WP4 – DEMONSTRATIONS (PROOF OF CONCEPTS, TEST AND VALIDATION)

D4.4 DEMO EXECUTION REPORT

This project has received funding from the Shift2Rail Joint Undertaking under the European Union's Horizon 2020 research and innovation programme under grant agreement no. 881825

Project Acronym	Ride2Rail
Starting date	01/12/2019
Duration (in months)	41
Deliverable number	D4.4
Call Identifier	S2R-OC-IP4-01-2019
GRANT Agreement no	881825
Due date of the Deliverable	30/04/2023
Actual submission date	15/06/2023
Responsible/Author	FIT
Dissemination level	PU
Work package	WP4
Main editor	Nicola Bassi
Reviewer(s)	OLTIS GROUP, ATTIKO METRO
Status of document (draft/issued)	ISSUED

Consortium of partners

PARTNER	COUNTRY
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INLECOM	Greece
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METROPOLIA	Finland

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DOCUMENT HISTORY		
Revision	Date	Description
0.1	15/05/2023	Draft submitted to reviewers for comments
1.0	22/05/2023	Candidate release submitted to reviewers for comments
1.1	07/06/2023	Candidate release submitted to all partners for comments
1.2	12/06/2023	Final release
1.3	15/06/2023	Submission

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Abbreviations and acronyms

CFM	Call For Members
CRM	Customer Relationship Management
CW	Cloud Wallet
D	Deliverable
DC	Driver Companion
DoA	Description of Action
EU	European Union
GDPR	General Data Protection Regulation
GHG	Greenhouse Gases
IT	Information Technology
IP	Innovation Programme
KPI	Key Performance Indicator
R2R	Ride2Rail
SERA	Single European Railway Area
S2R	Shift2Rail
T	Task
TC	Travel Companion
WP	Work Package

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1 INTRODUCTION

1.1 Scope of the project

Personal mobility solutions using private vehicles and public transport, in a synchronised composition of the travel segments that make up the journey, with the possibility of opting for the most advantageous "at that moment" solution, in terms of time, cost, itinerary, have become the reference paradigm for the organisation of urban travel and are gradually spreading to larger travel scales. The construction of these solutions is requiring many intellectual, economic and organisational resources for various reasons: for example, for making available the technical tools and the agreements between the various public transport operators necessary to make possible to synchronise segments for a single ticket office and the possibility of planning, through a single source of information, a journey on several modes. The challenge of achieving the possibilities of travel imagined on an urban and rural scale available to all possible public is truly difficult. Part of this complexity is certainly also the necessary change in habits concerning the use of the private car, both in the sense of abuse, i.e. using it even when not essential, and in the sense of exclusive use, that is, not sharing it with other people interested in travelling on the same route. Changing user habits is a challenge to face and manage as much as the challenge of technological innovation.

Technological possibilities brought disruptive change in recent years. Changes that have also involved people's habits: listening to music has become a private matter when it used to be shared before, the possibility to communicate with anyone at any time, the possibility to search for any type of information regardless of location or time of day. However, these changes have not yet affected the area of mobility where people are instead anchored, see the statistics, to the use of private vehicles, typically in single mode, unless it is impossible or at least obviously inconvenient.
It follows that to achieve the objectives set by the ambitious Fit For 55 plan[1], to ease the pressure of vehicular traffic on urban nodes, for that leap forward in the quality of life and in the management of one's time, the innovation of habits is the next stage.

For this reason it is important to combine laboratory and transport organisation activities with experimentation activities involving the end-users. It is in fact through the involvement of users that it is possible to learn how they react to the possibilities offered, which solutions they adopt more quickly, which ones with more difficulty and which ones are not adopted at all. Knowing the reaction of users is important also considering that the organisation of transport systems in urban areas heavily involves the public administration through economic and operational commitments which in turn affect all citizens. It is therefore necessary to reason in a context of mutual synergy between possibilities, solutions and resources in order to create truly useful and rapidly spreading services. In this sense, the Ride2Rail project is grafted into the conjunction between the technological proposal and its adoption by the public of users.

[1] https://www.consilium.europa.eu/en/policies/green-deal/

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Initiatives such as Ride2Rail are therefore welcome, because they allow, even if with a limited service proposal in terms of time and results, to collect useful data, through the demos that WP4 has organised, to identify the way to build services which, as happened for listening to music, can change people's habits and improve the environment and the quality of life.

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1.2 Executive summary

The purpose of this deliverable is to report on execution of demonstrations held in the four areas chosen as test sites. This report reports main facts that occurred from the planning (which structure has been described in the "D4.1 Demo implementation plan") to the end of activities for all demo sites and, finally, offers some considerations on achieved results and lessons learnt. The document will not provide many details about monitoring issues or data collecting, as these are reported in the "D4.5 Demo monitoring report".

The demonstrations proved on the field the Ride2Rail combined suite of travel offer classifications and software components, integrated into existing collective IP4 ecosystem. The enhanced Travel Companion, enriched with Ride2Rail functionalities and solutions, the Driver Companion and the crowd-based Transport Service Provider were tested and largely used in four different heterogeneous mobility contexts targeting diverse categories of end users and it is meaningful to assess how people differently liked (or disliked) the same set of services. Opinions of users on the above mentioned tested solutions depended not only on the technology maturity and the communication with the demo actors providing guidance, but also on the period of test, on the category of user, on the duration of the demo and on the effectiveness of the services.

Another relevant aspect of the WP4 activities was the management of issues that occurred during experimentation phases. In effect, the limited time given to test applications and services before demos generated some problems and at least one delay in demo execution. As it was mostly feared in the planning phase, the IT development was complex over expectations and caused, with a waterfall effect, some issues in the organisation process. Despite this, all four demonstrations were successfully executed and collected data that will be the object of analysis.

The report also covers detailed aspects on the execution of every single demo (Athens, Helsinki, Brno and Padua).

The document is structured as follows:

- chapter two begins with the background information regarding the Ride2Rail project, the Shift2Rail context and the purposes of WP4, and the report on project management,
- chapter three, four, five and six will enter in detail regarding single demo sites,
- chapter seven depicts final conclusions.

1.3 Scope of the document

This document intends to report the development of activities related to the WP4 Demonstrations (proof of concepts, test and validation) of the Ride2Rail project. The document is in the form of a report, describing what has been done in order to organise, implement and manage the four demonstrations that the project envisaged. Being the final report, space has been given for the due evaluations of how much worked and how much could have worked better. The qualitative assessments are to be understood in the form of lessons learned, useful for being applied in future planning occasions with the aim of improving and making further investments in the field of urban-rural mobility more effective. In addition to the description of the activities and the evaluations, ample emphasis is given to the presentation of the Demos performed in the four test cities: Athens, Helsinki, Brno and Padua. In fact, the detailed description of the individual demonstrations in the field is considered to be of great interest. In particular, the possibility of comparing the demonstration of functional sets in different places and at different times, and with different design maturity, allows us to acquire a rather detailed picture of what worked and why for the users and at the same time to grasp useful indications on how to operate the services that have not met the satisfaction expectations.

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2 DEMO EXECUTION: A GENERAL OVERVIEW

2.1 Ride2Rail

A key aspect of delivering more attractive services is to provide end-to-end (or first- and last-mile) travel solutions that enable rail as their core mode of transport. This can be challenging in a rural environment, where connectivity to rail is problematic. It is also relevant in urban or peri-urban environments where there may be poorer provision of public transit.

Contributing to Shift2Rail's IP4, Ride2Rail's overall objective is to develop an innovative framework for intelligent mobility, facilitating the efficient combination of flexible (ride-sharing) and scheduled transport services (rail, bus, and other public transport services), thus enhancing the performance of the overall mobility system. Ride2Rail should, in particular, address the first and last mile problem by offering a wider range of transit options, while harnessing the capacity of single occupancy vehicles, along with existing, or future, demand responsive transit.

Ride2Rail aimed to integrate multiple (public/private/social) data sets and existing transport platforms for promoting an effective ride sharing practice of citizens, making it a complementary transport mode that extends public transport networks.

The objectives of the Ride2Rail project are:

- To develop an innovative framework for intelligent mobility, facilitating efficient combination of flexible and scheduled transport services, integrating real-time information about public transport and ride sharing;
- To facilitate the comparison and the choice between multiple options/services classified by a set of criteria, for example environmental, travel time, comfort, cost;
- To encourage carpooling (and ride sharing acceptance) as complementary for public transport;
- To enhance the performance of the overall mobility system, reducing road congestion and environmental impact, reinforcing the mobility offer in rural and low-demand areas;
- To combine travel offer classifications and software components, integrating them into existing services within IP4 ecosystem;
- To induct the access to high-capacity services thanks to easy-to-use multimodal and integrated travel planning, booking, issuing and many other features made available by IP4;
- To design, develop and test in four real demonstrators a set of software components for the IP4 ecosystem, including an enhanced Travel Companion and the crowd-based Transport Service Provider;
- To produce recommendations for replicability.

To meet the objectives of the Ride2Rail project, a series of IT services were made available, partly already existing and partly created from scratch, which, integrated in the IP4 ecosystem, were supposed to allow users to organise their movements in cities and rural areas more smoothly and easily. To verify the effectiveness of the proposed technological solutions, 4 demo sites were identified which served as demonstration laboratories.

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The four Demo Sites are cities and their sourroundings (or portions of) that offer proper conditions to test services and where the operators/transport services providers involved in the project operate. In fact, the target of the solution offered was commuters, workers or students, that in those different contexts travel by means of different ways of transport. In particular, one of the above mentioned objectives of the project is to target "solo car users" i.e. people that use the car driving alone to their destinations, creating congestion, emissions, and moving not so efficiently. Ride2Rail services at demo site level could help commuters to share private cars with other commuters to go together to a train station/public transport hub or to find, at the time of the request, the best travel solution with public transports.

2.1.1 Athens – Main info

The demo area of Athens was the 20 km-long air-rail corridor between Athens Airport - Doukissis Plakentias (metro station & park&ride), along Attiki Odos toll road plus 3 intermediate stations in Eastern Attica: Pallini, Kantza, Koropi served by metro and suburban rail. The objectives of the demo were to examine and provide input on smart multimodal solutions integrating carpooling (thus increasing both car occupancy and rail ridership), demand-responsive carpool connections with rural Attica parts, integration of carpooling road paths with the urban rail network in conjunction with a nexus of peripheral urban rail hubs and to evaluate innovative concepts of multimodality serving as test site for the IT services assessment taking into account new forms of shared mobility.

2.1.2 Helsinki – Main info

The Helsinki Demo covered the Vuosaari district, a large area of 17.07 km² which is geographically the largest district in the city of Helsinki. It has several lowly populated areas. The district does not have any train stations, but it is served by two metro stations: Rastila and Vuosaari. The metro was used by 67.5 million passengers in 2017 (Helsinki, overall). The metro stations are served by at least 5 regular bus lines. The demo focused on improving access to rail and metro, for the first and last mile of commuter journeys. The demo addressed the mobility needs of people in Helsinki's most Eastern neighbourhood Vuosaari. The demo is based on on-demand services.

In the case of Helsinki, the demo included two parts, which both focus on reducing single-occupant private car trips:

- Testing the use of an automated shuttle bus in more rural areas, as part of a multi-modal last-mile journey, integrated in relevant travel planning applications.
- Testing the Ride2Rail solutions, with HSL as transport service provider in Helsinki integrated in the IP4 ecosystem.

2.1.3 Brno – Main info

The demo Brno Area involved the South Moravian region, where there are various local hubs used by daily commuters while travelling to work in the city of Brno (CZ). The demo had the purpose to encourage Ride2Rail users, such as solo car drivers, to share (via the tools provided by the project) the capacity of their cars with other travellers going in the same direction. Users of the services were commuter workers and students.

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2.1.4 Padua – Main info

Padua demo demonstrated, in a 20 Km area surrounding the city, Ride2Rail functionalities in a real-life environment, with regular commuter flows from/to suburban and rural areas. The two applications Travel Companion and Driver Companion, connected to Crowd-based TSP, have been made available to a group of students of Ca' Foscari University. Existing travel planning application provided by Trenitalia has been integrated with Ride2Rail features. This allowed users to receive recommendations to improve their mobility experience in all trip related phases, as well as the organisation of dedicated services (such as ride sharing, bus shuttles on demand peaks). The demo involved urban and regional (rail and bus) mobility service providers in Veneto Region, as well as shared mobility options such as ride sharing in a multi-modal journey context. For each Demo site in chapter 3 of this deliverable it is reported related insight with all information needed regarding preparation, execution and results.

2.2 Demo Execution Management

2.2.1 The Objectives and the Plan

Ultimately, the aim of Ride2Rail project was to impact positively in the following areas:

1. increasing the number of multi-occupancy vehicle trips, as opposed to single occupancy-vehicle trips
2. increasing the access to public transit for users in a rural and/or suburban setting
3. contributing to minimising emissions

In this view, Work Package 4 provided the demo context to evaluate the effectiveness of Ride2Rail services in four locations: Athens (Greece), Helsinki (Finland), Brno (Czech Republic), Padua (Italy). To proceed with a homogenous and coherent execution of the demo activities, a common guideline was shared among Demo Leaders under the direction of the WP4 Lead Partner. The Deliverable 4.1 Execution Plan depicts in detail the structure of the guideline, for ease of reading a short resume follows. First of all, implementation plans organised all aspects related to the running and the management of each demo, such as:

- activities required to run all demo phases (such as testing, communication, agreements with mobility companies),
- local stakeholders involved (such as universities or group of students), strategy for stakeholders' involvement, and roles in the demo activities,
- risks and risk management for all the demo phases,
- potential demand and targets, with corresponding indicators.

The guideline for the implementation included four main sections:

- **Activities and stakeholders:** this section defines the guidelines to be followed for the definition of the activities and the identification of stakeholders, necessary for the execution of the demo. It consists of the following four phases:
    - demo preparation: aimed at planning and providing a checklist of all technical and organisational activities needed for deploying the demonstration execution,

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- demo implementation: IT components are technically set up in the demonstrators and related software tools are customised and integrated with the local services ,
- demo execution: execution in the demo sites of the Ride2Rail solutions (enhanced Travel Companion and Driver Companion) to operate with local solutions of urban/rural mobility,
- demo monitoring: proposed KPIs and targets are collected and validated to permit a cross-site comparison.

User Engagement: engagement strategies are crucial actions necessary to ensure a fruitful execution of Ride2Rail pilots at each demo site.

- **Demand Targets:** setting the target of each demo: the users involved in the demo, the infrastructure and vehicles involved and the main results expected from each demonstration.
- **Assessment of Risk:** a detailed assessment of risks, developed considering local peculiarities, project and external factors.

2.2.2Preparation and Execution

The management of the Execution Plans on the individual Demo sites took place through a direction on two levels of the necessary actions:

- WP level: through the coordination of the activities between the project partners involved in the demos and the control and guidance of the activities to be carried out at the local level.
- Demo Site level: through communication activities for the dissemination of information on the project, recruitment of people to be involved as testers, coordination of companies and/or institutions involved in the provision of transport services.

