuable to any traveller.
A5 A7	Calculate door-to-door multimodal travel solutions covering also the first and last mile of a trip, and considering private transport to cover a leg of the trip	High	Door-to-door trip planning is a key factor, regarding the modal shift from private cars to public transport. This functionality is of high interest for all the TSPs, since it can be highly beneficial to both PTOs, Brainbox, and Taxiway. Taxi and car or bike-sharing services are often part of a trip chain, e.g., car -> train, car -> aeroplane, etc.
S7	Optimize fares considering the availability of multimodal trips with different combination of distance/time-based tariffs and classic public transportation tariff products.	High	A travel planning tool integrating all possible solutions, regarding different modes, trip durations and trip costs is valuable to any traveller.
19	<del>Commuters being suggested recurring travel solutions based on their trip history</del>	High	Smart trip planning considering trip patterns would facilitate commuters and other users with repetitive trip patterns.
A3	Utilize the user preferences about locations (stations, POI, etc.) to suggest specific travel solutions	High	As mentioned above, smart trip planning is a nice addition for the end-users and is thus to be considered of high interest.
12	Share a planned travel solution with another user	High	Already selected in 1 <sup>st</sup> phase demonstration scenarios.

ID	Enabled user experience	Interest score	Motivation for interest (current pain points, expected impact, etc.)
14	Have a travel arranger prepare the trip for a different user	Medium	This is considered a <i>nice-to-have</i> addition to the set of selected functionalities, but it's not crucial for the pilot or the TSPs.
<b>Booking &amp; Issuing</b>			
2	Book online all the payable parts of a planned journey.	High	Already selected in 1 <sup>st</sup> phase demonstration scenarios.
3	Pay for and get the digital tickets for the booked trip	High	The digitalisation of the fare system is a key factor in increasing the end users' security and convenience. However, regarding Athens' automated fare collection system (AFCS), special constraints should be considered and faced.
18	Pay for each ticket but get partially refunded at the end of a period if a cheaper alternative existed.	Low	This solution might be impossible to integrate because of the use of vouchers from OASA. Additionally, this policy would discourage people from using long-time fares.
13	Set up a group inviting users and issue the purchased group tickets	Medium	The solution would be of some interest as it provides a segmentation (thus better management/control) of fares and user groups. OASA does not currently support group ticketing.
4	After booking a travel offer, buy additional services such as meals or on-board Wi-Fi	Low	No such services are offered aboard public transport in Athens.
5	Instead of buying single tickets, buy a mobility package that includes all the needed means of transport and TSPs	High	Already selected in 1 <sup>st</sup> phase demonstration scenarios.
<b>Services during the travel</b>			
6	Have the app visualize the ticket in a QR Code format to ease the validation and inspection process	High	A voucher with QR code redeemable with AFCS tickets is necessary for a MaaS solution and it is required by some TSPs such as Taxiway
10	Have the app provide navigation information such as where to get on or off, departure and arrival times, etc.	High	Already selected in 1 <sup>st</sup> phase demonstration scenarios.

ID	Enabled user experience	Interest score	Motivation for interest (current pain points, expected impact, etc.)
9 A8	Be provided with quiz games, commercial offers and other entertainment services based on your location directly	High	Already selected in 1 <sup>st</sup> phase demonstration scenarios.
7	Integrate real-time information for different TSPs and receive notification for a planned multimodal trip	High	Already selected in 1 <sup>st</sup> phase demonstration scenarios.
8	If a disruption happens, be provided with alternative solutions	High	Already selected in 1 <sup>st</sup> phase demonstration scenarios.
<b>Other services</b>			
A2	Navigate an outdoor map that displays travel-related relevant content according to the user filters and the zoom level	High	This provision is very useful as proved by the widespread usage of similar function
11	Report situations around the traveller such as delays, crowded stations, broken equipment, etc.	High	Already selected in 1 <sup>st</sup> phase demonstration scenarios.
P8	View reports made by either TSPs or other travellers, comment, validate or add media to them	Medium	This functionality would facilitate, to some degree, the communication between different TSPs and their end-users, helping in the dissemination of information. It is a <i>nice-to-have</i> functionality, but it's not crucial for the pilot.
<b>Tools for TSPs</b>			
21	Join the Shift2Rail ecosystem by describing in a shared web catalogue the available web services for a TSP that can be integrated	High	This functionality is of high interest for the potential it has concerning future exploitations.

ID	Enabled user experience	Interest score	Motivation for interest (current pain points, expected impact, etc.)
P9	Manage travellers' reports, create new ones, modify, and delete them. Filter active reports and check statistics regarding time and type of active reports.	Medium	TSPs are willing to test this functionality but their interest may vary considering the type of reports handled and the relevance of statistics provided.
22 P6	Describe the products that can be used for a mobility package for travellers and/or propose the creation of new mobility packages for other stakeholders (e.g., TSPs)	High	Already selected in 1 <sup>st</sup> phase demonstration scenarios.
24	Build quiz games, commercial offers and other location-based experiences for the travellers to use	High	Already selected in 1 <sup>st</sup> phase demonstration scenarios.
P7	Check customers' data and manage claims	Medium	This could be a nice addition, but it's not crucial for the pilot or the TSPs.
A10 A11	Send messages to travellers in specific zones	High	This is a very useful functionality, especially in cases of service disruptions.
A9	Define meeting points based on location to groups of travellers	Low	Group travelling by public transport is not used in Athens, therefore the TSPs have no interest in managing groups of people.
22B	Perform descriptive, predictive, and prescriptive analysis on ticketing and/or validation datasets and visualize the results	High	This valuable functionality would allow the TSPs to better manage ticketing and validation procedures.
A13	Add, delete or adjust rules to process real-time events and detect complex event patterns	High	This is a valuable functionality for better real-time events management, especially for occurrences that may cause service changes or disruption.

ID	Enabled user experience	Interest score	Motivation for interest (current pain points, expected impact, etc.)
25	Block the travellers' ability to buy and receive tickets while the inspection is in progress	Medium	This attribute would be useful if an actual e-ticket could be used. This functionality exists for Athens' automated fare collection system (AFCS); validation of tickets is not allowed while an inspection is in progress (mainly for buses).
<b>Enablers for TSPs</b>			
S1	Enable the possibility of generating digital entitlements	Medium	This is currently being developed in-house since it's needed for C-REL.
S3 S5	Generate and update a journey planning service for the integration with other TSPs from timetable data	High	Integration of all TSPs timetables within a journey planning service is a key factor for MaaS.
A15	Register the financial transactions associated with a TSP in a distributed ledger.	High	This functionality would allow for better control of the transactions by each TSP.
S6	Host a node of the distributed ledger to directly handle a copy of registered transactions.	Low	
A12 A14	Enable a trip tracking service (notifying disruptions over the transportation network) for a TSP from an available event source	High	This functionality would allow for better control of transactions per TSP.
S2	Setup the fleet with devices sending real-time information about the vehicle status and position to then notify the travellers whenever the trip is affected	High	OASA Telematics already provides this service, informing the travellers about the bus position on the network, as well as its time of arrival at the bus stop. The TSPs have existing systems but they are not integrated with the IP4 functionalities. This could be a good functionality for the Athens pilot.

ID	Enabled user experience	Interest score	Motivation for interest (current pain points, expected impact, etc.)
S4	Have the travellers notified about disruptions by automatically-created messages that both inform the users and may also suggest alternatives	High	A very useful attribute increasing the travellers' awareness and response to disruptions. Thus, increasing their overall trust in the public transport system.