The two levels, in order to guarantee the execution of the demos, were carried out in terms of reciprocal dependence. It was necessary for the coordination and synchronicity of all the activities needed.

2.2.3WP Level

In the WP Level, the coordination activity was carried out between the project partners to make it possible to carry out the demos. In particular, the objectives of the general coordination were:

- Ensure that digital services to be tested were made available to users in time for demos.
- Address and control the activities to be carried out on the individual demo sites.

The coordination was done through weekly online meetings in which all the actors involved in each ongoing demo participated. In the meetings prior to the demos of Athens and Helsinki there was also the presence of the project partners responsible for implementing the technological solutions and managing the IT services. In fact, although WP3 "Development of enhanced Travel Companion and Ride-sharing TSP" was officially closed

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at that time, some developments were still under finalization and, above all, a close synergy between WP leader, demo teams and technical partners was necessary for field testing activities. The meetings developed according to a pattern that has consolidated over time:

- The organisation and leadership of the meeting were delegated to WP4 Leader (FIT Consulting).
- The Project Coordinator (UITP) also attended each meeting.
- The list of the activities to be carried out and the coordination of these was managed through a checklist showing the activity to be carried out, the responsible partners, the current state of execution, the deadline and any other comments/notes.
- The examination of any problems on the services and apps being tested was carried out through two different issue logs available to the Demo Leaders and the people in charge of the tests. For the Travel Companion and IP4 solutions, the Mantis tool was used to report/solve any issue to CFM partners.

Direct interactions (via email or call) between partners where held whenever needed. The weekly meetings were also organized while the demo was ongoing, to report issues and coordinate the activities/discuss the intermediate results.

The main coordination tool was the above mentioned Checklist, that covered activities to do before, during and after the demo. Follows the checklist for all three phases:

SECTION	#	TASK	STATUS	RESPONSIBLE	DEADLINE	REMARKS	DEPENDENCIES
User Management							
	1	Contact with potential test users from <partner name>					
	2	To determine person, who will be responsible for communication with testers during the pilot execution					
	3	To have fake credentials for DC & TC apps to give to users					
	4	To have a list of users and their credentials, testing that they work					
	5	To prepare materials for users to ensure seamless pilot execution (short description of project(s), poster, tutorial video, instructions, report template, …)					

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	6	Privacy Policy ready and available to users					
	7	Having ready the user's personal data collecting procedure					
	8	To have the final list of users (travellers and drivers)					
	9	Having ready the communication to give to the user his fake credential					
	10	To organise demo events with selected users					
	11	Having ready the communication to give the survey					
	12	Sending the survey to the test users					
	13	Having ready the system to collect fulfilled surveys and to give a code to gain incentives					
	14	To determine the final version of incentives					
	15	MANTIS Issue logger: accounts and accessibility for ???					
App development							
	16	Deploy demo's CbTSP instance					
	17	Load bulk credentials into the DC					
	18	Load bulk credentials into the TC					
	19	Filtering of travel solutions by transport mode					
	20	To create mailing list with one/more contact person(s) from CFMs and OCs in case of issues or necessities on TC and DC App					

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	21	To have confirmed (from CFMs side) that test cases have been performed successfully					
	22	To have final version of Terms & Conditions					
	23	To test (internal) DC & TC apps					
	24	To create issue log for internal testing (ensure communication between OCs, CFMs, and WP3 partners regarding DC & TC apps if any issues occur during the internal testing)					
	25	To test registration of fake credentials in DC & TC apps					
App distribution							
	26	To have links for DC (Driver Companion) & TC (Travel Companion) apps					
	27	Clean up test trips and any other sign of test from the app - on request!					
	28	User guide					
	29	Installation guide					
	30	Guides available to users					
Statistics and data							
	31	KPIs baseline values (where appropriate)					
	32	Data source ready (automatic/manual)					

Table 1: Checklist for activities before the demo

SECTION	#	TASK	STATUS	RESPONSIBLE	DEADLINE	REMARKS	DEPENDENCIES
User Management							
	1	Communication tools are working					

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	2	Referrals are ready to reply to users					
Eco System							
	3	Keep on ecosystem working					
App distributions							
	4	Keep on download links working					
Statistics and data							
	5	Data collecting (who's checking?)					

Table 2: Checklist for activities during the demo

SECTION	#	TASK	STATUS	RESPONSIBLE	DEADLINE	REMARKS	DEPENDENCIES
User Management							
	1	Collect surveys					
	2	Incentives distribution					
	3	Communication of demo's ending					
	4	Thank you message to test users via email					
Statistics and Data							
	5	Collect data regarding KPIs					
	6	Distribution of Collected KPIs					

Table 3: Checklist for activities post Demo

2.2.4 Demo Site Level

At the local level, the Demo Leaders autonomously organised and carried out the planned activities for running the demos. The checklist previously shown was modified according to specific cases (for example, not all sites had to translate the interfaces apps) as per the execution plan of reference.

Important tools for coordinating the technical activities in the periods before and during the demos were the Issue Logs in which record the problems technical and non technical issues that emerged in the use of IT services during the testing have been reported. The Issue Logs themselves also served as a communication tool to update on the status of the solutions. Unfortunately, it was not possible to have, as would have seemed obvious, a single Issue Log due to the use of two Apps (the Travel Companion and the Driver Companion)), integrated through the CB TSP, managed by different organisations, it was necessary also to distinguish the anomaly reporting references. As mentioned above, Mantis was used for Travel-

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Companion related issues. An excerpt from the Issue Log dedicated to the Driver Companion is shown as an example.

Ride2Rail Issue Log Sheet

Section reserved to testers							Section reserved to owners				
ID	Brief Name	Description	Impact	Tester	Date Added	Severity	Owner	Follow up Date	Status	Close Date	Notes on Closure
Unique identifier	Brief 3-5 word description of the issue	Description of the issue	Notes on this issue's impact on the project or other activities	Name of the person who catched the issue	Date this issue was added to this list	Severity of this issue: 1-High, 2-Medium, 3-Low	Person who is responsible for evaluating and resolving this issue	Date to review issue	Status of item: 1-Open, 2-In Progress, 3-Closed	Date this issue was resolved	Notes or results on the resolution of this issue, such as final decision document location, results of implementing requested fix, etc
1	Exceeding the capacity of vehicles	It is possible to have more passengers than the vehicle capacity is (2 seats)	non-blocking	Petra Juránková (OLTIS)	21/10/2022	medium	Nicola Bassi		Closed	26th Oct	Behaviour by design
2	Cancellation of the ride	The passenger is not informed byTC that the ride has been canceled by the driver in DC, i.e. the passenger doesn't receive notification. Is this information sent from DC (R2R solution) to TC (IP4 ecosystem?	non-blocking	Petra Juránková (OLTIS)	21/10/2022	high					
3	Shared rides - Origins and destinations	Shared rides in "My trips" in the TC app are displayed without the particular origins and destinations, i.e, only as "Origin", "Destination" or "name.service_road	non-blocking	Petra Juránková (OLTIS)	21/10/2022	medium					

Figure 1: Issue Log sample

The details of the conduct of the Demos are referred to in the following chapter.

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3 ATHENS DEMO

3.1 Overview

Athens is located within the Attica Region and is the capital and largest city of Greece, with a population close to four million, it is also the seventh largest city in the European Union. The Region of Attica has an area of 3,808 km^2, a population of about 3,923,000 citizens and is divided administratively into 113 Municipalities, while the municipality of Athens due to its large size is subdivided into 7 districts (Economopoulou et al., 2013).

Attica's public transport network consists of five different public transport modes: metro, suburban railway, tramway line, buses and trolleybuses, which are run by different operators (Spyropoulou, 2020). The Athens Metro network comprises three lines with 67 stations, covering 85.3 km of railroad and transfers around 1,400,000 passengers/day (Attiko Metro S.A., n.d.). Line 1 commenced its operation in 1869, and lines 2 and 3 in 2000 with subsequent system extensions in 2004, 2007, 2009, 2010, 2013 and 2021 with a total of 39 new underground metro stations (Spyropoulou, 2020; Zarkadoula et al., 2022). The suburban railway commenced its operation in 2004, it is 20.7 km long and connects the Athens International Airport with the city centre of Athens and the port of Piraeus (Spyropoulou, 2020. The tramway line links the centre of Athens with the port of Pireaus, the P. Faliro area (south district next to Pireaus), and the southern suburb of Voula. The tram commenced its operation in 2004 and operates in a 31.3km long network (Attiko Metro S.A., n.d.; Spyropoulou, 2020). Finally, there is an extensive bus and trolleybus network, consisting of about 260 bus routes and 19 trolley bus routes, covering most of the Athens metropolitan area (Spyropoulou, 2020).

The demo area was the 20 km-long corridor between the Athens Airport and the Doukissis Plakentias metro station (with Park and Ride), along Attiki Odos toll motorway. This area comprises territories of five (5) municipalities with low population densities compared to the core centre of the Athens municipality.

Municipality	Total Area (km^2)	Population	Population density (inh/km^2)	24h Travel Demand	PT Share (%)
Athens	39.0	664,046	17,026.8	1,491,531	78
Vrilissia	3.9	30,741	7,882.3	64,142	32
Penteli	36.1	34,934	967.7	27,051	27
Pallini	29.4	54,415	1,850.9	66,088	30
Paiania	53.2	26,668	501.3	28,833	27
Koropi	102.0	30,307	297.1	57,712	26

Table 4: Demographic and travel demand features of municipalities represented in study area (Source: ELSTAT & ATTIKO METRO)

The metro and suburban rail serve also the 3 intermediate stations between the Airport and D. Plakentias stations: Pallini, Kantza, Koropi.

For the Athens demo, two test sites were foreseen:

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1. Paid P+R with 500 parking spaces (PS) at D. Plakentias, which is located about 12 kms from Athens' city centre (i.e., Syntagma square).
2. Free municipal P+R with 300 PS at the Koropi station, which is located 13 kms south of D. Plakentias station.

Both sites are shown with yellow circles in Figure 1 ; 50 ride-sharing lots will be allocated for the project's scope in each site.

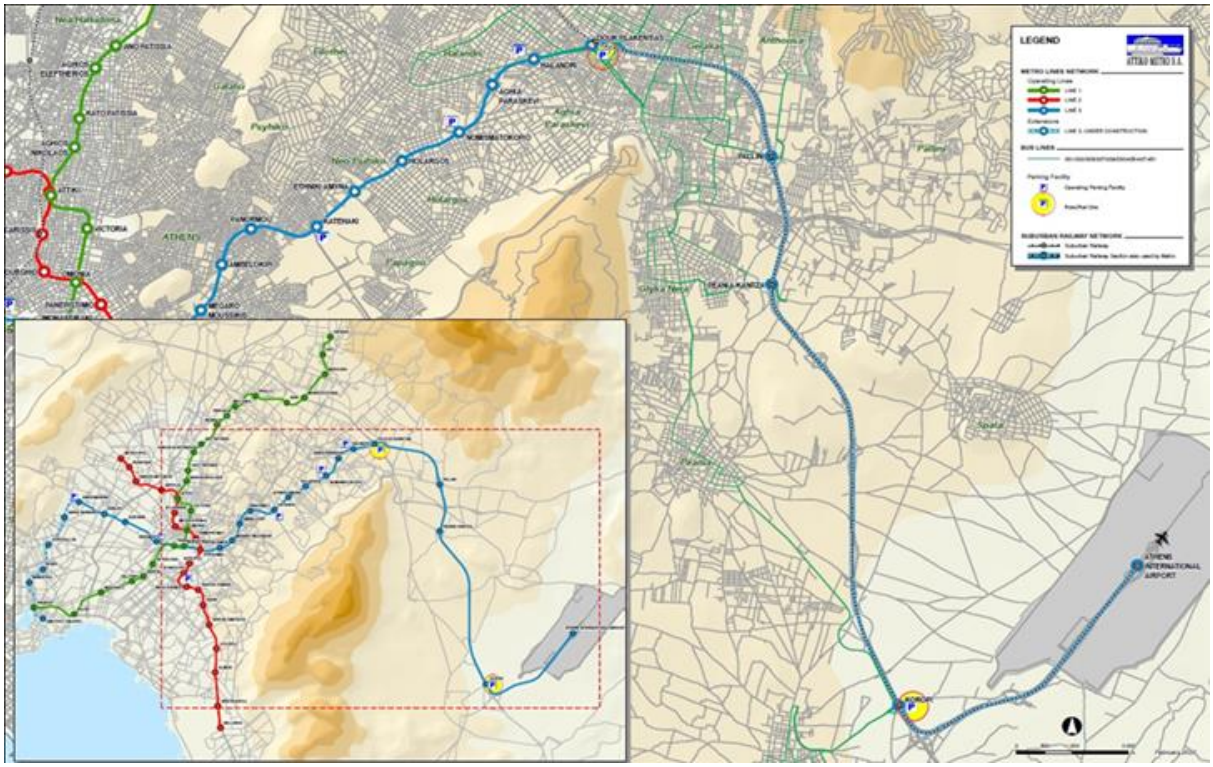

Figure 2: Athens Metro Network and Intermodal Hubs (in yellow)

Both stations are equipped with P&R facilities which encourage ride-sharing for multimodal travellers. Table 2 shows the main features of the parking facilities at both sites. The utilisation rate at D. Plakentias P&R station is moderate due to parking charges. At the D. Plakentia hub, the P&R operator leases the land from the metro owner (ATTIKO METRO). The average parking duration is estimated to be 6-8 hours. The parking lot at Koropi station, is saturated during weekday morning peak hours. Furthermore, parking spill over of about 300 passenger cars is recorded on a regular basis.

Metro/Suburban Rail Station	Area (m^2)	Capacity	Fees per hour
Doukissis Plakentias (DP)	15,200-paved	630 spaces	0.5€ (up to 12 hours per day)
Koropi (KR)	6,100-unpaved	300 spaces	Free

Table 5: P&R facilities features in the selected intermodal hubs

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The stakeholders participating at the demo were categorised as project partners and external stakeholders. The project partners were:

- Centre for Research and Technology Hellas – Hellenic Institute of Transport (CERTH/HIT),
- ATTIKO METRO AE (AMETRO),

The external partners mobilised through bilateral communications were:

- POLIS PARK,
- Municipalities of Koropi, AgiaParaskevi, Penteli, Vrilissia, Pallini, Paiania

3.2 Goals

The overall goal of the demo was to enhance the connection of low-density Attica Region areas to public transport (PT) modes, and specifically to the metro network, through the provision of demand responsive ride-sharing services.

- Travellers going to Athens (north and centre) from peri-urban areas, with low frequency of PT services, often use their cars for their trips.
- Ride-sharing services were offered through a dedicated app, for the 1st and/or last leg of the trip.

More specifically, the objectives of the demo were:

a) to examine and provide input on smart multimodal integration for the PT-ride-share mode, whereas ride-sharing works as a complement to PT (i.e. feeder) for the first/last mile part of a journey, thus increasing both car occupancies and urban rail ridership, when linking low-and high-density areas of Attica,
b) to serve as test sites for the platform assessment, considering new forms of shared mobility,
c) to evaluate innovative concepts of multimodality.

The target values of the relevant indicators of the demonstration have been set and described in Table 6. The target value of each indicator represents the scope of the demo, e.g., the number of passengers involved and using Ride2Rail solutions, the number of trips surveyed, the number of trips attracted to rail or multimodal solutions, etc. The following table reports the potential demand for the demo, as assessed in Ride2Rail DoA, and the newly assessed targets.

Indicator	Potential demand	Target
Passenger trips estimated	80,000 trips (30,000 commuter trips) p.a.	2,000 p.a.
Maximum number of car trips potentially attracted to rail/ride sharing	40,000 p.a.	200 p.a.
Number of parking spaces designated for Ride2Rail at the urban gate D. Plakentias	50	20 (during demo)

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Number of parking spaces designated for Ride2Rail at the extra-urban Koropi station	50	5 (during demo)
Number of app users during demo	-	50
Number of ride-sharing trips performed with the app during demo	-	10

Table 6: Activities and stakeholders for the Athens demo

Volunteers for the ultimate demo to test the Ride2Rail Travel Companion platform were recruited by conducting a Stated Preference (SP) experiment.

The SP experiment involved solo parkers and bus feeder users at both test sites to assess ride-sharing acceptance as access/egress mode to rail. These are grouped by trip purpose:

1. Potential riding commuters matched to driving commuters,
2. Potential occasional riders matched all drivers (commuting and occasional). Other segments refer to income, age, gender (drivers & riders), employment status, work time flexibility (riders).

3.3 Facts

The RIDERAIL Demo in Athens was scheduled to take place for two working weeks, from the 11th of July until the 22nd. Due to various technical issues however, that arose during the week dedicated to testing (4-8 of July), the Project partners along with the CFMs decided to postpone the starting of a demo for a week. During this week all efforts were placed on the improvement of the application and on the overcoming of all problems. Finally, the Ride2Rail demo lasted 1 week, from 18th to 22nd July 2022. During the demo period, several functionalities were tested within the "Travel Companion" app and the "Driver Companion" app. More specifically the functionalities integrated in the "Travel Companion" app were: Offer Categorizer, Offer Matcher & Ranker, Agreement Ledger, Incentive provider, Crowd Based TSP.

The following storytelling provides the basic concept of the Athens demo-site:

- Marietta is an employee living in Koropi.
- She commutes daily from Koropi to Zografou.
- She needs to go shopping after work.
- On her return trip to home, she looks for a bus ride to reach Evangelismos metro station.
- After shopping in the vicinity, she rides on the metro to Doukissis Plakentias station in the late evening when bus service level is low.
- Thanks to the Travel Companion, she uses a ride-sharing driver to reach home.

The Athens demo engagement strategy was twofold; on one hand extensive dissemination was conducted through social media and demo actors' websites, while on the other hand volunteers for the ultimate demo to test the Ride2Rail Travel Companion platform were recruited through the conduction of a Stated Preference (SP) experiment.

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3.4 Stated Preference Questionnaire

A Stated Preference (SP) experiment was used to identify demo-users. The main aim of the survey was to investigate for the users of the metro/suburban rail system in the Attica Region, who commute from the eastern areas to Athens and vice versa, the willingness to use for their first/last mile of their trip a ride-sharing service either as drivers or as riders. For these users, at the moment the main segment of their trip is completed by metro or suburban rail, whereas the last/first segment by other means of transport or on foot.

These travellers complete a trip from home to their destination and vice versa, which usually consists of three segments:

a) From home to the metro/suburban rail station (Doukissis Plakentias or Koropi);
b) From metro/suburban rail station to another metro/suburban rail station using the metro/suburban rail or a combination of these;
c) From metro/suburban rail station to their final destination by any transport mode or on foot.

The reverse order applies for the return-home trip.

For the Athens-demo, the first and last segments (first/last mile) are of interest for using ride-sharing services. Trip makers with respect to first/last mile can be classified in the following categories (strata):

1. Travellers who use PT bus;
2. Travellers who drive alone (solo drivers) to/from any of the two stations;
3. Travellers who drive with one or more co-riders to/from any of the two stations;
4. Travellers who take taxi to/from any of the two stations;
5. Travellers who are riders – not drivers- of another car travelling to/from any of the two stations.

The first four categories may expect benefits in terms either of travel time savings, travel cost reductions, comfort and convenience or combination of these. The last category is not of interest in the specific survey given that these specific travellers do not benefit from ride-sharing either as drivers or as riders. The completion of the survey requires 15 or even 20 min.

The initial questionnaire sample was 5,399 respondents; 64.5% of the interviews were conducted at D. Plakentias station while the remaining 35.5% at Koropi station. More than 95% of the questionnaires were conducted on the metro/suburban railway platforms of both stations.

More than 70% of the respondents hold a driving licence, while almost 60% of the respondents own a private passenger vehicle. Survey participants were asked about their trip purpose and more than half (51%) are commuters, approximately 25% travel for personal reasons and 3% travel for business and other purposes.

For the majority of the respondents (84.6%) the trip origin is their home, and for 54% of the respondents the destination is their work. Regarding the transport mode used during the first mile of their trips, almost 62% were made with a private vehicle, 45.4% as a driver with no passengers (SOV) and 16.3% as a driver with passengers (HOV). The bus was used by

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29.3% of the sample and 9.1% of the respondents used a taxi during the first mile of their trip (Figure 3).

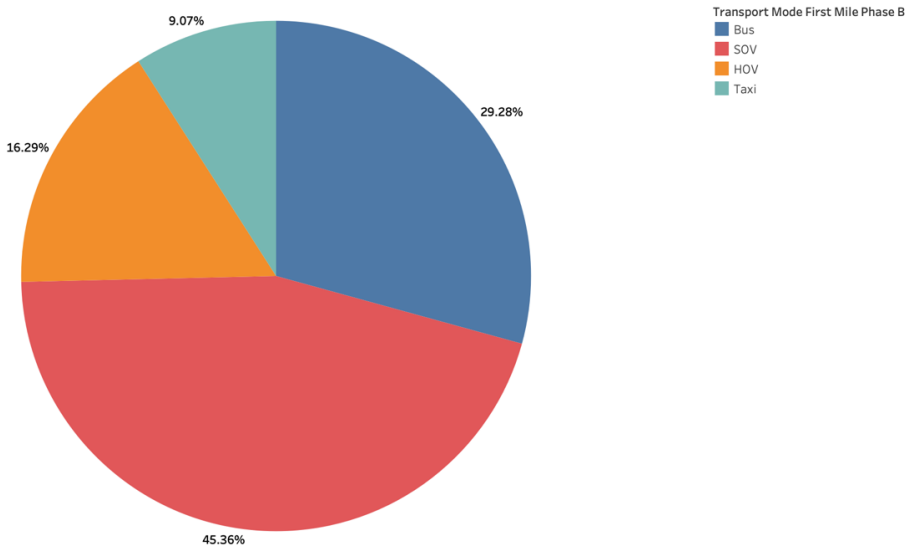

Figure 3: Transport Mode of First Mile trips

Regarding the last mile of their trip, 68% of the respondents continued their trip on foot while 18.4% continued by bus (Figure 4).

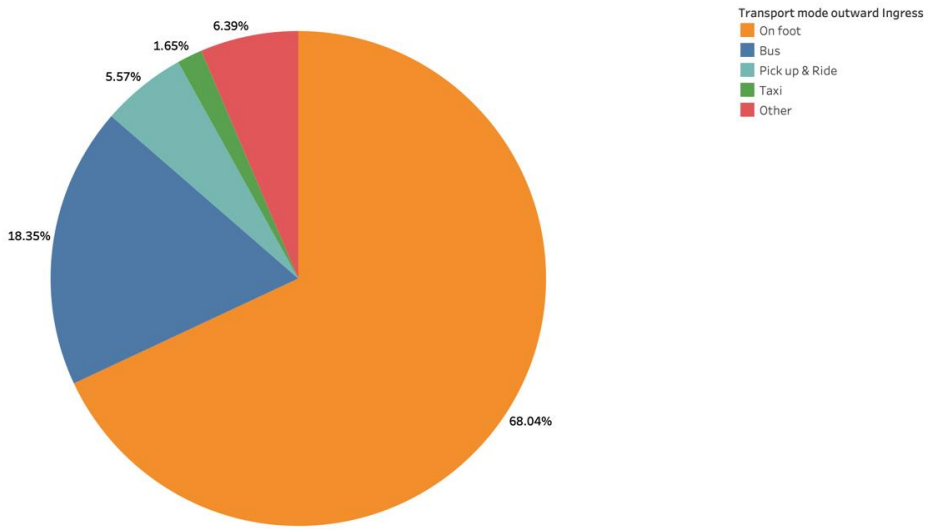

Figure 4: Transport Mode (Outward Engress)

To investigate the willingness of respondents to use ride-sharing as drivers or passengers, a series of game cards with different attribute levels were presented to them. More than 57% of the sample selected ride-sharing as a driver or a rider.

Figure 5 presents the mode choice per user type according to the current used transport mode for the first mile of their trip. Current bus users prefer mostly to continue using the bus rather than shifting to a ride-sharing option. On the contrary, taxi users prefer mostly to

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shift to ride-sharing as riders, while single occupancy vehicle or high occupancy vehicle drivers prefer ride-sharing as drivers.

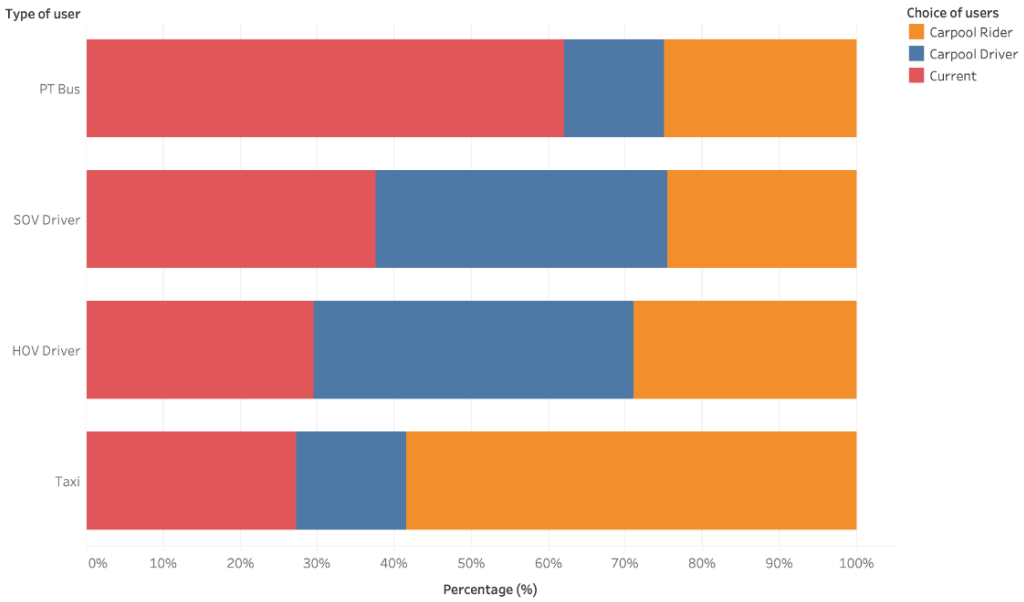

Figure 5: Choice of users per group

By applying the survey results it becomes possible to estimate the number of users who are willing to change their current travel mode to another mode, i.e., becoming ride-sharing drivers or riders for their trip segment home to metro/suburban rail station.

3.5 Incentives and participation

In the framework of the SP survey, two distinctive phases took place; during the 1st phase the screening of questionnaires at the stations took place (field survey) using Computer Assisted Personal Interview (CAPI) technique. Overall 5.400 persons were approached with 2.000 of them being found eligible to participate at the survey. During the 2nd phase, the full RP/SP survey was completed by the respondents at home or at work, using the Computer Assisted Web Interview (CAWI) technique. All in all, 1.250 agreed to proceed and 414 completed phase 2. Following, 406 respondents of those who completed phase 2, accepted to participate at the R2R Athens Demo by giving their email addresses. 406 invitations by email were sent to them on July 18th 2022, by Attiko Metro.

Following the SP experiment and after having sent the email, more than 100 users stated that they would be willing to participate at the Athens demo; the final number of participants however was lower, most probably because of the timing of the demo execution, which coincided with people's summer vacation (July and August are considered vacation period in Greece). This was a risk already taken into consideration in the planning phase, but unfortunately the demos'/project calendar did not allow any postponement or modification in the schedule, also due to the complex integration calendar on CFMs side, essential for allowing Ride2Rail partners to get a working and fully functioning Travel Companion.

It should be noted that, in addition to the dissemination strategy and the SP survey, the Athens demo partners provided specific incentives, in order to persuade identified users to

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participate in the Athens demo. More specifically, ride-sharing passengers were awarded a voucher of 30€ for groceries (supermarket), while drivers were awarded a 50€ voucher for gasoline. All incentives were provided by specific companies in Athens, where users could redeem them after the completion of the demo. The final figures describing the participants at the Athens demo are as follows:

- Number of registered users (travellers): **19**
- Number of registered users (drivers): **9**

As the demo week progressed, an email was sent to users asking them to fill in a survey and rate the ridesharing app they had been testing. The first email was sent on the 19th of July, with two more reminders following on July 22nd and on the 24th (2022). The participants agreeing to complete the survey were:

- Number of users that completed the survey: **17**

3.6 Conclusions

During the execution of the project, several challenges were faced. Firstly, the Stated Preference survey started on the 20th of June instead of the 29th of April 2021, as was initially planned. This 7-week delay was due to the time required for the design of a questionnaire that could be approved by Attiko Metro, a procedure that took much longer than it was initially anticipated. . However, this issue did not impact the demo as it did not interfere with the integrations' calendar and the demo schedule. During the completion of the main survey, an additional problem was identified and was the low number of trip makers falling into two specific categories.

- Trip makers using their private vehicle together with other riders.
- Trip makers who use a Taxi.

Regarding the execution of the survey, the most difficult issue was related to respondents' consent. The Lime survey platform did not provide such a feature and clicking on a box was not approved as adequate by the Attiko Metro Protection Officer. To overcome such issues, hard copy statements were also developed and distributed to respondents.

Coming to the actual demo, the main issues that were dealt with, along with the conclusions drawn are analysed in the following sections.

3.6.1 Planning of the demo

The Ride2Rail Demo was planned to take place in the beginning of July 2022. This choice was made in order to include, apart from local commuters, also tourists visiting Athens during the specific time period. This choice however, although informed, had an unexpected negative side effect on participation, which was the fact that July 2022 was a very hot month in Athens and this caused a general run to holidays. Moreover, the fact that the actual starting date of the demo was postponed from the 11th to the 18th of July, made the circumstances even less favourable for the participation of users. As mentioned in previous sections, there was a decrease in the number of actual demo participants, as compared to the number of participants that agreed during the SP to participate in the demo. For this reason, one of the main lessons learned is that it is of imperative importance to plan well in advance the time period during which the actual demo will take place. Implementing a demo during the summer and in general, during holiday seasons, should be avoided at all costs. This was taken into account for all other demos.