### 5.3. Padua

This demo site is located within the geographical area surrounding Padua, focusing on rural and suburban areas, and targeting workers and students in their daily commuters. The main objective of this demonstration scenario is to improve mobility planning while offering to the customers different multimodal services by enhancing the management services of the FSI Group. These multimodal services need to be made available to customers by assimilating all mobility options within the Padua area into mobility packages centred around the specific requirements of the citizens, with the final goal of connecting urban and rural areas through multimodal mobility services.

**FST** (Demonstration Site Leader), a technology company fully owned by FSI Group, is involved in the IP4MaaS Padua demonstration site to foster the integration of the following operators:

- **Trenitalia**: national train operator
- **Busitalia Veneto**: bus operator in the Veneto region

The additional IP4MaaS partners involved in the Padua demonstration site are Cefriel, POLIMI and FIT.

Table 20 reports the interest and motivation toward IP4 solutions for the Padua demonstration site. The table considers the results obtained in applying the full methodology for the definition of demonstration scenarios in C-REL and the information gathered through the template for F-REL.

**Table 20 - Padua: Interest and motivation towards IP4 functionalities**

ID	Enabled user experience	Interest score	Motivation for interest (current pain points, expected impact, etc.)
<b>Travel Companion</b>			
0	Mobile application for travellers to access integrated travel services	High	Already selected in 1 <sup>st</sup> phase demonstration scenarios.
15 P5	Web application for travellers to access integrated travel services (planning, booking, and issuing) and filing claims	Low	Not interested in this functionality and the proposed features (e.g., registration with Gmail).
20	Mobile application for kids with limited access to travel services and offering a simplified interface	Low	Not interested in offering services that can target kids.
16	Possibility of accessing a limited set of travel services without the need of creating an account	High	Already selected in 1 <sup>st</sup> phase demonstration scenarios. Guest users are allowed by Trenitalia, Busitalia requires registered users to access online services.
17	Possibility to set different travel preferences according to different travel profiles for the same account	High	Already selected in 1 <sup>st</sup> phase demonstration scenarios.
P1	Register/access a personal account using biometrics (fingerprint, face, etc.)	Low	Not interested in this functionality, in particular, there are concerns related to data protection and technical issues.
P2	Set up a personal e-wallet to easily manage payments and refunds through the app	High	Interested to enhance the overall experience with the application.
<b>Journey Planning</b>			
1 A1 A6	Calculate multimodal travel solutions from an origin to a destination integrating different TSPs, including offers price calculation.	High	Already selected in 1 <sup>st</sup> phase demonstration scenarios. Interested to enhance the journey planning service for Trenitalia. Busitalia is interested but doesn't have an available journey planning service for the integration (cf. S5)
A5 A7	Calculate door-to-door multimodal travel solutions covering also the first and last mile of a trip, and considering private transport to cover a leg of the trip	Medium	Interested to enhance the journey planning service for Trenitalia. Busitalia is interested but doesn't have an available journey planning service for the integration (cf. S5)

ID	Enabled user experience	Interest score	Motivation for interest (current pain points, expected impact, etc.)
S7	Optimize fares considering the availability of multimodal trips with different combination of distance/time-based tariffs and classic public transportation tariff products.	Low	Both TSPs are not interested in this functionality. Trenitalia's web services already shows the best price option for each "travel class" and the user can choose among them.
19	<del>Commuters being suggested recurring travel solutions based on their trip history</del>	Low	Both TSPs are not interested in this functionality. No major impact is expected given the fact that, if a user is a commuter, it would already know everything about a recurring travel solution (without even using the application).
A3	Utilize the user preferences about locations (stations, POI, etc.) to suggest specific travel solutions	Low	Both TSPs are not interested in this functionality. No major impact is expected given the fact that commonly frequented train stations and bus stops are already known by a user selecting them as preferred.
12	Share a planned travel solution with another user	High	Already selected in 1 <sup>st</sup> phase demonstration scenarios.
14	Have a travel arranger prepare the trip for a different user	Low	Both TSPs are not interested in this functionality. Trenitalia already provides a similar service, Busitalia only allows registered users to plan a trip for themselves.
<b>Booking &amp; Issuing</b>			
2	Book online all the payable parts of a planned journey.	High (Trenitalia) NA (Busitalia)	Already selected in 1 <sup>st</sup> phase demonstration scenarios.
3	Pay for and get the digital tickets for the booked trip	High	Selected in 1 <sup>st</sup> phase demonstration scenarios. TSPs are interested in testing this functionality but only in the context of the demonstrator (issuing of products is handled by different providers at the moment).
18	Pay for each ticket but get partially refunded at the end of a period if a cheaper alternative existed.	Low	Not interested in this functionality for commercial and business reasons.
13	Set up a group inviting users and issue the purchased group tickets	High	Already selected in 1 <sup>st</sup> phase demonstration scenarios.
4	After booking a travel offer, buy additional services such as meals or on-board Wi-Fi	High (Trenitalia) NA (Busitalia)	Selected in 1 <sup>st</sup> phase demonstration scenarios. Ancillary services cannot be booked online at the moment, therefore it will probably not be possible to test this functionality.



ID	Enabled user experience	Interest score	Motivation for interest (current pain points, expected impact, etc.)
5	Instead of buying single tickets, buy a mobility package that includes all the needed means of transport and TSPs	Medium	Selected in 1 <sup>st</sup> phase demonstration scenarios. Interested in this functionality to enhance the multimodal offer of the FS group (involving both Trenitalia and Busitalia). Limited interest in testing it because a higher impact is expected by involving additional transport stakeholders (e.g. sharing mobility, parking, etc.).
<b>Services during the travel</b>			
6	Have the app visualise the ticket in a QR Code format to ease the validation and inspection process	Low	Both TSPs are not interested in this functionality. It is already possible for Trenitalia and Busitalia is not interested in testing it.
10	Have the app provide navigation information such as where to get on or off, departure and arrival times, etc.	High	Already selected in 1 <sup>st</sup> phase demonstration scenarios.
9 A8	Be provided with quiz games, commercial offers and other entertainment services based on your location directly	Medium	Interested to enhance the service but not as functionality with high priority.
7	Integrate real-time information for different TSPs and receive notification for a planned multimodal trip	High	Already selected in 1 <sup>st</sup> phase demonstration scenarios.
8	If a disruption happens, be provided with alternative solutions	High	Already selected in 1 <sup>st</sup> phase demonstration scenarios.
<b>Other services</b>			
A2	Navigate an outdoor map that displays travel-related relevant content according to the user filters and the zoom level	Low	Not interested in testing this functionality. There is WiFi available on Frecciarossa high-speed trains which let users access different similar services.
11	Report situations around the traveller such as delays, crowded stations, broken equipment, etc.	High	Already selected in 1 <sup>st</sup> phase demonstration scenarios.
P8	View reports made by either TSPs or other travellers, comment, validate or add media to them	High	Interested to enhance the service.
<b>Tools for TSPs</b>			