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Coming on to another issue related to planning, the time frame that was foreseen for the technical testing of the application was positioned one week before the actual demo. This proved to be less than needed, in terms of working days, plus having the testing week before the demo week led to the postponement and hence shortening of the demo execution (1 week instead of 2). The technical partners along with the demo leaders strenuously worked on optimising the application in a very short period of time and succeeded in having it ready in order for the demo to be executed properly. The lesson learnt however is that to be on the safe side, the technical testing should start at least 3 weeks before the demo and last for at least 2 weeks. This was taken into consideration but unfortunately often there was incompatibility with the CFMs integration calendar and not often it was possible to perform the internal testing more than 1 week before the demo start.

3.6.2 Allocation of responsibilities

During the testing of the application and to have it ready for the demo execution, one of the issues that arose was the fact that technical responsibilities were shared between members of the consortium and CFMs, the latter out of project control capabilities. Despite strong effort from consortium members in coordinating such actions, this objective complexity led to some misalignments between technical and operational activities that slowed down the testing process. For this reason, it is of significant importance to allocate well in advance responsible partners for each role, as well as at least 1-2 persons per partner as a contact point for each issue. This was taken into consideration for all the other demos, with the creation of a core demo team and the consequent reduction of massive interactions with CFMs involving many (often not relevant) actors.

3.6.3 Translation of the Travel Companion (TC)

During the preparation of the Travel Companion one of the issues that was extensively discussed was whether or not to translate the application in the local languages. The outcome of this discussion was that each demo leader, along with local participants, were left free to decide what best suited their pilot case. In the case of Athens, the local partners decided that it would be best to translate the app in Greek, given that some of the user groups targeted may not be familiar, to the extent needed, with the English language. Some of the main conclusions and lessons learnt through this process are listed below:

- The demo leader needs to decide if all the parts of the app, or no part at all will be translated. Having some parts translated and others only in English was confusing.
- The way to perform the translations needs to be revisited; some parts were not translated properly due to lack of context.
- It would be useful to have local names in local languages as well.

All the above have been taken into consideration as much as possible for all following demos.

3.6.4 Downloading of the Travel Companion (TC)

Two different tools have been used by testers in the demo: the Driver Companion and the Travel Companion. In case a user wished to participate as both a driver (offering rides) and

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as a traveller (taking rides), he or she needed to download two different applications, install and combine them. This procedure presupposed that the user had a quite high technological knowledge when it comes to installing and using apps. This however is not the case for the medium user targeted by the project demo. Another level of complication is given by the fact that the Travel Companion is an Android only application not downloadable from the Google Play store, but only via an .apk shared by the demo leader. This caused the demo leader to provide to the user all the necessary support to deal with the download of the app ans successfully complete it.

Moreover, each one of the systems (driver and traveller) was accompanied by a separate user guide, as well as a specific document including the Terms and Conditions to which the user provided consent to participate. It would be much more efficient and user friendly, if there was only one download requested, one user guide to go through and one T&C document to agree with.

3.6.5 Operational and Technical issues

Coming to the actual use of the application by the users, the main operational and/or technical issues that were noted and should be resolved in any future similar endeavours are listed below (these are strictly linked to the IP4 ecosystem itself, therefore are more targeted to CFMs, and largely communicated in different meetings. However, in most of the cases the carachteristics and the "nature" of the ecosystem did not allow all below points to be addressed as it would be optimal to):

- The addresses and POIs from other countries (also participating at the project and demos) need to either be erased or hidden during the time period of the demo in a particular city. It was somewhat confusing for users to identify an address through places from other countries.
- Using the available map was actually the easiest way to identify an origin or destination; related also to the above-mentioned issue.
- Loading of the request for a ride or for the provision of a ride took a lot of time in some cases.
- Ride offers from drivers were sometimes not matched to any traveller.
- The guidelines provided in the user guides were considered very complex in particular for non IT literate users, therefore the demo leader had to interact more strongly with some categories of people to instruct them properly.

3.6.6 Survey

During the execution of the demo and as described above, the users were asked to complete a survey in order to rate their overall satisfaction with the Travel Companion (TC). The survey was sent twice during the demo week and once at the end of it, reminding the users to participate.

Once completing the survey, the users were asked to send an email with a code depicted at the end of the survey in order to receive their incentive (voucher).

The main conclusion drawn from this procedure was that the survey should be automatically sent to the user immediately after the use of the app; It was observed that once the email

was sent, 3-5 users would enter the survey and complete it on the spot. This proves that, should the request for the participation in the survey had been sent at the end of the trip, the number of users actually completing the survey would have been much higher. This was taken into consideration for the other demos.

Coming to the code users were asked to send, this was in the form of XXX_Ride2Rail_Athens. Unfortunately, users were expecting a unique code to appear on their screen. For this reason, they didn't recognize the one sent and therefore in some cases didn't send back the email requesting the prize. This was taken into consideration in the other demos, leaving up to the demo leader to decide if the proposed format for the code was suitable or not.

3.6.7 Final conclusions

The overall execution of the Ride2Rail demo in Athens was a unique and very successful experience for all involved parties; CFMs, technical partners, demo leader, demo participants and users. It proved that the ridesharing concept is in general considered a viable solution, both as a stand-alone mode and as part of a multimodal trip, for transportation in urban and peri-urban areas.

In the sections above, the main lessons learnt from the execution of the Ride2Rail Demo in Athens were depicted. These are summarised below:

- Efficient planning of the demo is of imperative importance for its success. Holiday seasons should be avoided at any costs, while sufficient time should be foreseen for testing of the application, prior to it being made available to actual users.
- Clear responsibilities should be allocated to all involved parties throughout all the phases: development, testing, demo execution.
- Having the application translated in the local language is an added value and a facilitator of the demo's success. This however is true only in the case of a high quality, ideally professional, translation.
- It is essential that only one download is necessary, accompanied with one user guide and one document of Terms and Conditions to which the user needs to agree.
- No POIs from other cities being depicted, shorter loading time, efficient matching between driver and traveller and user-friendly guides are a few of the operational and technical issues that need to be resolved.
- A short and not the point survey, sent immediately after the user has finished using the app, ensures high participation in the evaluation and provision of high quality input.

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4 HELSINKI DEMO

4.1 Overview

Helsinki demo area generally consisted of the Helsinki Region Transport's (HSL), the public transport authority of Helsinki Region, area of operation depicted in Figure 6 below. The HSL area consists of Helsinki, Espoo, Vantaa, Kauniainen, Siuntio, Kirkkonummi, Sipoo, Kerava and Tuusula and is divided into four zones, identified by letters A, B, C and D, spreading out from the centre of Helsinki.

Figure 6: Helsinki Region Transport (HSL) area of operation [HSL area and zones 2022]

Part I of the demo was carried out specifically in East of Helsinki in zone B in Vuosaari where the testing of an automated shuttle bus took place in the autumn 2021. The route shown in Figure 7 was recommended by the traffic planners of the City of Helsinki and was chosen for the demo based on this and while recognizing it to be suitable for the bus. Part II, testing the Ride2Rail, functionalities, was not limited to a certain specific zone of the HSL area thus the activities of the demo and trips made by recruited test users could take place anywhere on the HSL area.

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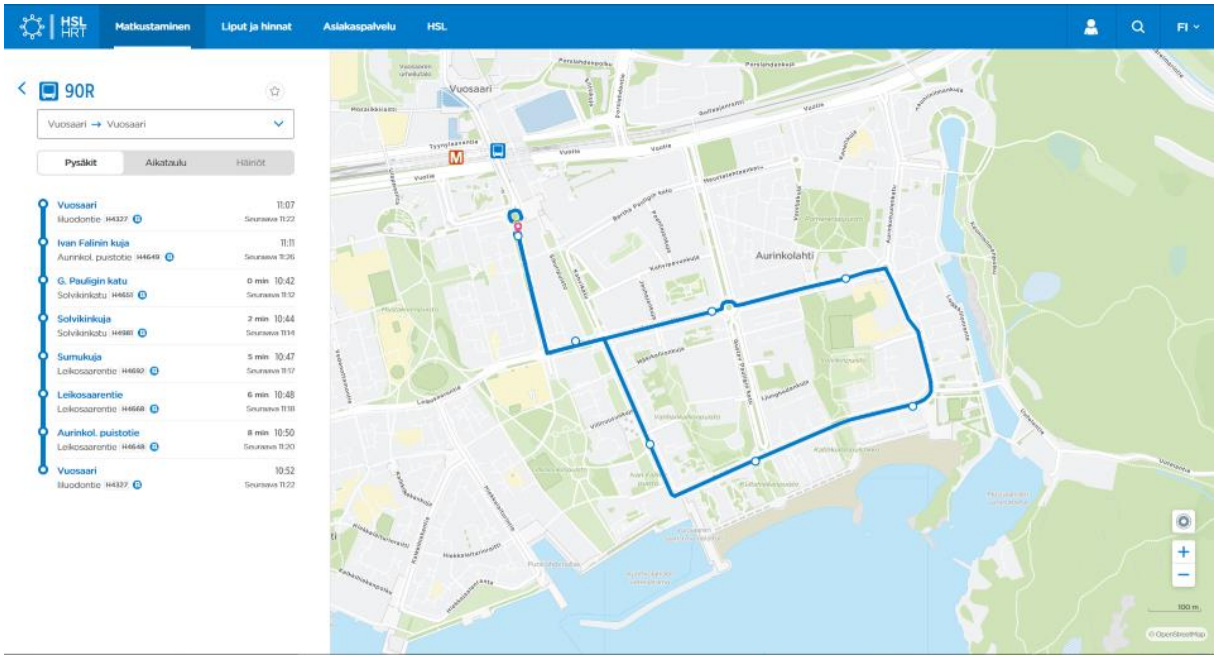

Figure 7: Route of the robobus 90R [Reittiopas 2021]

4.2 Goals

As described in Chapter 4.1 the Helsinki demo was separated in two different parts focusing on reducing single-occupant private car trips. More specifically the main expectations from Ride2Rail in case of Helsinki were:

- Improved connection with rural or peri-urban areas through ride-sharing and shared automated services
- Better access to rail and public transport as part of a multi-modal travel experience
- Reduced barriers to the use of shared modes of transport
- Develop, test and evaluate crowd-based travel services for the first time in Helsinki

Goal of the robobus demo was to research how well an automated bus could improve access between the metro station and the neighbourhood as well as offer an opportunity for developing automated shared vehicle solutions in road traffic. In particular the focus of the robobus demo was also to test for the first time in Helsinki the possibility of on demand calls of robobus operation as part of public transport.

The partners of the Ride2Rail project in Helsinki were particularly interested in testing ridesharing as a new mobility habit for users in the capital region of Helsinki. However, it may be that ridesharing as an alternative in the capital region with well-functioning public transport requires a longer period of time for testing and high-quality applications to facilitate the adoption of new mobility patterns.

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4.3 Facts

Activities for the demo were focused on both parts (Part I and II to be carried out in parallel. However as there were delays in the delivery of the applications to be used, and for this reason it was decided to proceed separately with the parts and implement first the robobus demo while also preparing for the second part of the demo which would take place in a later phase of the project.

4.3.1 Demo Part I - Robobus demo

Demo part I in Ride2Rail focused on testing the robobus (Figure 8) as part of a multi-modal last-mile journey, integrated in the HSL travel planning application (Reittiopas). This involved an approximately two months long demo where the bus operated on a regular route in Vuosaari between September 25th and November 17th 2021 for a fixed period of time per day. The bus was integrated in the HSL Reittiopas with line number 90R and was operated on public roads like a normal bus in the area among other traffic. The route (Figure 7) was approximately 2 km long, had 7 bus stops and was driven in one direction from Vuosaari metro station to the vicinity of the Aurinkolahti Beach.

Figure 8: Robobus 90R [Laitinen 2021]

Features of the robobobus, storage facility and safety operator

The robobus, Iseauto, and the service to operate it was delivered after a procurement in cooperation by an Estonian company Auve Tech and Finnish Roboride. Before the launch of

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the procurement negotiations were held with various potential suppliers. Most importantly before the procurement various aspects needed to be planned and agreed with different parties:

- Planning of the route in detail
- Demonstrating the route to potential suppliers
- Discussing the route with the city
- Discussing the route with HSL
- Informing and discussing with local transport safety agency (Traficom)
- Planning all necessary traffic arrangements and bus stops for the route
- Finding a storage and charging place for the bus near the route

The most difficult part was proven to be the finding of the storage and charging place for the bus near the route which eventually also delayed the procurement process and start of the demo. Without this facility it would have been basically impossible to carry out the demo as the bus would have needed to be transported away from the operational area every night for charging which would not have been viable. Luckily the facility was at last found by the parkingyard of the local Vuosaari Health station where also electricity was available through an electric pole which is usually used for preheating vehicles during cold seasons. However, a modification was needed for the pole to withstand higher currents needed for charging the bus. All in all, it was not optimal to have the bus stored outside due to possible vandalism, cold weather and poor maintenance possibilities. Some additional cover and reservation for the place was gained by having fences around the bus as seen in Figure 9.

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Figure 9: Robobus storage place at the Vuosaari Health Station [Rutanen 2021]

Testing automated vehicles in Finland is possible with a test plate certificate and test plates which are granted by the Finnish Transport and Communication Agency Traficom. Supplier of the robobus service was responsible for applying the certificate and plates. After receiving the plates (also seen in Figure 3) for the robobus it was possible to operate the vehicle among other road users on public roads. The plates were received just after the vehicle was transported to the demo area and when it was time to start teaching (mapping and programming) the vehicle to drive on the dedicated route.

Iseauto is an electric SAE Level 3 or 4 automated shuttle bus that is able to autonomously follow the route and stop on obstacles. Vehicle was occupied with an on-board safety operator throughout the demo who was also the driver in charge of the vehicle. The operators were holders of class B driver licence prior to the demo. Operators were trained in automated vehicles in general, handling the specific vehicle and interacting with passengers. Operation was started with a trial operation in which operators were guided to solo-operation of the service. Safety operator was responsible for supervision of the system and guiding passengers. Operator was also responsible that safety procedures were followed. Operator set the destination and the vehicle followed the pre-defined and programmed route. Operator supervised the vehicle and assisted in challenging situations that were typically roundabouts, crosswalks and unprotected left turns. The speed of the

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vehicle was limited to 20 km/h in the demo due to technical restraints of the automated system of the vehicle.

The bus had seats to accommodate a maximum of six persons plus two folding benches which were basically dedicated for the safety operator. Though the area of the folding benches were also the place where strolls or wheelchairs should be placed leaving very little space for other passengers and the safety operator.