ID	Enabled user experience	Interest score	Motivation for interest (current pain points, expected impact, etc.)
21	Join the Shift2Rail ecosystem by describing in a shared web catalogue the available web services for a TSP that can be integrated	High	Interested as this is one of the main objectives of the project.
P9	Manage travellers' reports, create new ones, modify and delete them. Filter active reports and check statistics regarding time and type of active reports.	High	Interested to enhance the service
22 P6	Describe the products that can be used for a mobility package for travellers and/or propose the creation of new mobility packages for other stakeholders (e.g., TSPs)	Medium	Selected in 1 <sup>st</sup> phase demonstration scenarios. Interested in this functionality to test how to enhance the multimodal offer of the FS group (involving both Trenitalia and Busitalia). Limited interest in testing it because a higher impact is expected by involving additional transport stakeholders (e.g. sharing mobility, parking, etc.).
24	Build quiz games, commercial offers and other location-based experiences for the travellers to use	Medium	Interested to enhance the service but not as functionality with high priority.
P7	Check customers' data and manage claims	Low	Not interested in checking and managing customers' data and claims.
A10 A11	Send messages to travellers in specific zones	High	Interested to enable communication with users.
A9	Define meeting points based on location to groups of travellers	Low	Not interested because no major impact is expected, stations (train) and stops (bus) are usually used as meeting points without the need of defining specific ones.
22B	Perform descriptive, predictive, and prescriptive analysis on ticketing and/or validation datasets and visualize the results	Low	Not interested. Trenitalia already visualizes and analyzes relevant data.
A13	Add, delete or adjust rules to process real-time events and detect complex event patterns	Low	Not interested as it is already implemented a similar service for both TSPs.
25	Block the travellers' ability to buy and receive tickets while the inspection is in progress	Medium (Busitalia), Low (Trenitalia)	Interested in testing this functionality to reduce dodging for Busitalia, the possibility of integrating validation and inspection should be evaluated. Already in use for Trenitalia.

**Enablers for TSPs**

ID	Enabled user experience	Interest score	Motivation for interest (current pain points, expected impact, etc.)
S1	Enable the possibility of generating digital entitlements	Low	Not interested because digital entitlements are already in use for both TSPs.
S3 S5	Generate and update a journey planning service for the integration with other TSPs from timetable data	High (Busitalia) Low (Trenitalia)	Busitalia is highly interested in this functionality to enable the integration of the service for journey planning in IP4. Trenitalia is not interested because already provides a journey planning service.
A15	Register the financial transactions associated with a TSP in a distributed ledger.	Low	Not interested in this type of functionality.
S6	Host a node of the distributed ledger to directly handle a copy of registered transactions.	Low	Not interested in this type of functionality.
A12 A14	Enable a trip tracking service (notifying disruptions over the transportation network) for a TSP from an available event source	Low	Not interested as it is already possible for a similar service for both TSPs
S2	Setup the fleet with devices sending real-time information about the vehicle status and position to then notify the travellers whenever the trip is affected	Low	Not interested because a similar service is already in use for both TSPs.
S4	Have the travellers notified about disruptions by automatically-created messages that both inform the users and may also suggest alternatives	Low	Not interested because a similar service is already in use for both TSPs.

## 5.4. Osijek

The demonstration site of Osijek mainly targets people living in the rural area in Osijek-Baranja County in Croatia. Commuters, and especially students, travelling daily to the city of Osijek are the main target group for the demonstration site. The main objective of the demonstration site is to test the added value of the IP4 solution in connecting current PT services and new services currently in implementation (e-car-sharing and bike & e-bike-sharing schemes) to offer a seamless multimodal experience to travellers.

The PTO involved in the IP4MaaS Osijek demonstration site is **GPP Osijek**. GPP Osijek currently operates in the City of Osijek's wider administrative area (City of Osijek, Čepin, Antunovac and Erdut) providing transport services with its 12 Bus and 2 tram lines. GPP Osijek also manages e-bike-sharing (station-based), car-sharing (station-based) and e-scooter sharing systems (free-floating).

HZ Putnicki Prijevoz (HŽPP), the national rail operator, is not directly involved in the project but offered support to also integrate information on available train solutions.

The additional IP4MaaS partners involved in the Osijek demonstration site are DYVOLVE (demonstration site leader) and FIT.

Table 21 reports the interest and motivation toward IP4 solutions for the Osijek demonstration site. The table considers the preliminary results obtained in C-REL and the information gathered applying the full updated methodology, through the template and the workshop, for the definition of the demonstration scenarios for F-REL.

**Table 21 - Osijek: Interest and motivation towards IP4 functionalities**

ID	Enabled user experience	Interest score	Motivation for interest (current pain points, expected impact, etc.)
<b>Travel Companion</b>			
0	Mobile application for travellers to access integrated travel services	High	High interest because currently each public transport (bus/train) and sharing mobility service (car/bike/scooter) requires a separate application to plan/perform a trip. A single mobile application could enable an easier-to-use travel experience (especially for the young population) and facilitate a broader usage of different travel services offered by local TSP.
15 P5	Web application for travellers to access integrated travel services (planning, booking, and issuing) and filing claims	Medium	High interest because it offers a service currently not available. A Web application is a primary tool, more accessible for certain users, to support a broader usage of the different travel services offered by local TSP.
20	Mobile application for kids with limited access to travel services and offering a simplified interface	Low	This functionality would not significantly contribute to the demonstration site goals. No major impact is foreseen by offering this functionality to users.
16	Possibility of accessing a limited set of travel services without the need of creating an account	Medium	This possibility could enable an easier-to-use experience for travellers and impact positively the usage of travel services and public transport (more potential users because no registration is needed to access travel services).

ID	Enabled user experience	Interest score	Motivation for interest (current pain points, expected impact, etc.)
17	Possibility to set different travel preferences according to different travel profiles for the same account	Low	Medium interest because it is not foreseen a high adoption of this functionality by users. This functionality is not critical for the usage of the application, and public transport users either have stable preferences (and in this case, they often do not use the app to plan the trip) or they would like to set one-time preferences. It would be interesting to investigate preferences considering mobility sharing services, e.g., a parent with a child that needs to rent a bike with a child seat.
P1	Register/access a personal account using biometrics (fingerprint, face, etc.)	Medium	This functionality could improve user experience (increased safety perception of the app by users), but it would not significantly contribute to the demonstration site goals.
P2	<del>Set up a personal e-wallet to easily manage payments and refunds through the app</del>	Medium	This functionality could improve the user experience among the younger population, especially students that represent a relevant share of the passengers, by simplifying the ticket purchase process. It would be less beneficial for elderly people.
<b>Journey Planning</b>			
1 A1 A6	Calculate multimodal travel solutions from an origin to a destination integrating different TSPs, including offers price calculation.	High	High interest to integrate offers from different mobility services available in Osijek in a single solution for the user GPP is interested in integrating their different service (PT and sharing mobility). GPP doesn't provide already an integrated journey planning solution. Currently, a user needs to access different platforms to plan a journey involving GPP tram/bus, HŽPP train and/or sharing mobility services. Regarding sharing mobility, the user should use different bike/car/scooter sharing applications to check the position of sharing stations and use a third-party app to calculate the route to reach the destination. A high impact is expected, increasing the usage of public transport.
A5 A7	Calculate door-to-door multimodal travel solutions covering also the first and last mile of a trip, and considering private transport to cover a leg of the trip	High	High interest because, currently, a user cannot plan a door-to-door journey involving GPP public transport services (tram/bus) and GPP sharing mobility services (bike-, e-scooter-, car- sharing). Moreover, no door-to-door journey planning is available for HŽPP (train operator) but only station-to-station. A high impact expected, increasing the usage of mobility services and reducing the usage of private cars also thanks to shared mobility services to cover the first/last mile.

ID	Enabled user experience	Interest score	Motivation for interest (current pain points, expected impact, etc.)
S7	Optimize fares considering the availability of multimodal trips with different combination of distance/time-based tariffs and classic public transportation tariff products.	High	High interest because GPP is considering the development of new tariffs that could support the recently implemented flexible transport services for shared mobility. This functionality would be an essential tool for users and TSPs. Currently, no integrated rates are available for HŽPP trains and GPP public transport. Optimized fares could motivate users to adopt multimodal solutions combining GPP's micro-mobility solutions or car-sharing with classic PT.
19	<del>Commuters being suggested recurring travel solutions based on their trip history</del>	High	Trip history data could be used to speed up the travel navigation to most travelled destinations. Route suggestions make it faster and simpler for users to choose a route, and an improved user experience can increase loyalty to the usage of the application. Digitransit app (an alternative solution for integrated journey planning) doesn't provide this functionality.
A3	Utilize the user preferences about locations (stations, POI, etc.) to suggest specific travel solutions	Medium	The functionality is interesting for tourists that may want to know how to include a tourist attraction in their travel solutions. Citizens may not be interested because they already know how to travel in the city.
12	Share a planned travel solution with another user	Medium	Not sure if users will be interested in such functionality. Nice to have but not crucial for multimodality adoption. GPP is more interested in other IP4 solutions.
14	Have a travel arranger prepare the trip for a different user	Medium	This functionality would not significantly contribute to the demonstration site goals. Not crucial for multimodality adoption. GPP is more interested in other IP4 solutions.
<b>Booking &amp; Issuing</b>			
2	Book online all the payable parts of a planned journey.	High (GPP Sharing Mobility), NA (GPP PT)	High interest in testing how this solution can be applied to sharing mobility services. No booking process for public transport tickets. Currently, a user needs different applications to purchase a ticket for public transport and to book a sharing mobility ride. Moreover, a vehicle for sharing mobility services cannot be booked in advance therefore a user may need to change the planned travel solution if no vehicle is available. This solution would facilitate and contribute to adopting multimodal travel solutions in Osijek.

ID	Enabled user experience	Interest score	Motivation for interest (current pain points, expected impact, etc.)
3	Pay for and get the digital tickets for the booked trip	High	High interest because currently there are many different apps for different modes of travel that require separate ticket or service purchases (e.g., bike-sharing, car-sharing etc.). Moreover, students and tourists could use their devices to buy digital tickets without being dependent on working hours of ticket sale points or spending a lot of time purchasing tickets during travel (at each leg of the trip). The solution could increase multimodality adoption.
18	Pay for each ticket but get partially refunded at the end of a period if a cheaper alternative existed.	Medium	This possibility could positively impact the user experience by facilitating access to cheaper travel alternatives, but it would not significantly contribute to the demonstration site goals.
13	Set up a group inviting users and issue the purchased group tickets	Medium	This possibility could positively impact user experience, especially if coupled with special offers for groups. Currently, a user needs to purchase separately tickets/subscriptions for GPP public transport services and HŽPP.
4	After booking a travel offer, buy additional services such as meals or on-board Wi-Fi	NA	This possibility could positively impact user experience, but it would not significantly contribute to the demonstration site goals. Users could be offered additional touristic services, e.g., a cheaper ticket for a Christmas tram ride or Happy Christmas Hour (giving gifts to children during a ride) while booking a trip. However, currently, ancillary services are not available.
5	Instead of buying single tickets, buy a mobility package that includes all the needed means of transport and TSPs	NA	Currently, all the apps are separated with no bundling options, and GPP is highly interested in supporting the combined usage of public transport and sharing mobility services (both offered by GPP). Different travel packages with discounts (e.g., 30 min rides with bike-sharing) could be introduced to motivate users to make multimodal trips. GPP is considering the definition of new tariffs to integrate traditional and flexible transport services, therefore is not interested in defining mobility packages with other TSPs (cf. also 22).
<b>Services during the travel</b>			
6	Have the app visualise the ticket in a QR Code format to ease the validation and inspection process	High (GPP PT), NA (GPP Sharing Mobility)	Interested because the process of ticket validation and ticket control could be sped up with QR codes in an app. Not applicable for sharing mobility services.

ID	Enabled user experience	Interest score	Motivation for interest (current pain points, expected impact, etc.)
10	Have the app provide navigation information such as where to get on or off, departure and arrival times, etc.	High	High interest because currently there are no navigation tools available during the travel that would show information, therefore, the user may have difficulties in finding information on when to get off and/or on the location of the bike-sharing station. This functionality would improve the user experience, no need to focus on indoor and outdoor PIS (e.g., in vehicles) because the app notifies the user to get on or off the vehicle. Moreover, the app can guide users at interchanges, e.g., to find a bike-sharing station or the next stops for PT.
9 A8	Be provided with quiz games, commercial offers and other entertainment services based on your location directly	Medium	This functionality would not significantly contribute to the demonstration site goals. It could be helpful as a promotional tool for TSPs and for collecting user feedback in some cases. The functionality could improve GPP's visibility and promote the usage of all available travel modes.
7	Integrate real-time information for different TSPs and receive notification for a planned multimodal trip	High	High interest because currently there is no mechanism available to notify users of disruptions. The users must check social networks to receive news about disruptions on GPP lines. Features of interest are (i) real-time updates about delays/cancellations on the specific journey planned by a user, and (ii) notification if there are no sharing mobility vehicles available at a given station (exploiting real-time data about sharing stations).
8	If a disruption happens, be provided with alternative solutions	High	High interest in this functionality to promptly provide users with alternative solutions, not only in case of disruptions but also if a sharing vehicle is not available at a given station.
<b>Other services</b>			
A2	Navigate an outdoor map that displays travel-related relevant content according to the user filters and the zoom level	Medium	Interested because currently there is no multimodal outdoor map that includes all modes of transport (PT stops, car-/bike-/scooter-sharing stations, etc.) and POIs. This functionality could simplify the app usage increasing the number of PT users. It could be especially useful for tourists or during specific events.
11	Report situations around the traveller such as delays, crowded stations, broken equipment, etc.	Medium	Interested because currently, no communication channel allows users to report situations related to travel services. It could complement the current usage of radio stations for reporting situations. Positive effect because reports from a large set of users could generate timely information about travel services, e.g., about disruptions.



ID	Enabled user experience	Interest score	Motivation for interest (current pain points, expected impact, etc.)
P8	View reports made by either TSPs or other travellers, comment, validate or add media to them	Medium	Interested in this functionality because there is no interactive communication channel that would help users in visualising and sharing reports. This functionality may have a positive impact on the use of the application, e.g., to access updated reports.
<b>Tools for TSPs</b>			
21	Join the Shift2Rail ecosystem by describing in a shared web catalogue the available web services for a TSP that can be integrated	Medium	This functionality allows TSPs to promote their travel services facilitating the integration of web services of different TSPs to support multimodal scenarios. The impact expected may be influenced by TSPs' unwillingness to provide access to their services.
P9	Manage travellers' reports, create new ones, modify and delete them. Filter active reports and check statistics regarding time and type of active reports.	Medium	Interested because, currently, no communication channel allows users to provide reports and they need to go to the office. This functionality could also be an excellent tool for business analytics and help in understanding users' needs and their level of satisfaction.
22 P6	Describe the products that can be used for a mobility package for travellers and/or propose the creation of new mobility packages for other stakeholders (e.g., TSPs)	NA	The creation of mobility packages through the CMMP could not be in line with CMMP scope (multi-company agreements) given the fact that all the considered services are operated by GPP (cf. also 5).
24	Build quiz games, commercial offers and other location-based experiences for the travellers to use	Medium	This functionality would not significantly contribute to the demonstration site goals. It could be helpful as a promotional tool for TSPs and for collecting user feedback in some cases. The functionality could improve GPP's visibility and promote the usage of all available travel modes.
P7	Check customers' data and manage claims	High	High interest in this tool to define a more efficient communication with customers. Better communication with users could help in understanding users' needs and improve the level of satisfaction.