Figure 10: Robobus interior [Rutanen 2021]

Operational details and traffic arrangements

After the contract and before launch of the demo operational details were agreed with Roboride and Auve Tech. This included:

- Operational schedule of the bus
- Integration to HSL systems
- Service level and reporting of deviations in operation schedule
- Communication methods
- Data that should be collected
- Handling of personal data
- Traffic arrangements on site
- Charging and storing the bus
- Vehicle delivery and launch of the demo

In the beginning it was decided that the robobus would operate in scheduled mode between Monday and Friday in total 8 hours per day from 8:00-12:00 and from 16:00-20:00. Due to insufficient battery capacity (16 kWh) and despite the battery charging pause between the service hours, the schedule mode service hours were reduced by 2 hours to 9:00-12:00 and

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16:00-19:00 from 10.11.2021 onwards. The on-demand mode, where passengers could call the bus to a predefined bus stop by using a web based application, was used on weekends from 9:00-12:00 and 15:00-18:00.

The actual preparation and activities during the demo were broadly:

- Implementation of traffic arrangements
- Preparing the charging/storing facility
- Transport of the vehicle to pilot site
- Mapping of the route
- Programming of the route
- Operator training
- Integration with HSL route planner
- Operating the vehicle
- Monitoring the operation and reporting deviations

Some of the robobus's bus stops were located on regular HSL bus line stops but also new bus stops were established and used only for the purpose of the robobus. These bus stops were located on roadside parking places which needed to be reserved with specific temporary traffic arrangements to make them more visible to other road users and to prevent others parking their vehicles on these specific places which would hamper the operation of the robobus. This included yellow paintings as seen in Figure 11. Also bus stop signs were placed on every robobus bus stop and some of them was mounted on a regular HSL bus stop pole as seen in Figure 12 whereas some of the signs were placed on temporary stands.

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Figure 11: Traffic arrangement for the reservation of robobus bus stop [Rutanen 2021]

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Figure 12: Ride2Rail robobus bus stop sign mounted on regular HSL bus stop pole [Rutanen 2021]

Some challenges were encountered during the setup phase of the demo as a roadwork (Figure 13) began simultaneously when it was time to start the programming of the route. Mapping of the route, where the bus collects data of the surrounding environment and produces a precise map which the bus uses for navigation, had been completed earlier. After the mapping the trajectory (driving line) on where the bus actually drove was fine-tuned during the programming while also adjusting the speeds and behaviour in intersections on certain road sections. During both mapping and programming as well as after these phases it would be important that the environment stays unchanged but the roadwork caused some issues and delayed the start of the demo for some days.

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Figure 13: Roadwork on the robobus's route

Preparation of the operation included also discussions with HSL to ensure compatibility of schedules with lines 90 and 560 which were partly operating on the same route with the robobus.

Operation of the robobus and passenger feedback

Operation of the robobus started on 25th September 2021 on which day also passengers could hop on in the bus. Despite the fact that the demo had to be carried out during autumn rather than in the summer, which would have been preferable as the bus could have attracted people who were going to the Aurinkolahti beach, the operation of the robobus gathered vast interest with the total number of passengers being 1.112. During the evening shift from 4 to 8 PM there was often a situation that people could not enter because of space restrictions.

On-demand service provided at weekends was also used by the passengers. Approximately one third of the rides at times of on-demand service were ordered via Roboride's web-application seen in Figure 14. There were in total 104 on demand calls via the web application. As there was an onboard safety operator inside the bus, it was also possible that the operator stopped the bus on bus stops and took passengers onboard without an actual call.

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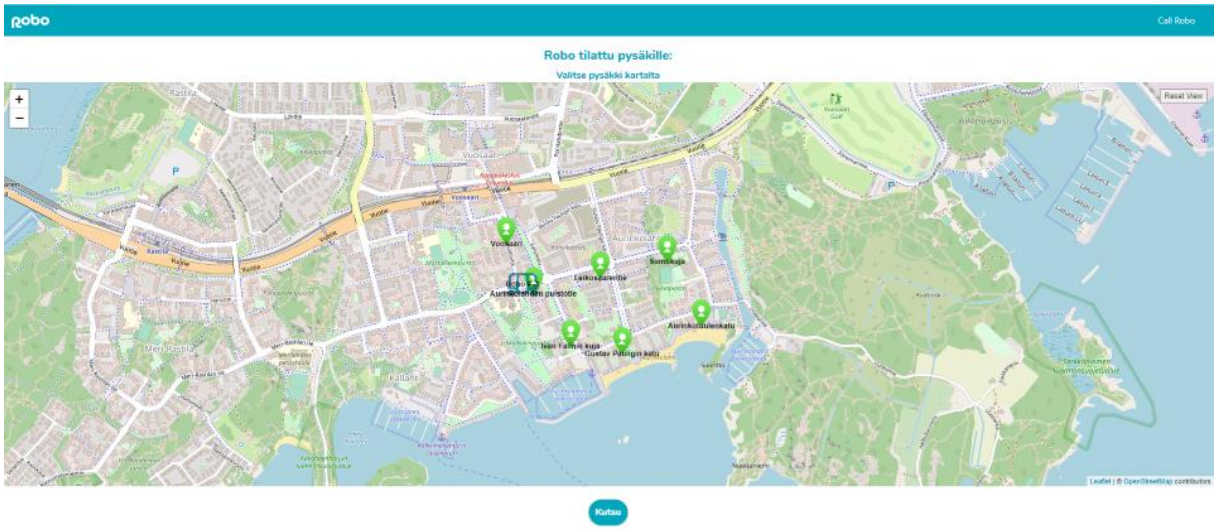

Figure 14: Roboride's on-demand web-application

Feedback on the service was mainly positive. People were happy to use the bus even if there were technical problems such as sudden brakings. Top feedback throughout the trial:

- Service is easy to use, comfortable and convenient.
- Smooth rides.
- Vehicle should be bigger.
- Service hours should be extended.

Other feedback:

- People ask how long it will last and when it will come back.
- Large group tried to fit in with a stroller and could not fit in. Disappointed.
- Should be also available at summertime when there is more traffic.
- Door open button could have a label. Passengers sometimes use it to stop the bus.
- Cannot find stops. Vuosaari stop is particularly problematic. People try to find it at the bus yard.
- Sometimes rough overtakes in roundabout by other traffic.
- Many remember the previous trial 2 years ago and say there has been great progress.
- Has additional stops compared to line 90 which is good.
- 3rd screen could have info for passengers: Next stop + time. Same as regular buses.
- One passenger did not find all the information in one place. Scattered around websites. Could be in one site.
- Some passengers are sceptical. Do not want to board.
- One driver stopped behind the bus and gave negative feedback by yelling.
- Solvikinkuja parking spot (which were reserved for the robobus demo) used by elderly people in area with scarce parking space in summertime.

Vehicle had conservative obstacle detection to be able proceed autonomously, which led to sudden brakings in some situations, for instance when joining and exiting a roundabout, joining traffic from a bus stop or crossing a crosswalk. Operator used obstacle detection

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override to prevent sudden braking and obstacles in the way could be passed by operator-triggered automated passing feature or manual steering. Operator also used cameras as driving aids and manual control to assist the automation. Challenging situations for the automation and solutions to overcome these situations are described in Table 7.

Situation	Challenges in automation	Sulution used
Joining & exiting roundabout	Sudden braking if autonomous	Obstacle detection override
Unprotected left turn (from liluodontie to Leikosaarentie)	-	Autonomous driving
Joining traffic from a stop on the lane	-	Autonomous driving
Joining traffic from a pocket stop	Sudden braking if autonomous	Timing of departure by operator
Crossing a crosswalk	Sudden braking if autonomous	Obstacle detection override
Passing an obstacle (e.g. parked car)	Passing autonomously did not always work	Automated passing Manual steering

Table 7: Challenging situations for the automation

Operators found the tasks meaningful. Their tasks consisted of vehicle management, troubleshooting and interacting with users of the service which also still refers to the need for an onboard safety driver with this level of automation.

The robobus operated within the demo site the entire duration of the demo and therefore the environment can be deemed as suitable for the vehicle. However, the automation level needs improvements to operate without an onboard safety operator. In addition there were some service brakes listed in Table 8.

Time	Effect on service	Reason
09.10 19:00-20:00	3 missed departures	Software update
24.10 09:00-10:00	1 hour on-demand lost	Door froze
27.10 08:00-09:00	3 missed departures	Connectivity issue

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03.11 19:00-20:00	3 missed departures	Battery ran out
04.11 08:00-12:00	12 missed departures	Charger issue
04.11 16:00-17:00	3 missed departures	Computer issue
07.11 08:00-12:00	12 missed departures	Charger issue
08.11 09:00- 10.11 21:00	57 missed departures	Accident (with no consequences), roll out of a replacement vehicle
17.11 19:00- 20.11 18:00	39 missed departures 12 hours on-demand lost	Accident (with no consequences), no time to investigate & conduct checks to continue (end of agreed demo duration)

Table 8: Service breaks

Out of in total 954 planned departures (from the first bus stop according to the schedule) 132 departures were missed due to reasons listed in Table 5. This means that approximately 14 % of the planned departures were not realised. This indicates both the lack in the operational conditions as well as available technology. More precisely:

- Operating in general under pilot conditions.
- No official maintenance and storing facilities for the vehicle(s) and local technical personnel.
- Only one vehicle in use (no replacement vehicle).
- No resources of an official public transport operator.
- Using a pilot vehicle with unfinished technology and with test plates as no validated and type approved automated vehicles exists.

4.3.2 Demo part II - Testing the Ride2Rail functionalities

The second part of the Helsinki demo was about testing the Ride2Rail functionalities, as much as possible integrated with existing mobility platforms (e.g. public transport route-planner). The main purpose of the demo was to test the ride-sharing functionality created in the Ride2Rail project together with the Travel/Driver Companion application.

The Helsinki demo team first created an engagement strategy for the planning of the demo followed by its execution. Prior to the demo, the Helsinki team kept regular contact with the local transport service provider HSL with regards to its OpenMaas API and its sandbox environment that was used in the project. The overall integration to the HSL OpenMaaS API sandbox environment worked well and the demo execution was possible. However, due to numerous limitations in the technical features of the TC and DC apps the testing was conducted internally within a focus group organized/coordinated by Helsinki demo actors.

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The main reason was that at the moment of the user engagement strategy creation, it was unclear when the apps would be ready for internal testing and how they would have worked. Therefore, it was decided to only have an internal testing of the applications combined with test users from a Metropolia course on smart mobility.

The Helsinki team created an engagement strategy that included a detailed description of the activities related to the testing of the two applications in Helsinki. As planned in the engagement strategy, a local event was organised on 19 September 2022 for appr. 50 persons to recruit test users from the students of Metropolia University of Applied Science. Unfortunately, despite several reminders to participate in the testing, none of the students signed up to test the applications as part of the demo.

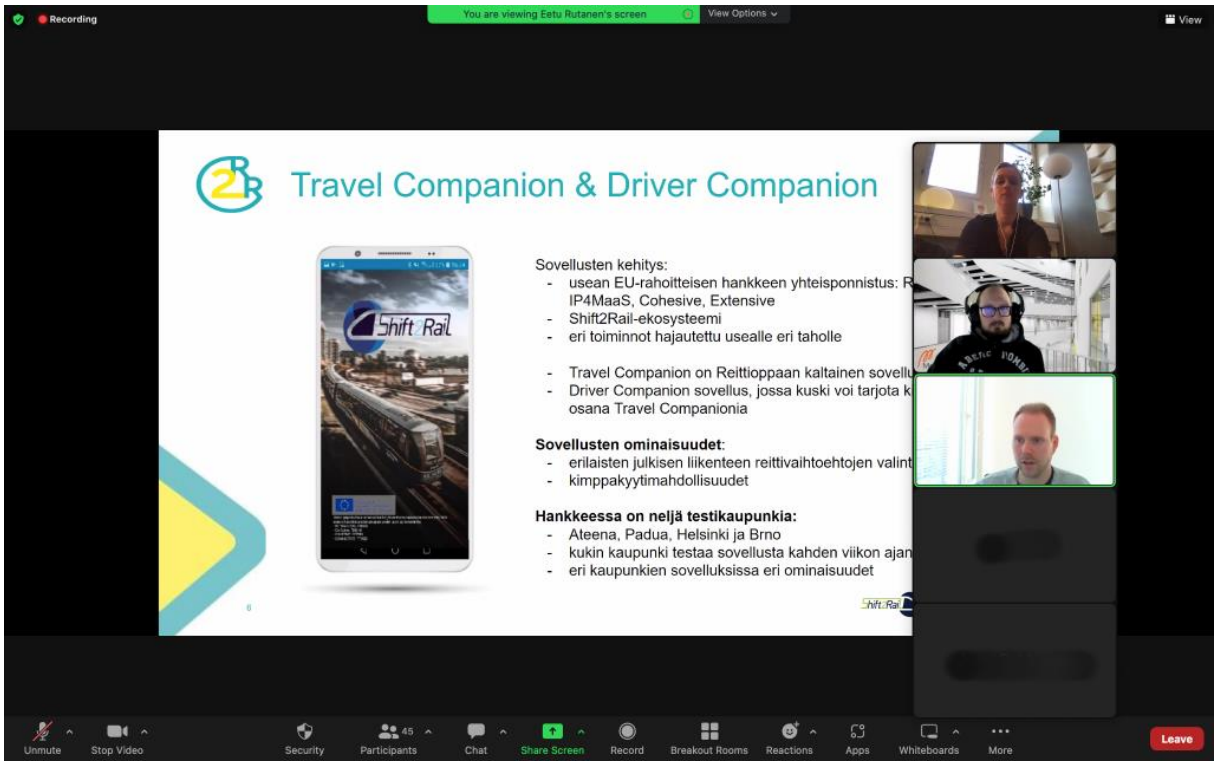

Figure 15: Online local event with 50 participants

Eventually a total of 20 test users were found. In order to have more test users, it would be useful to have the applications ready well before the start of the demo in order to instruct the demo team and allow them to get more familiar with the tools in advance. This would also help a better engagement strategy. The applications were available for the first time for internal testing a week before the start of the demo with several technical issues to be solved and reported to CFMs.

The applications were tested for two weeks in Helsinki on 3 - 16 October 2022.

Before the start of the demo, the Helsinki team customised the Travel Companion manual. In the end, the manual was not distributed to the test users for several reasons. First, the applications should be self-explanatory in a way that a user does not need a manual to be able to use an application. Also, the content of the manual did not bring added value to

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the testing, since it did not clearly explain different functionalities and how to use them. Instructions and guidelines have been given directly by the demo team.

In Ride2Rail, considering the nature of the ecosystem and GDPR potential risks, it was decided to provide to all participants a set of pre-defined anonymous credentials, as the management of "real" credential would have introduced additional complexity in data security in a so complex IT environment involving component developed by consortium members and by external entities (i.e. CFMs). Indeed, this choice facilitated the management of data and the compliance with GDPR but ideally it would be possible, as an improvement of the Travel Companion tool, to allow people to register with their real email and names.

The Helsinki team provided the application developers/CFMs with requested files (ex. GeoJSON) and links to the HSL Open Maas API environment as well as examples of routes for the testing of the application. Also, the team carried out a lot of internal testing of the applications and reported problems through the Mantis platform and Issue Log excel sheet which were used for the management of the issues.

As a part of preparing for the demo, the Helsinki team took part in the WP3 and WP4 meetings of the project as well as the Consortium Meeting. Dissemination activities took place, for instance, in the Stakeholders' Workshop in Karlsruhe, the Transferability Workshop in Paris in November (online) and the Smart City World Expo in Barcelona in November 2022.

Once the internal testing was done and the demo period started, the Helsinki team had regular communication with the test users: sending the above mentioned pre defined set of credentials and instructions on how to use the apps, reminders for testing and finally the survey. Also, the team created ad-hoc ridesharing options in the DC for the test users to see if they can find and book them on TC.

In October, the Helsinki team was able to carry out the testing of the two applications as planned. There were a total of 22 downloads for the TC application and 7 for DC. 17 people answered the survey after testing.

The functionalities used in the Helsinki demo were:

- navigation
- journey planner
- trip tracking
- group travelling

The following functionalities were originally planned but not used because of the HSL sandbox environment

- issuing
- validation
- inspection

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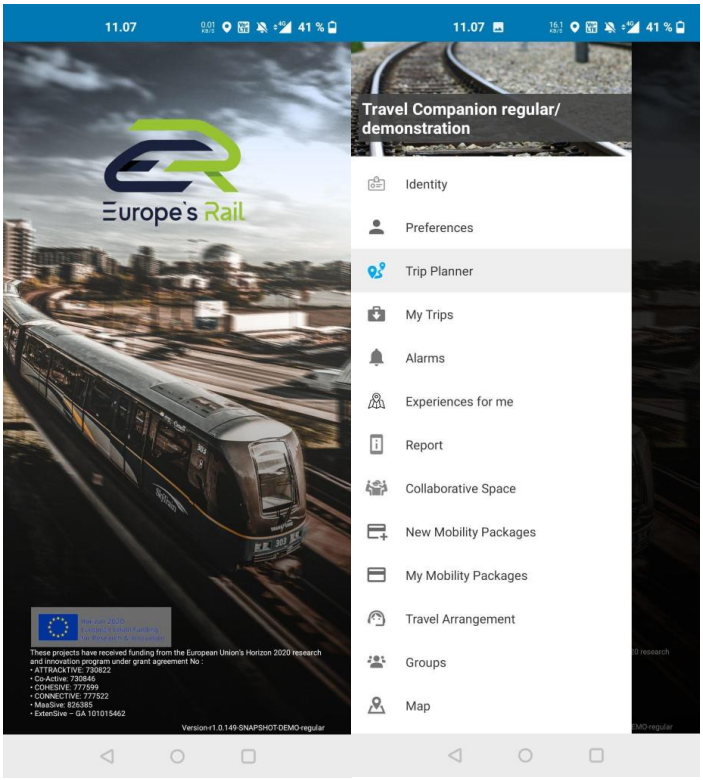

Figure 16: Travel Companion app

4.4 Conclusions

Part I of the Helsinki demo focused on testing the use of an automated shuttle bus (robobus) as part of a multi-modal last-mile journey, integrated in HSL travel planning applications. The demo was successful in the sense that a robobus was able to operate in the defined area in Helsinki Aurinkolahti and provide a complementary mobility service to passengers during the two-month demo period.

During the demo the safety operator had to regularly assist the vehicle in various situations which indicates that the automation should be developed further to operate the vehicle without an onboard safety operator. Design of the vehicle, operational models of the service and related remote functions should be developed further as well. The vehicle should operate at higher speeds and the reliability should be improved. However, it seems that people really appreciated and were very satisfied of the service and feel confident to use it. Though it must be noted that there was still an onboard safety operator which passengers could rely on (important to make people feel safer). Overall, the experience can be defined very successful considering the feedback received and the number of people that hopped on the bus.

Applying the permit for automated vehicle testing took longer than anticipated and pre-trial planning & roll-out needs to be allocated more time. Setting up autonomous service requires lots of work. Bus stops were not installed before operation started which caused confusion.

Site should be fully ready before rollout. Indoor storage facilities would extend the operation times as it makes the vehicle more energy-efficient.

Development of automated public transport has been somewhat slower than was anticipated a few years ago and there are still no valid service options to be adopted by public transport authorities or operators and to be integrated officially as part of public transport operation. There are still several aspects which need to be developed further. Demonstration should focus more on the technical development of the vehicles and related remote services. Transporting passengers should be a secondary objective or not an objective at all as it is generally slowing down the development while part of the effort has to be then focused on offering a service. Of course, it is important to involve the users in the development to maintain inclusiveness. But in several cases related to automated public transport, a model can be taken from already existing well working public transport services and vehicles.

After the preparation period, the Helsinki demo Part II started on time and applications worked for the two weeks. Reported problems were solved promptly. The demo team received support from the WP4 leader and CFMs when reporting technical issues in the internal testing phase prior to the actual demo. Also, the use of the HSL OpenMaaS API worked well, even though some results changed when shown in the TC. At times, the apps gave peculiar routes and results (ex. TC assumed that there's a private car waiting at the end of the journey which is not the case for most of the travels searched from the applications). Also, the TC showed routes that do not exist and that don't have a name (unknown line to unknown destination) or suggested waiting times of up to 6 hours. It was unclear at which point of the process the routes retrieved from the HSL OpenMaas API changed in a way that the suggested route was no longer logical or the TC suggested a route that does not exist. All these issues have been reported to CFMs who worked on the improvement/correction of the app.

Ridesharing means a change of mobility habits and therefore two weeks was a very short time to test it. Also, having enough users to suggest shared rides in the applications would have been needed to have real experiences on ride-sharing.

Ridesharing cannot be done anonymously. Ridesharing is very much based on trust, when stepping into the car of an unknown person and taking the journey with him or her. Trust is related to security on the way, but also just being able to be sure that the other person shows up and is not late. When trust and security is missing, ridesharing is not a viable alternative to public transport. In the Driver Companion, it was not possible to make changes in the offered rides or to cancel them. Because of GDPR, it was impossible to establish a communication between the passenger and the driver. Also, because of having anonymous drivers and passengers, they had no possibility to recognise one another or to communicate with each other beforehand. The applications knew the users' locations, but did not share them with the driver/passenger. As a lesson learnt, it is important to allow users to use their real names and to communicate. For this to be possible, the ecosystem need to be changed to be fully GDPR compliant. This was communicated to CFMs.

In the demo, the two applications were separate. It was not convenient that the apps were only available for Android phones and they had to be downloaded through a link and not from the app store. This was a feature that most likely made finding test users more difficult. Also, having the DC as a feature of the TC would make the use of the applications and the ridesharing functionality easier. Similarly as per other issues, this was largely known and unfortunately it was not possible, on Ride2Rail side, to do nothing, as a modification is needed on the IP4 ecosystem side to make the download and the utilization of the TC more easy for all categories of users.

One of the main findings in the demo was that much more emphasis should have been put on user experience in the development of the apps: vocabulary and logic of the apps is considered by some users hard to understand. Some test users reported that they did not understand certain keywords and features of the applications. For instance, the ridesharing option was marked as “cbtsp-two” which is not understandable to users. Also, the meanings of words like collaborative space, tracking, PRM type, single pass BC, gis-car-tsp, trip tracking, experiences for me: phone/glasses were unclear to users. It was not clear what was meant by “Ride2Rail score” which apparently prioritised some routes over others. As already mentioned, the user guides (sometimes complex) needed to be integrated by the work of demo leader supported by demo actors, who had to properly train the users and prepare them to the demo.

Some of the observations made by test users were (the vast majority is addressed to CFMs/developers of the IP4 ecosystem, as it specifically concerns the main carachteristics of the Travel Companion and the ecosystem in which it is developed – it is important to mention once again that all the below have been reported to CFMs in the different meetings organized):

- A shared ride was always longer in time and distance than a route by private car.
- No possibility to change or cancel a booked ride in TC.
- No notification if the offered ride is fully booked (either for the driver or passenger) or if the ride is cancelled by the driver. And the offered ride is still visible in the TC even though it is fully booked.
- Maximum available seats in a car limited to 2 and the number of seats does not change when booking rides in the car.
- No possibility to conversate between driver and rider.
- Past trip doesn’t disappear from the app when the timeframe has passed.
- Sometimes metro lines are marked as “unknown line” to “unknown direction name”.
- The user always needs to login to the app when opening it.
- The app puts some of the street names automatically in Swedish though they are written in Finnish.
- Location of the Collaborative Space is in Portugal and “Identity” in Spain.

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The following suggestions are proposed to improve the apps (the below can be considered for a future experience, keeping into consideration what the ecosystem, the maturity of the apps and the features of the available technologies can allow):

- Communication possibility between the driver and passenger.
- Possibility to manage preferences of the drivers car, including available seats.
- Possibility to cancel a booked ride.
- Updating the amount of available seats (taking into account reserved seats).
- Focus on the vocabulary of the apps (e.g. cbtsp-tw, gis-car-tsp) and make them more clear to users.
- Focus on an intuitive user interface that is self-explanatory.
- Allow people to register using their real names and emails.

All the above have been taken into consideration for the further releases of the app, of course when possible considering the unavoidable limitations of the ecosystem and the requirements for being properly integrated in it. Collaboration with CFMs was established and kept ongoing at all stages of demo preparation and execution, with lessons learnt communicated in multiple occasions and used as a baseline for improving the tool, as an iterative process requires.
As a general conclusive comment, the Helsinki demo team would have needed more time for testing the applications before the demo period, since the test users needed help in understanding how the applications work. This has been already mentioned above in the chapter. Unfortunately, the calendar of demo, the calendar of integrations on CFM side and the schedule of the project did not make possible to extend the demo period, despite it would have been optimal to monitor the utilization of the tools on a longer basis and with people getting progressively more and more familiar, and also to address the issues with a higher level of punctuality and efficiency. A higher effort was asked to the demo leader to provide support to the users while encountering issues with the app utilization and in general instructing them.

Finally, some test users found some survey questions very detailed for a period of “only” two weeks of testing, however it was unavoidable as the timing of the demo was well known and the survey is providing many information for the demo evaluation.

Despite the issues reported above, the overall feeling was positive in the context of a research project such Ride2Rail. In particular, the overall goal of the project and the tools develop constitute a very interesting concept with a very high potential to be further exploited, via the constant improvement of the tools (and all comments reported have been taken into account for the new app releases, of course considering what was possible to implement by the nature of the ecosystem, its features, its rigidities and its constituting elements). To address one of the lessons learned from the first two demos, training sessions have been organized by the demo leaders in the following project demos, to better instruct users, avoiding complex and re-iterative communication and simplifying the user guides to make the user experience more clear and easy.

5 BRNO DEMO

A seamless experience of multimodal travel is a key to promote the modal shift towards public and shared mobility and promoting a sustainable mobility. To achieve this, customers need to feel in control of their own trip and public transport needs to be easy to use and flexible as possible. The availability of services at user fingertips and when they are needed is essential for urban mobility as well as for extra-urban and city-to-city connections.
To verify how and where the Ride2Rail project can ensure the achievement of these goals, Brno demo was focused on travellers commuting from the Znojmo district to the city of Brno.

5.1 Overview

Thanks to investments in the development of infrastructure, several transport local hubs were built or reconstructed in the South-Moravian region. The commuters use these transport hubs for travelling to work, school etc. in the city of Brno. For this reason, three groups of the testers have been identified:

- employees commuting to Brno regularly/several times per week
- students commuting to Brno regularly/several times per week
- other commuters travelling to Brno for other reasons (e.g. to Brno's hospitals)

As written above, this demo focused on commuting from the Znojmo district to the city of Brno (see Figure 17). According to the statistics from the above-mentioned district, up to 4.000 commuters travel to Brno every day. Approximately half of them commute to Brno by public transport and half of them commute to Brno by their own cars. One of the goals of this demo site was to motivate these commuters to travel by car from their homes to a public transport hub, where they transfer to any of the means of public transport. As already mentioned, new transport terminals including parking spaces were built in easy-to-travel areas and this allows commuters to change the mode of transport (from private car to public transport) easily and conveniently. Thanks to the statistics it was possible to find out that most of these commuters travel alone, each in a separate car. For this reason, another specific challenge of the Brno demo was to encourage such so called "solo" car drivers to share the capacity of their cars with other travellers.

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Figure 17: Demonstration scenario between Znojmo – Brno

5.2 Brno demo phases

Many tasks had to be done before, during and after Brno demo execution. All activities are displayed in the Figure 18. In particular, Brno pilot contained three phases. The first phase was the preparatory phase, the second one was the execution phase and the third one was the evaluation phase.

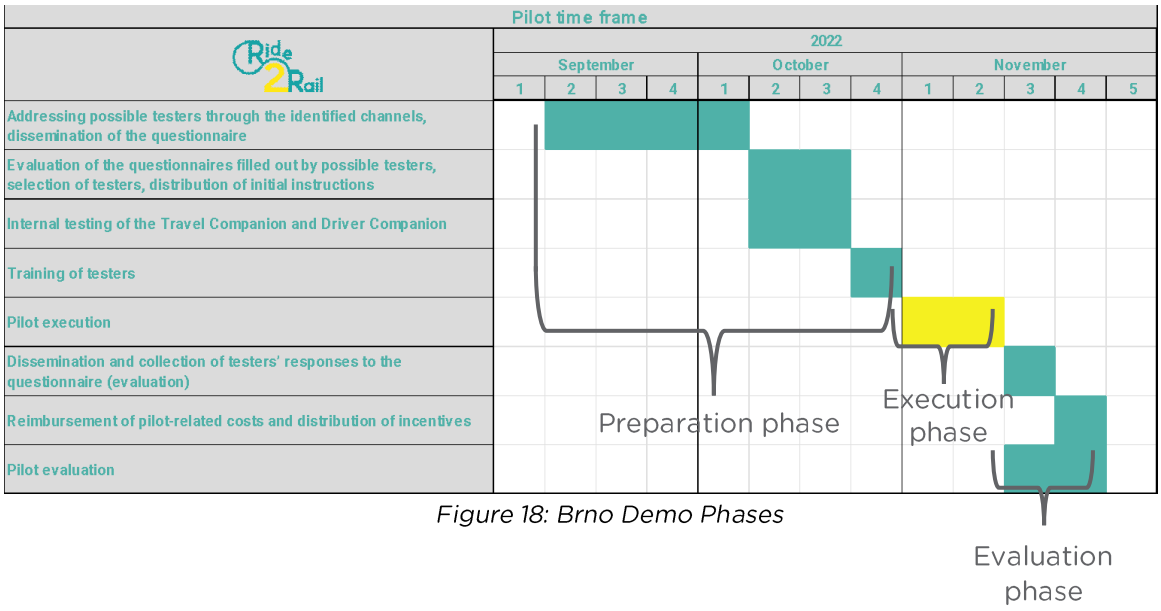

Figure 18: Brno Demo Phases

The preparation phase lasted for 7 weeks and it consisted of following activities:

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- Responsible partners addressed possible testers and disseminated the questionnaire through identified channels, e.g., leaflets in the vehicles with the monitors, social media, websites. This activity started 7 weeks before the demo execution, and it lasted 4 weeks;
- The evaluation of questionnaires, selection of testers and distribution of the basic instructions to the selected testers started 3 weeks before Brno demo execution and these activities lasted 2 weeks;
- Internal testing of the Travel Companion and the Driver Companion apps and preparation of tutorial videos, materials and presentation for online training session started three weeks before the demo execution;
- The training of selected testers started immediately before Brno pilot execution. After this training session, the responsible partners sent the detailed instructions, the tutorial videos, the presentation, the user guides and the templates of the daily report to the testers. This activity started one week before the demo execution.