ID	Enabled user experience	Interest score	Motivation for interest (current pain points, expected impact, etc.)
A10 A11	Send messages to travellers in specific zones	Medium	This functionality could improve the user experience, but it would not significantly contribute to the demonstration site goals. It could complement the current usage of radio stations to report situations. Could be useful for tourists or during specific events.
A9	Define meeting points based on location to groups of travellers	Low	This functionality could improve the user experience for groups of travellers, but it would not significantly contribute to the demonstration site goals. Moreover, GPP currently doesn't fulfil the requirements for this feature (e.g., 2D/3D plans of stations).
22B	Perform descriptive, predictive, and prescriptive analysis on ticketing and/or validation datasets and visualize the results	Medium	This functionality could be an excellent tool for business analytics. A better understanding of users' behaviour could help in developing new business models.
A13	Add, delete or adjust rules to process real-time events and detect complex event patterns	Low	This functionality could improve the user experience, but it would not significantly contribute to the demonstration site goals.
25	Block the travellers' ability to buy and receive tickets while the inspection is in progress	Medium	This functionality would not significantly contribute to the demonstration site goals. However, it could motivate passengers to buy tickets before boarding, which may result in more tickets sold (benefit for TSP).
<b>Enablers for TSPs</b>			
S1	Enable the possibility of generating digital entitlements	Low	Not interested because digital entitlements are already available for GPP and a different solution may not be applicable due to technical incompatibility.
S3 S5	Generate and update a journey planning service for the integration with other TSPs from timetable data	High	This functionality could have an important role in the integration of railway transport (HŽPP – public availability of GTFS data). The testing of this functionality is a precondition for the integration of railway transport.
A15	Register the financial transactions associated with a TSP in a distributed ledger.	Low	The TSP is not interested in this type of functionality. The benefits of the functionality are not clear.

ID	Enabled user experience	Interest score	Motivation for interest (current pain points, expected impact, etc.)
S6	Host a node of the distributed ledger to directly handle a copy of registered transactions.	Low	The TSP is not interested in this type of functionality. The benefits of the functionality are not clear.
A12 A14	Enable a trip tracking service (notifying disruptions over the transportation network) for a TSP from an available event source	Medium	This functionality could complement the current usage of radio stations for reporting situations and make public transport services more reliable from the user perspective. Currently no real-time updates about delays and cancellations (only alerts through social networks) so the presence of a suitable event source should be evaluated.
S2	Setup the fleet with devices sending real-time information about the vehicle status and position to then notify the travellers whenever the trip is affected	Medium	Real-time information plays a significant role in terms of reliability for PT. This functionality could improve the journey planning process.
S4	Have the travellers notified about disruptions by automatically-created messages that both inform the users and may also suggest alternatives	Medium	This functionality would help users in choosing alternative solutions if a failure/disruption occurs. Currently, updates are provided via social networks.

## 5.5. Warsaw

The Młociny transport hub, which is situated in the North of Warsaw, is the focus of the demonstration site. This transport hub is the Interchange building connecting the P + R car park with the bus, tram and subway terminus. Młociny node itself is a modern facility on the surface enabling the uninterrupted flow of passengers from the metro to the city and suburban buses, trams and cars. It includes a 4-storey car park with 1452 parking spaces, a bus station with a loop, a roofed tram terminus, commercial premises, traveller services and technical service. The car park is connected to the Młociny transport hub and has a bus depot and a waiting room at the bus station with a passenger service point. There are 4 tram lines, 12 daily bus lines, 7 nightly bus lines and one metro line. There are also 2 bike-sharing stations with 45 bicycles available to use between March and November. The Młociny transport hub is mainly used by the inhabitants from North districts of Warsaw (Bielany, Białołęka) and neighbouring communes (Warszawa Zachód, Nowy

Dwór Mazowiecki, Legionowo). The main objectives of the demonstrations are to trigger MaaS principle implementation and to improve the current ecosystem by adopting new technologies.

The PTO and TSP involved in the IP4MaaS Warsaw demonstration site are:

- **MZA** (Miejskie Zakłady Autobusowe): the largest bus operator in the Warsaw Metropolitan Area.
- **TRAM WARSZAWA**: a municipal tram operator in Warsaw Metropolitan Area.
- **MIASTO WARSZAWA**: the coordinator of public transport services and park+ride systems of the Warsaw Metropolitan Area.

The additional IP4MaaS partner involved in the Warsaw demonstration site is AITEC.

Table 22 reports the interest and motivation toward IP4 solutions for the Warsaw demonstration site. The table considers the preliminary results obtained in C-REL and the information gathered applying the full updated methodology, through the template and the workshop, for the definition of the demonstration scenarios for F-REL.

**Table 22 - Warsaw: Interest and motivation towards IP4 functionalities**

ID	Enabled user experience	Interest score	Motivation for interest (current pain points, expected impact, etc.)
<b>Travel Companion</b>			
0	Mobile application for travellers to access integrated travel services	High	This would allow for the integration of timetables from different TSPs while also improving the quality of the information available to the passengers.
15 P5	Web application for travellers to access integrated travel services (planning, booking, and issuing) and filing claims	Medium	On top of the positive impact of a mobile app, a web application would also target specific groups of people that may not be able (or want) to use a mobile app (e.g., the elderly).
20	Mobile application for kids with limited access to travel services and offering a simplified interface	Low	Local rules do not allow children under 13 to travel alone, hence limiting the effect of such functionality.
16	Possibility of accessing a limited set of travel services without the need of creating an account	High	This functionality should be the basic form of using the app, allowing the TSPs to reach a wider group of passengers.

ID	Enabled user experience	Interest score	Motivation for interest (current pain points, expected impact, etc.)
17	Possibility to set different travel preferences according to different travel profiles for the same account.	High	This functionality eliminates the need to configure the search each time, thus making the app easier to use.
P1	Register/access a personal account using biometrics (fingerprint, face, etc.)	High	This functionality would improve the app's UX, making it easier for the user to log into the app.
P2	<del>Set up a personal e-wallet to easily manage payments and refunds through the app</del>	High	While this functionality would improve clearings between TSPs and passengers, ZTM is currently introducing its payment mechanism.
<b>Journey Planning</b>			
1 A1 A6	Calculate multimodal travel solutions from an origin to a destination integrating different TSPs, including offers price calculation.	High	ZTM, MZA and TW do not provide journey planning. The user should use a third-party App (Jakdojade) to calculate specific routes. This solution currently is missing some information about specific routes or services. A planner including more services might convince more users to use public transport by finding better solutions.
A5 A7	Calculate door-to-door multimodal travel solutions covering also the first and last mile of a trip, and considering private transport to cover a leg of the trip	High	Jakdojade doesn't provide door-to-door solutions. With this functionality, the user could access information and routes to park&ride facilities.
S7	Optimize fares considering the availability of multimodal trips with different combination of distance/time-based tariffs and classic public transportation tariff products.	High	This would increase the level of integration with other TSPs while offering a better service for the passengers.

ID	Enabled user experience	Interest score	Motivation for interest (current pain points, expected impact, etc.)
19	<del>Commuters being suggested recurring travel solutions based on their trip history</del>	Low	A similar functionality is already supported by ZTM. Since timetables change very often and, at the time of planning, better options could exist, there is no interest in this feature. Additionally, commuters usually know the route and avoid using a journey planner.
A3	Utilize the user preferences about locations (stations, POI, etc.) to suggest specific travel solutions	Medium	The functionality might be interesting but the TSPs do not have a curated list of POIs and some POIs of the users may not be known from the TSP.
12	Share a planned travel solution with another user	High	This functionality would ease the process of organizing a trip and coordinating with other users (e.g., a friend that knows the number of the tram that a user got)
14	Have a travel arranger prepare the trip for a different user	High	Having a trip arranged is very useful for people not familiar with the city. It could potentially lead to the creation of communities, boosting user engagement.
<b>Booking &amp; Issuing</b>			
2	Book online all the payable parts of a planned journey.	Low	Local public transport doesn't support ticket/seat booking.
3	Pay for and get the digital tickets for the booked trip	Low	Local public transport doesn't support ticket/seat booking.
18	Pay for each ticket but get partially refunded at the end of a period if a cheaper alternative existed.	Low	Local public transport doesn't support ticket/seat booking.
13	Set up a group inviting users and issue the purchased group tickets	Low	Local public transport doesn't support ticket/seat booking.
4	After booking a travel offer, buy additional services such as meals or on-board Wi-Fi	Low	Local public transport doesn't support ticket/seat booking.
5	Instead of buying single tickets, buy a mobility package that includes all the needed means of transport and TSPs	Low	Warsaw already has a high level of integration that includes all the PTOs and TSPs.

ID	Enabled user experience	Interest score	Motivation for interest (current pain points, expected impact, etc.)
<b>Services during the travel</b>			
6	Have the app visualise the ticket in a QR Code format to ease the validation and inspection process	Medium	This is beneficial for the TSPs since it could lead to a further increase in e-ticket sales and, over time, to a potential withdrawal of paper tickets.
10	Have the app provide navigation information such as where to get on or off, departure and arrival times, etc.	High	This feature is absent from current solutions.
9 A8	Be provided with quiz games, commercial offers and other entertainment services based on your location directly	Low	While it might be useful for building a community of users, this feature is not expected to have a high impact on travellers.
7	Integrate real-time information for different TSPs and receive notification for a planned multimodal trip	Medium	The quality and amount of information provided to the users would improve significantly, thus improving existing solutions.
8	If a disruption happens, be provided with alternative solutions	High	The quality and amount of information provided to the users would improve significantly, thus improving existing solutions.
<b>Other services</b>			
A2	Navigate an outdoor map that displays travel-related relevant content according to the user filters and the zoom level	Low	This functionality is not needed.
11	Report situations around the traveller such as delays, crowded stations, broken equipment, etc.	High	Some information regarding the state of the services is currently available on the WTP website but this feature could improve the amount and quality of the information provided to the travellers.

ID	Enabled user experience	Interest score	Motivation for interest (current pain points, expected impact, etc.)
P8	View reports made by either TSPs or other travellers, comment, validate or add media to them	High	Aside from improving the amount and quality of the information provided to the travellers, this could lead to the creation of a community that would also allow the TSPs to monitor online reports and opinions.
<b>Tools for TSPs</b>			
21	Join the Shift2Rail ecosystem by describing in a shared web catalogue the available web services for a TSP that can be integrated	High	Accessing data provided by all the TSPs is beneficial and can lead to the optimization of door-to-door long-distance trips.
P9	Manage travellers' reports, create new ones, modify, and delete them. Filter active reports and check statistics regarding time and type of active reports.	High	This functionality would allow accessing data regarding all the TSPs while also improving the quality of the information provided to the travellers.
22 P6	Describe the products that can be used for a mobility package for travellers and/or propose the creation of new mobility packages for other stakeholders (e.g., TSPs)	Low	All the TSPs in the demo site operate on the same ticket tariff.
24	Build quiz games, commercial offers and other location-based experiences for the travellers to use	Medium	It might be useful for building a community of users.
P7	Check customers' data and manage claims	Low	The risk of managing personal data outweighs the benefit of this functionality.
A10 A11	Send messages to travellers in specific zones	High	It would allow the TSPs to send instant information to the travellers whenever a disruption happens.



ID	Enabled user experience	Interest score	Motivation for interest (current pain points, expected impact, etc.)
A9	Define meeting points based on location to groups of travellers	Low	The TSPs have no interest in managing groups of people.
22B	Perform descriptive, predictive, and prescriptive analysis on ticketing and/or validation datasets and visualize the results	High	This valuable functionality would allow the TSPs to better manage the public transport system.
A13	Add, delete or adjust rules to process real-time events and detect complex event patterns	Medium	This functionality may lead to the creation of ad-hoc algorithms to adjust the travel planner functionality based on the current (live) state of the services.
25	Block the travellers' ability to buy and receive tickets while the inspection is in progress	High	This helps prevent fraud and may lead to an increase in ticket sales.
<b>Enablers for TSPs</b>			
S1	Enable the possibility of generating digital entitlements	Low	The TSPs already support digital tickets.
S3 S5	Generate and update a journey planning service for the integration with other TSPs from timetable data	Low	The TSPs have no interest in such functionality.
A15	Register the financial transactions associated with a TSP in a distributed ledger.	Low	There is a low probability of testing this functionality during the demonstration.
S6	Host a node of the distributed ledger to directly handle a copy of registered transactions.	Low	The TSPs have no interest in such functionality.

ID	Enabled user experience	Interest score	Motivation for interest (current pain points, expected impact, etc.)
A12 A14	Enable a trip tracking service (notifying disruptions over the transportation network) for a TSP from an available event source	High	While the functionality is useful, the requirements are not met by the TPSs, thus making it not feasible in Warsaw.
S2	Setup the fleet with devices sending real-time information about the vehicle status and position to then notify the travellers whenever the trip is affected	High	The information required for this functionality is already being collected but is not currently used to provide additional services to travellers.
S4	Have the travellers notified about disruptions by automatically created messages that both inform the users and may also suggest alternatives	High	While the functionality is useful, the requirements are not met by the TPSs, thus making it not feasible in Warsaw.

## 5.6. Liberec

The demonstration site of Liberec focuses on the Liberec Region in the Czech Republic, with possible extension to the entire area of Borderland CZ/D/PL comprising Liberec, Zittau and Bogatynia regions. The demonstration site focuses on empowering travel solutions in the cross-border section to serve countryside high school students commuting to Liberec and tourists from outside the region. It also includes a cross-demonstration site scenario for users travelling from Liberec to Warsaw.

The **KORID LK** regional transport authority is involved in the IP4MaaS Warsaw demonstration site and coordinated transport services in the region. The *ČSAD Liberec*, PTO and school-bus operator, and *ARRIVA vlaky*, rail operator, is not directly involved in the project but offered support to include their transport services.

The additional IP4MaaS partners involved in the Osijek demonstration site are OLTIS (demonstration site leader) and UNIZA.

Table 23 reports the interest and motivation toward IP4 solutions for the Liberec demonstration

site. The table considers the preliminary results obtained in C-REL and the information gathered applying the full updated methodology, through the template and the workshop, for the definition of the demonstration scenarios for F-REL.

**Table 23 - Liberec: Interest and motivation towards IP4 functionalities**

ID	Enabled user experience	Interest score	Motivation for interest (current pain points, expected impact, etc.)
<b>Travel Companion</b>			
0	Mobile application for travellers to access integrated travel services	High	Essential for the pilot execution, there currently is no planner app that integrates all the services from both the Liberec and Warsaw areas.
15 P5	Web application for travellers to access integrated travel services (planning, booking, and issuing) and filing claims	High	On top of the motivation provided for the mobile app, a web application is an important alternative both for users who don't want to use the app, and for testers.
20	Mobile application for kids with limited access to travel services and offering a simplified interface	Low	Kids are out of scope for the goals of the cross-demonstration site pilot.
16	Possibility of accessing a limited set of travel services without the need of creating an account	High	This functionality matches one of the traveller profiles (tourist who visits the monuments in the Liberec region) and it allows for the app usage without the need to handle certain personal data.
17	Possibility to set different travel preferences according to different travel profiles for the same account.	Medium	This functionality seems not very important for the pilot itself but might be interesting to users.
P1	Register/access a personal account using biometrics (fingerprint, face, etc.)	Low	While it would boost security and allow for faster logins, this functionality doesn't match the goals of the pilot and is not considered an important improvement from an R&I perspective.
P2	<del>Set up a personal e-wallet to easily manage payments and refunds through the app</del>	High	The TSPs are interested in testing a refund mechanism, which could be implemented using an e-wallet.