The **execution phase** lasted 2 weeks. During this phase, the testers tested both applications. The responsible partners were in touch with testers, monitored the progress of the pilot during the whole execution phase, if any problems/issues occurred. For this reason, the testers received the contact details of the responsible partner/person.

The activities after the demo execution were included within the **evaluation phase**. Following activities were completed:

- The partners disseminated the final survey to the testers immediately after the demo execution.
- After completed collection of the final survey from the testers, the responsible partner provided the incentives (vouchers) to the testers. This activity started one week after the demo execution, and it lasted 1 week.
- The overall demo evaluation started immediately after the pilot execution. The overall evaluation lasted 2 weeks, and it was the last activity related to Brno demo.

5.3 Goals

The goals of the demo were:

- To motivate commuters who had only travelled by cars so far to start travelling by car from their home only to a public transport hub, where they transfer to public transport.
- To encourage those car drivers who travelled alone to share the capacity of their car with other travellers.
- To reduce GHG emissions and also traffic and parking congestions.

Defined KPIs were intended to ensure the achievement of these goals. Defined KPIs related to Brno demo are described in Figure 19. For example, KPI 1 shows that 200 testers should have been involved in the Brno demo. However, the COVID-19 changed the situation and travellers' habits have been changed and it was difficult to reach this KPI. Due to COVID-19, travellers are no more willing to share their rides because they are afraid to travel with strangers. The thresholds have been then set at 50% of the target values.

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KPI	Initial KPIs	50% KPIs
KPI#1 Number of Ride2Rail app users	200	100
KPI#2 Number of completed Ride2Rail app trips	4000	2000
KPI#3 Number of completed multi-occupancy vehicle trips with Ride2Rail app	800	400
KPI#4 Number of completed trips involving public transit/rail with Ride2Rail app	100	50
KPI#5 Number of completed commuter trips with Ride2Rail app	40	20
KPI#6 Number of completed rural trips with Ride2Rail app	4000	2000
KPI#B1 Reduction of need for parking spaces	20	10
KPI#B2 Number of surveyed users attracted to Ride2Rail app	60	30
TARGET Reduction of CO2 (kg)	3400	1700

Figure 19: KPIs for Brno demo site

5.4 Facts

This chapter contains all the values and outputs that were achieved during Brno demo execution. These outputs are graphically processed and divided into 3 subchapters. The first subchapter describes general information about the testers and their assigned role/s. The second subchapter focuses on specific testing data. The third subchapter deals with the testers' perception of the IP4 and Ride2Rail solutions (Travel Companion and Driver Companion).

It is also very important to note for this chapter that within Brno demo, the testers were assigned to one of three roles:

- if they were only testing the Travel Companion app, they represented the role of the **passenger**,
- if they were only tested the Driver Companion app, they represented the role of the **driver**,
- if they were testing both applications, they represented both the **passenger** and the **driver** role.

5.4.1 General information about testers

A total of 60 testers took part in Brno testing. The largest group were men and the detailed distribution of the testers by gender is shown in the figure below.

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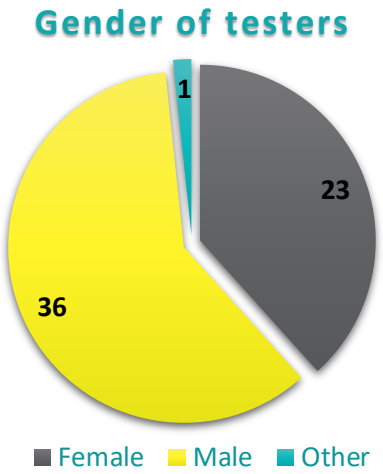

Figure 20: Distribution of testers by gender

The majority of testers' agewas between 22 and 35;fewest testers were between the ages 56 and 65. The detailed distribution of the testers according to age structure is available in the figure below.

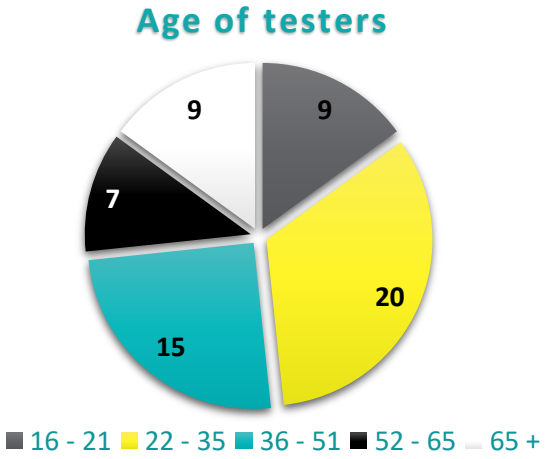

Figure 21: Distribution of testers by age

There were 36 employed testers within Brno demo, the second largest group consisted of the students (13 testers), the third group consisted of the unemployed (9 testers) and 1 tester was retired.

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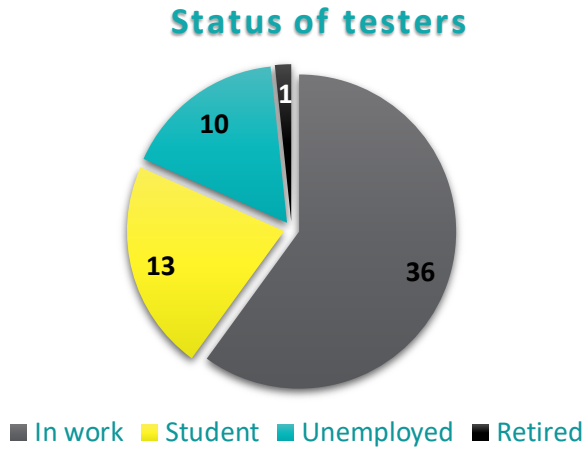

Figure 22: Distribution of testers by status

The testers had the option of testing the applications Travel Companion and Driver Companion separately or both applications simultaneously. Most of the testers performed the passenger role (tested only the Travel Companion). Many testers performed both roles (tested both apps). The smallest group of testers were testers who represented the role of the driver (tested only the Driver Companion).

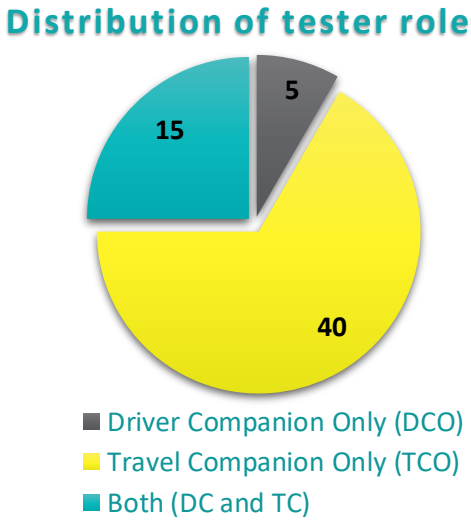

Figure 23: Distribution of testers by role

5.4.2 Specific data

As part of the Brno demo, a total of 1.946 rides were made, from which 76 rides were shared rides offered by drivers via the Driver Companion. The graph below shows that the most rides were made on 7.11. and 8.11. (Monday and Tuesday), when the testers made a total of 222 rides per each day. On the contrary, the fewest rides were recorded on 6.11. (Sunday) during which 29 rides were made.

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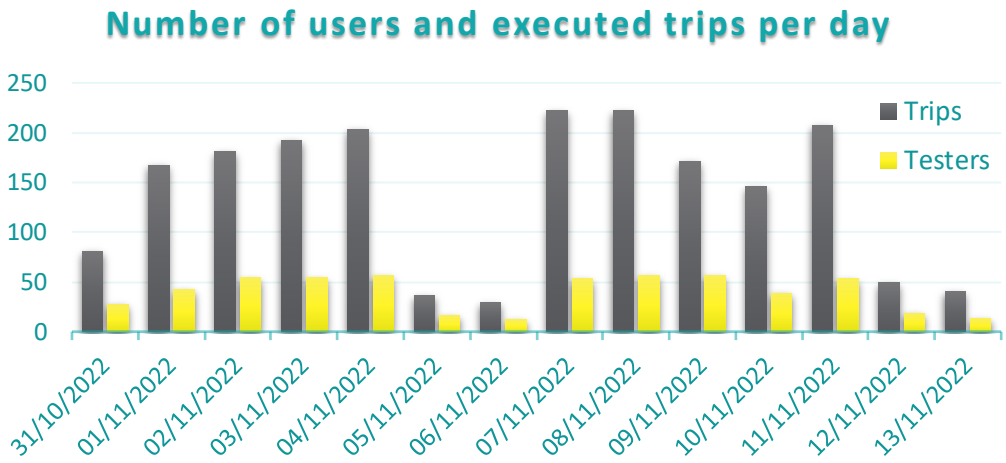

Figure 24: Distribution of executed trips per day

The graph below represents the number of trips and their characteristics that were made by testers using only the Travel Companion app, i.e., representing the role of the passenger.

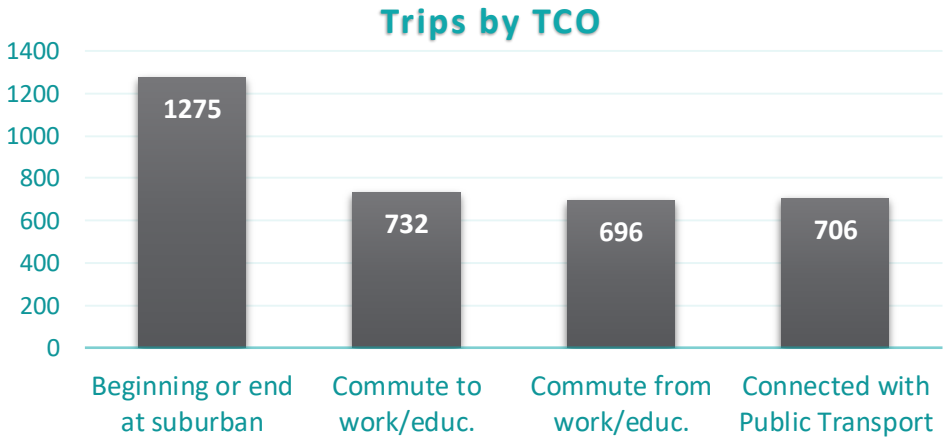

Figure 25: Distribution of executed trips per day

The number of trips and their characteristics that were performed by testers using only the Driver Companion application and representing the driver role are shown in the graph below.

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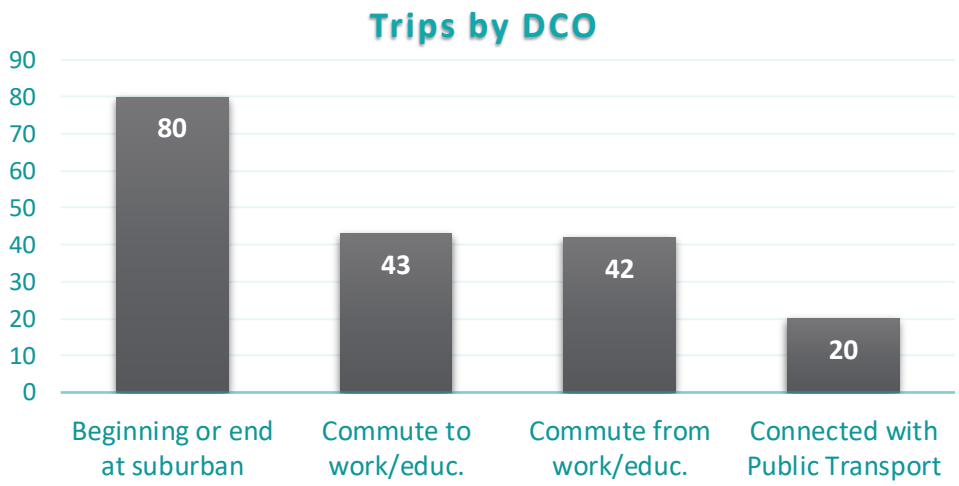

Figure 26: Distribution of executed trips per day

The graph below represents the number of trips and their characteristics that were made by testers using both applications (the Travel Companion and the Driver Companion), i.e., representing both roles of the passenger and the driver.

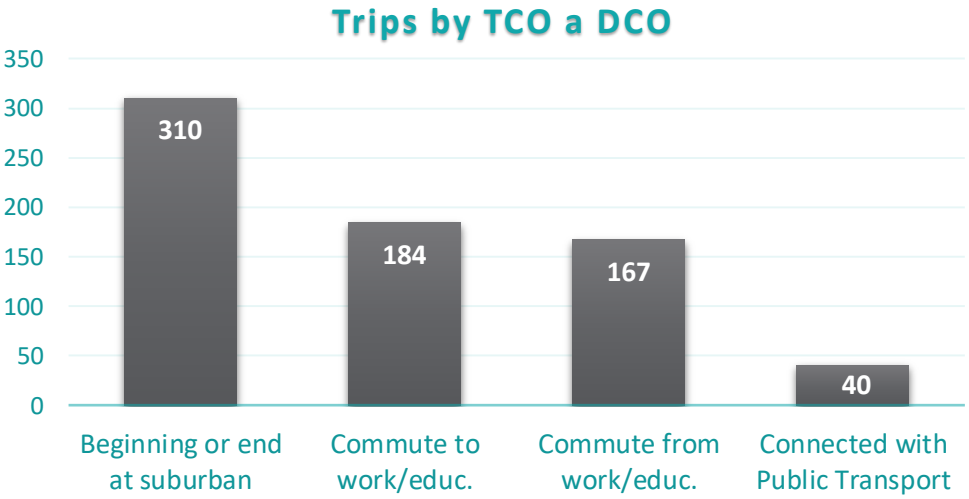

Figure 27: Distribution of executed trips per day

The evaluation of the applications in terms of usability, the testers rated the Driver Companion by the highest rates (55 %), but only if they tested the Driver Companion separately, i.e., if they represented the role of the driver. If testers tested both applications (the Travel Companion and the Driver Companion) then the Driver Companion has the lowest rating (39 %) in terms of usability.