ID	Enabled user experience	Interest score	Motivation for interest (current pain points, expected impact, etc.)
<b>Journey Planning</b>			
1 A1 A6	Calculate multimodal travel solutions from an origin to a destination integrating different TSPs, including offers price calculation.	High	Essential for the pilot execution, there currently is no planner app that integrates all the services from both the Liberec and Warsaw areas.
A5 A7	Calculate door-to-door multimodal travel solutions covering also the first and last mile of a trip, and considering private transport to cover a leg of the trip	High	The requirements are met (GTFS data and Journey Planning API), and the aim of these functionalities meets the pilot goals, especially considering cross-border solutions that currently do not support such functionality.
S7	Optimize fares considering the availability of multimodal trips with different combination of distance/time-based tariffs and classic public transportation tariff products.	Medium	This functionality could be interesting but more details about the requirements are needed since it might not be applicable.
19	<del>Commuters being suggested recurring travel solutions based on their trip history</del>	Low	Commuters don't usually need a journey planner. Additionally, long period user trips data can't be gathered during the pilot execution.
A3	Utilize the user preferences about locations (stations, POI, etc.) to suggest specific travel solutions	High	This functionality seems like an interesting improvement for the end-users, but its value might be impacted if the user needs to set the preferences in advance.
12	Share a planned travel solution with another user	Medium	The current solutions do not support this functionality so it would be useful for some users but given the pilot goals it is not of high interest.
14	Have a travel arranger prepare the trip for a different user	Medium	The current solutions do not support this functionality so it would be useful for some users but given the pilot goals, it is not of high interest.

ID	Enabled user experience	Interest score	Motivation for interest (current pain points, expected impact, etc.)
<b>Booking &amp; Issuing</b>			
2	Book online all the payable parts of a planned journey.	High	This functionality is necessary for issuing, validation, and inspection of tickets. It currently requires multiple apps, and such a solution would interconnect different booking services without having to move/copy data (cross-border scenario).
3	Pay for and get the digital tickets for the booked trip	High	This functionality is necessary for the validation and inspection of tickets.
18	Pay for each ticket but get partially refunded at the end of a period if a cheaper alternative existed.	Medium	It could be an interesting functionality. Currently under discussion with HaCon (to be specified in more detail by CFM), but not required for testing.
13	Set up a group inviting users and issue the purchased group tickets	Low	Group ticketing is not available.
4	After booking a travel offer, buy additional services such as meals or on-board Wi-Fi	Low	No ancillary services can be booked in advance (e.g., Wi-Fi, meals, ...).
5	Instead of buying single tickets, buy a mobility package that includes all the needed means of transport and TSPs	Low	No integrated tickets which include external bike/car-sharing services or parking credit are available. Mobility Packages (e.g., transport services and parking) will be available in other cities in two-three years.
<b>Services during the travel</b>			
6	Have the app visualise the ticket in a QR Code format to ease the validation and inspection process	High	This functionality enables the testing of the validation and inspection functionalities, which matches the goals of the pilot.
10	Have the app provide navigation information such as where to get on or off, departure and arrival times, etc.	High	There currently is no integrated navigation functionality during the travel. The user may need to use a different application to get directions on when to get off, how to reach the next stop and the next arrival time for the following leg.

ID	Enabled user experience	Interest score	Motivation for interest (current pain points, expected impact, etc.)
9 A8	Be provided with quiz games, commercial offers and other entertainment services based on your location directly	Low	While waiting times may be long between different legs, this functionality doesn't match the goals of the pilot.
7	Integrate real-time information for different TSPs and receive notification for a planned multimodal trip	High	Real-time updates regarding delays and cancellations for the selected travel solution are not provided as notifications to the end-users. This functionality would allow them to respond to disruptions as soon as possible.
8	If a disruption happens, be provided with alternative solutions	High	In case of a disruption, it may be difficult to find an alternative solution combining different means of transport. IDOS offers no re-planning functionalities.
<b>Other services</b>			
A2	Navigate an outdoor map that displays travel-related relevant content according to the user filters and the zoom level	Medium	It is an enhancement that might be interesting to end-users, but is not required for testing
11	Report situations around the traveller such as delays, crowded stations, broken equipment, etc.	Medium	There currently is no mobile app with such a comprehensive option to provide feedback for testers.
P8	View reports made by either TSPs or other travellers, comment, validate or add media to them	Low	This functionality is too far from the goals of the pilot, and it is not of high interest from an R&I perspective.
<b>Tools for TSPs</b>			
21	Join the Shift2Rail ecosystem by describing in a shared web catalogue the available web services for a TSP that can be integrated	High	This functionality is one of the fundamental goals of the entire IP4.

ID	Enabled user experience	Interest score	Motivation for interest (current pain points, expected impact, etc.)
P9	Manage travellers' reports, create new ones, modify, and delete them. Filter active reports and check statistics regarding time and type of active reports.	Medium	This functionality is not strictly required but, depending on n. 11 and P8, it might be a useful addition for the TSPs.
22 P6	Describe the products that can be used for a mobility package for travellers and/or propose the creation of new mobility packages for other stakeholders (e.g., TSPs)	Low	This functionality is impossible to test, neither mobility packages nor NeTeX format are supported by involved TSPs.
24	Build quiz games, commercial offers and other location-based experiences for the travellers to use	Low	While waiting times may be long between different legs, this functionality doesn't match the goals of the pilot.
P7	Check customers' data and manage claims	Medium	This functionality is not required by the pilot or TSPs but, if available, they are interested in testing the CRM portal and support for claims management
A10 A11	Send messages to travellers in specific zones	Medium	It would allow the TSPs to send instant information to the travellers whenever a disruption happens.
A9	Define meeting points based on location to groups of travellers	Low	This functionality is not aligned with the pilot goals. Moreover, the requirements cannot be met.
22B	Perform descriptive, predictive, and prescriptive analysis on ticketing and/or validation datasets and visualize the results	Medium	This functionality doesn't match the goals of the pilot. However, the results of such analysis can help to improve the reliability of the offer.
A13	Add, delete or adjust rules to process real-time events and detect complex event patterns	Low	The requirements set by the CFM are not met.

ID	Enabled user experience	Interest score	Motivation for interest (current pain points, expected impact, etc.)
25	Block the travellers' ability to buy and receive tickets while the inspection is in progress	High	This functionality seems to include the use of a proprietary solution, not matching the pilot goals. However, the TSPs are interested in testing it, if possible
<b>Enablers for TSPs</b>			
S1	Enable the possibility of generating digital entitlements	Low	This functionality seems to include a proprietary solution, not interesting to the TSPs from an R&I perspective.
S3 S5	Generate and update a journey planning service for the integration with other TSPs from timetable data	Low	This functionality is not aligned with the pilot goals.
A15	Register the financial transactions associated with a TSP in a distributed ledger.	Low	This functionality is not aligned with the pilot goals.
S6	Host a node of the distributed ledger to directly handle a copy of registered transactions.	Low	The TSPs have a low interest in such functionality.
A12 A14	Enable a trip tracking service (notifying disruptions over the transportation network) for a TSP from an available event source	Low	The requirements set by the CFM are not met by the involved TSPs.
S2	Setup the fleet with devices sending real-time information about the vehicle status and position to then notify the travellers whenever the trip is affected	Medium	While probably more aligned with R2R project goals, the TSPs have an interest in testing it.



ID	Enabled user experience	Interest score	Motivation for interest (current pain points, expected impact, etc.)
S4	Have the travellers notified about disruptions by automatically created messages that both inform the users and may also suggest alternatives	Low	This is a complementary functionality to trip tracking. TSPs currently have a low interest in testing this.

## 6. Conclusions

This deliverable provided a detailed description of the outcomes of IP4MaaS WP2. The purpose of this deliverable was to provide:

- An **updated picture of the software services** that are available in each demonstration site for integration in the Shift2Rail digital ecosystem. Technical information regarding these software services has also been **uploaded on the Asset Manager** to facilitate its sharing with CFM project partners.
- An overview of **users' needs and expectations** with respect to IP4 travel experiences, as they emerged from a conversational survey administered to travellers from demonstration sites (and beyond) and an opinion mining activity run on social media
- A description of the **updated methodology** adopted by the IP4MaaS project for the definition of demonstration requirements and scenarios. Some of the steps of the methodology, described in deliverable D2.2, are updated considering the feedback and experience from C-REL
- The results of the application of the methodology for the **demonstration scenario definition for F-REL** to the Barcelona, Athens, Liberec, Osijek, Padua, and Warsaw demonstration sites (in the case of Barcelona, Athens and Padua it represents an update and extension of what was included in deliverable D2.2; in the case of Liberec, Osijek and Warsaw it represents the full application of the updated methodology)

The latest information regarding the software services available in each demo site have been collected. This information is also stored on the AM and shared with CFM project partners. The information in the AM will be kept updated through the execution of the demonstrations (for example to provide the latest information about GTFS data).

The results of the opinion mining activity that has been carried out with reference to the Spanish and Italian demo sites have been presented. They indicate that the main topics of interest/concern for travellers are related to the “ticketing”, “scheduling” and “security” keywords. In summary, it seems that travellers (unsurprisingly) care especially about possibility of getting tickets for their trips, the scheduling of their trips, and their security.

Following the analysis of the results gathered from the user needs and expectations survey, all IP4 solutions, as presented in the survey, recorded a high interest and relevance in the high majority of respondents. This confirms that indeed those features can provide an added value to travellers and that the research and innovation direction of IP4 is indeed touching upon a clearly perceived need of European people.

A demonstration scenario is defined as the intersection between an IP4 solution and an IP4MaaS TSP. The updated methodology adopted by the IP4MaaS project and described in Section 4.1, led to the definition of demonstration scenarios for F-REL demonstrations in Barcelona, Athens,

Padua, Osijek, Liberec and Warsaw.

Annex IV represents the list of potential demonstration scenarios identified by IP4MaaS for F-REL for each demonstration site.

The provided table reports the interest collected for each IP4MaaS TSP towards the proposed IP4 solutions. Following the outcomes of the applied methodology, discussed in Section 4.1, the identified demonstration scenarios are represented by the cells reporting a *high* interest at the intersection between an IP4MaaS TSP (column) and an IP4 solution (row).

The table also reports *medium* and *low* interest to provide a twofold contribution.

On one hand, it can support IP4MaaS partners in the finalisation of the execution plan for IP4MaaS demonstrators following different criteria. For example, a modification of the demonstration scenarios may be required because of: (i) issues in the integration phase, (ii) to showcase in at least one demonstrator the IP4 solutions not selected by any TSP, (iii) to balance the number of functionalities tested in each demonstration scenario, etc.). In these cases, *medium* and *low* interests should be considered to guide the required modifications.

On the other hand, the complete set of values provides feedback from key transport stakeholders towards each IP4 solution. Colour shades are added to the table to provide also a *heatmap* representation of the overall interest registered by IP4MaaS TSPs towards IP4 solutions.

As commented in Section 2.1, functionalities 19 and P2 analysed through the templates for the definition of the demonstration scenarios, are not reported in Annex IV because discarded from the final list of F-REL IP4 solutions.

The provided table is complemented by (i) the map of available assets for each TSP, and (ii) the demonstration scenario requirements described in this deliverable. The elements provided by D2.3, together with “D3.2: List of operational KPIs, analysis of the users’ satisfaction and methodology as a whole, F-REL”, are inputs for WP4 to enable the definition of a technology integration plan and an execution plan for each F-REL demonstrator.

## 6.1. Next steps and links with other work packages

To conclude, this deliverable summarises how the outcomes of WP2 described in this deliverable can contribute to other WPs of the IP4MaaS project:

- Needs and expectations collected through the conversational survey and the opinion mining activity and the analysis of IP4 solutions for F-REL demonstrations are used to finalize the list of operational KPIs and the satisfaction survey in WP3. The results are described in “D3.2: list of operational KPIs, analysis of the users’ satisfaction and methodology as a whole, F-REL”.
- WP4 will integrate the demonstration scenarios and requirements with the map of assets defined for each TSP, to identify a detailed technology integration plan and execution plan (“D4.3: Demonstration Execution Plan and Technology Integration Plan, F-REL”) for F-REL demonstrations in Barcelona, Athens, Padua, Osijek, Liberec and Warsaw.

## 7. References

- [1] Schuler, Douglas, and Aki Namioka, eds. *Participatory design: Principles and practices*. CRC Press, 1993.
- [2] Celino, Irene and Re Calegari, Gloria. "Submitting surveys via a conversational interface: an evaluation of user acceptance and approach effectiveness.", *International Journal of Human-Computer Studies* 139, (2020)
- [3] Wilcoxon, F. (1992). "Individual comparisons by ranking methods." In *Breakthroughs in statistics* (pp. 196-202). Springer, New York, NY.
- [4] RIDE2RAIL Consortium, "D3.3 - Crowd-based Travel Expert Service", Technical Report, 2022, available from <https://ride2rail.eu>.

## 8. List of Annexes

### Annex I

The list and description of IP4 solutions made available by the ExtenSive project for demonstrations in IP4MaaS are provided in the attached document “IP4MaaS\_D2.3\_Annex\_I\_IP4-solutions.xlsx”.

### Annex II

The complete diagram clustering the set of IP4 solutions and identifying their relations is provided in the attached document “IP4MaaS\_D2.3\_Annex\_II\_IP4-solutions-diagram.png”.

### Annex III

A blank template for the definition of demonstration scenarios considering the interest and motivation of IP4MaaS TSPs towards IP4 solutions are provided in the attached document “IP4MaaS\_D2.3\_Annex\_III\_Demonstration-scenarios-template.pptx”.

### Annex IV

The complete table for the definition of demonstration scenarios considering the interest of IP4MaaS TSPs towards IP4 solutions is provided in the attached document “IP4MaaS\_D2.3\_Annex\_IV\_F-REL-Demonstration-scenarios.xlsx”.

### Annex V

Exports of the workshop boards implemented in Miro for the Osijek, Liberec and Warsaw workshops.

### Annex VI

Content and formulation of the conversational survey to collect needs and expectations of travelers described and analysed in Section 3.1.

### Annex VII

The matrix contains a recap of all IP4 functionalities, the interest of the demonstration sites as well as the result of the technical requirements checking detailed in Section 3.3. Please note that this mapping contains the information updated at the beginning of May 2022, but the requirements checking will continue and evolve in the context of the demonstration planning within WP4.

### Annex VIII

Details about the opinion mining activity performed on social media, summarized and explained in Section 3.2.