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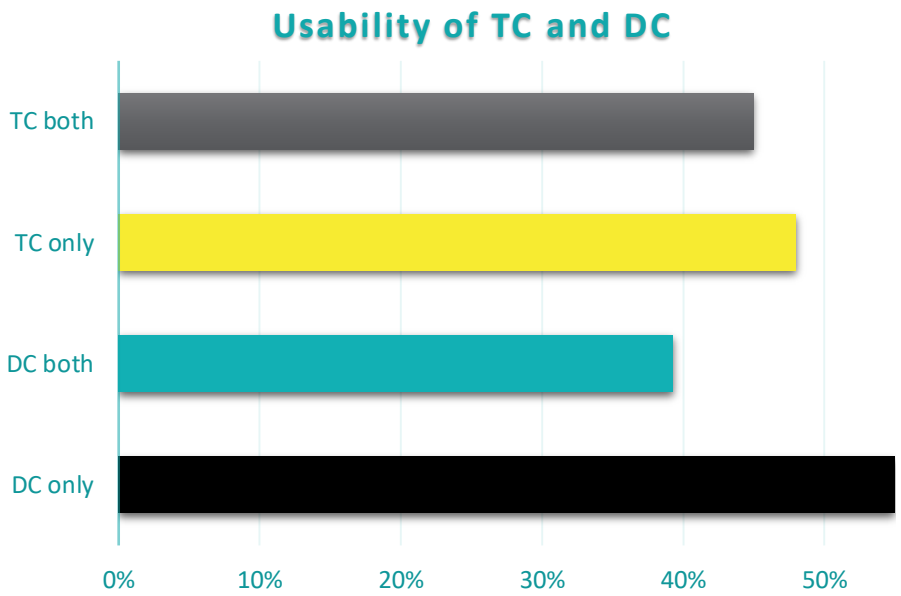

Figure 28: Usability of Travel Companion and Driver Companion

The testers also evaluated the categories that are crucial for them when choosing a travel solution. On a scale of 1 (most important) to 10 (least important), they rated 12 indicators that influence their selection criteria. The questionnaire shows that the most important factor that can influence passengers' decision-making process is speed. On the contrary, the least influencing indicator is panoramic. The overall results are shown in figure below.

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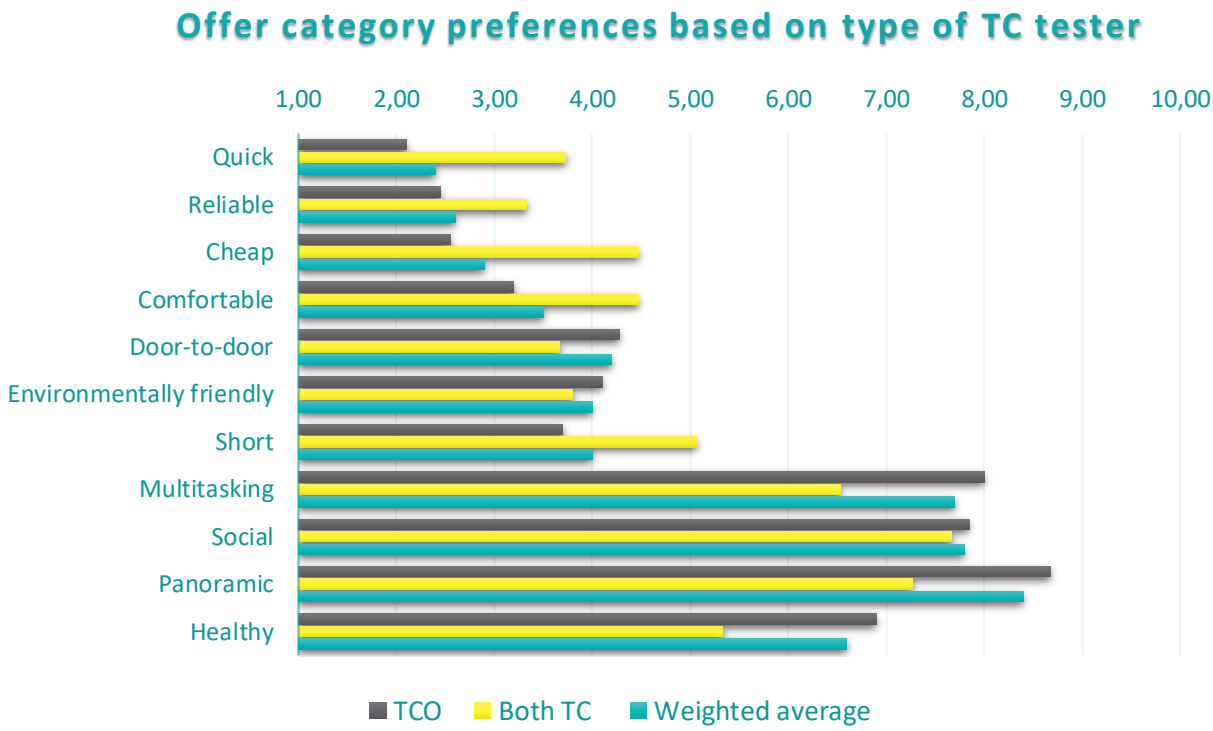

Figure 29: Preferences of testers

5.4.3 Testing of the demonstration scenario

Figure 30 shows a demonstration scenario, i.e., the journey from Znojmo to Brno. The testers were asked if they would be willing to participate in testing of this scenario under the supervision of OLTIS and UNIZA. Two testers agreed with this possibility. Two cars were available, and the trip was planned and executed step by step. It means that first of all, the trip from Znojmo to Lechovice (P+R place) was executed, then from Lechovice (P+R place) to Miroslav (P+R place) and finally (P+R place) from Miroslav to Brno.

Figure 30: Testing of the demonstration scenario

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5.4.4 Testers' perception of the Ride2Rail solution

During the testing, the testers faced several positive as well as negative aspects of the tested applications. The following section describes the most frequently three positive (like) and three negative (dislike) aspects. The evaluation was completed by the testers who tested the Travel Companion (Passenger role) and the Driver Companion (Driver) and by the testers who tested both applications (Passenger + Driver).

Travel Companion	
Like	Like
Many innovation functionalities	Many innovation functionalities
Integration of all means of transport into one travel solution	Integration of all means of transport into one travel solution
Possible to buy one travel ticket for all transport modes in one place	Possible to buy one travel ticket for all transport modes in one place

Table 9: Likes and Dislikes of the Travel Companion from users' point of view (Passengers)

Driver Companion	
Like	Like
Ecological transportation of travellers	Ecological transportation of travellers
Economical travel solution (ride-sharing saves costs)	Economical travel solution (ride-sharing saves costs)
Stop search assistance	The overbooking is allowed

Table 10: Likes and Dislikes of the Driver Companion from users' point of view (Drivers)

Travel Companion + Driver Companion	
Like	Like
Applications are user-friendly and easy to use	Applications are user-friendly and easy to use
Great idea	Great idea
Integration of all means of transport, possibility to share rides and save costs	Integration of all means of transport, possibility to share rides and save costs

Table 11: Likes and Dislikes of the Travel Companion and the Driver Companion from users' point of view (Passengers and Drivers))

5.5 Conclusion

As already mentioned above, there were defined several KPIs for Brno demo, which should have been achieved during the testing. Out of 9 KPIs and 1 target, 4 KPIs were achieved. The following KPIs were achieved:

- Number of completed trips involving public transit/rail with Ride2Rail app[2],

[2] For "Ride2Rail app" it is intended the combination of all solutions proposed by the project (enhanced TC / DC).

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- Number of completed commuters' trips with Ride2Rail app,
- Reduction of need for parking spaces,
- Number of surveyed users attracted to Ride2Rail app.

The remaining KPIs were not met, mainly due to the insufficient number of testers who participated in Brno pilot execution. The main reason, which has already been mentioned, is that due to COVID-19, travellers are way less willing to share their rides because they are afraid to travel with strangers and to make available their private vehicles to people they do not know. Incentives have been provided and at the end the overall number of attracted people can be considered very satisfactory considering the circoumstances.

Number of Ride2Rail app users	200	100	60
Number of completed Ride2Rail app trips	4000	2000	1946
Number of completed multi-occupancy vehicle trips with Ride2Rail app	800	400	76
Number of completed trips involving public transit/rail with Ride2Rail app	100	50	766
Number of completed commuters' trips with Ride2Rail app	40	20	1864
Number of completed rural trips with Ride2Rail app	4000	2000	1665
Reduction of need for parking spaces	20	10	28
Number of surveyed users attracted to Ride2Rail app	60	30	60
TARGET Reduction of CO2 (kg)	3400	1700	347,7

Table 12: KPIs related to the Brno demo site

From the testing and the evaluated survey, it is obvious that the testers appreciated the possibility of connecting public passenger transport with individual car transport and that they liked both the applications and the potential they have, in line with other demos but also more as Brno was carried out after Athens and Helsinki, taking into consideration all the lessons learned from the other demos and implementing them, when possible, on field. Despite the issues that occurred in the applications during the testing, both applications had an overall positive evaluation. The aim of this demo was to encourage travellers who travel to Brno, by using a private car, to share their regular rides with other commuters. Alternatively, to encourage them to use their private cars to travel to the nearest local hub, where they then transfer to public passenger transport. This was achieved.

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6 PADUA DEMO

6.1 Overview

The pilot in Padua demo took place in a 20km radius surrounding the urban centre of Padua (Italy) involving urban and regional mobility service providers in Veneto and concerning rail, road and bus, and ridesharing as travelling modes.

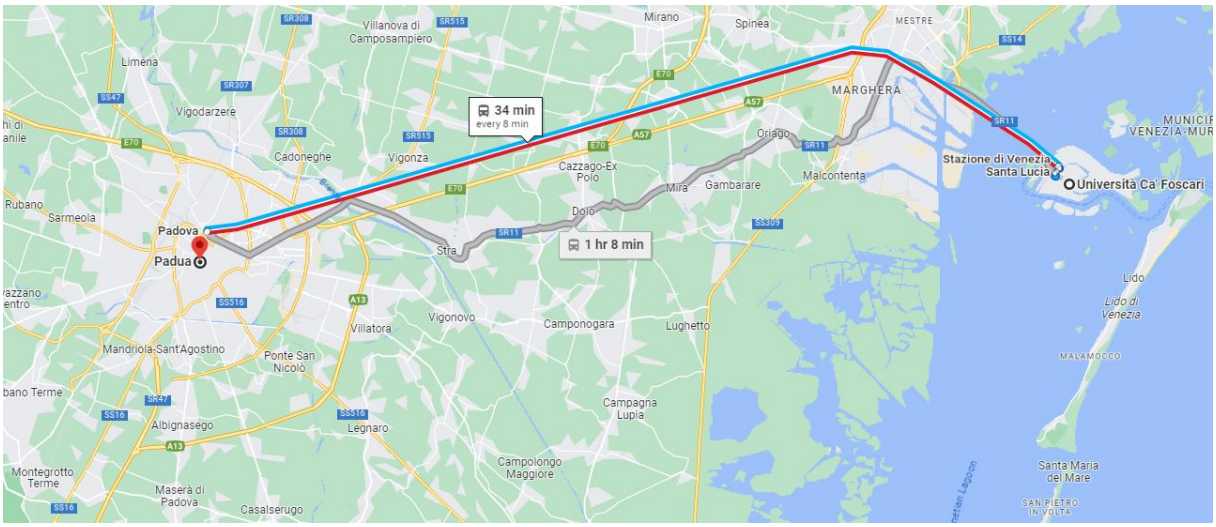

Figure 31: Padua demo site

During the demo, both the Driver and the Travel Companion apps were tested, while the specific functionalities put under the spotlight included:

- Preference & Profile.
- Trip Planner.
- Trip Sharing.
- Navigation.
- Issuing.
- Booking.
- Traveller's Feedback.
- Guest User.
- Offering a Ride.
- View your journey.
- Collaborative Space.

6.2 Goals

Since cities can sometimes become unlivable due to smog, traffic congestion and overcrowded public transport, the project and specifically the demo in Padua aimed to test the Travel Companion and Driver Companion applications in order to cope with these problems.

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Padua demo, through the above mentioned application pursued the following main objectives:

- To encourage carpooling (and ride sharing acceptance) as complementary for public transport and car drivers who travel alone to share the capacity of their car with other travellers: nowadays, it happens very often that going to work or to university or in general in any kind of journey, it could be possible to see people travelling alone in a car that is homologated for 3, 4 or 5 people. This raises many doubts about the sustainability of these travel routines, as well as the effects this has on traffic.
- To improve the efficiency of public transportation services: although most areas with transport infrastructures are well equipped, there is sometimes a lack of integration between different modes of transport, which makes travelling inconvenient.
- To reduce GHG emissions and traffic and parking congestions: bad travel habits, such as travelling alone or preferring car travel to public transport raise serious questions about the sustainability of these modes of travel.

6.3 Facts

Since the demo area is located in the proximity of the Ca' Foscari University of Venice, we agreed to focus our Engagement strategy on the students at this university, involving the commuter population travelling in the area. Since early 2022, contacts have begun with the University's professors in order to organise how to involve the student population. So, the demo has focused in the urban and suburban area of Padua and surrounding areas, taking place from 17/04/2023 to 21/04/2023 and focused on commuters belonging to the Padua province and travelling mostly to/from the University of Ca' Foscari. The demo was organized later than the other demos because it was organized in parallel with the IP4MaaS demo in the same area (IP4MaaS is a Shift2Rail Open Call project complementary to Ride2Rail, with many partners in common, including the Padua demo leader). The integration of the TSPs in Padua required more time than expected and for this reason the demo took place in 2023.

The Transport Service Providers (TSPs) involved in the project were BusItalia, which handles road transport, and Trenitalia, which deals with rail transport. In order to ensure the largest possible number of testers, a student engagement plan was structured through emails sent by university staff to students' mailboxes, including “Save the date” emails, reminders and an Engagement event on the Padua Demo and the TC and DC apps.

The Engagement event for students was held on 14/04/2023 and lasted about 1 hour. During the event, the goals of the project and the purpose of the applications to be used were explained to the students such as, for example, the fact that it is possible to integrate mobility services, to provide multimodal connections for passengers, to share a trip as well as related information (travel time, distance, etc.) or to exchange passenger feedbacks by reporting nearby events. In addition, (as done in all demos) a pre defined anonymous set of credentials used to be able to register in applications were provided to students during the event as well as information about surveys to collect feedback about the demo. Simpler rules and guidelines have been provided. The survey was provided and managed by UNEW and consisted of a set of questions that captured what and how many functionalities were used as also ratings/feedback from users. Although in some cases an online event is more convenient in terms of feasibility (and also as a consequence of COVID-19, that caused a huge spread of on-line tools for organizing events), the Padua demo team observed that an

on-site live events is potentially more effective in terms of user engagement. This is indeed very specific to the local context. However, the timing of the demo made more complex the organization of a on-site event due to the post-Easter period (with several students still away from the demo area).

Below are provided the most relevant statistics with reference to the execution phase of the Padua Demo.

- Number of app downloads: 79.
  - 77 downloads for the TC application.
  - 2 downloads for the DC application.
- Clicks on distribution link: 79.
  - 77 clicks on TC distribution link for the TC application.
  - 2 clicks on the distribution link for DC.
- Unique Users: 9.
- Surveys completed: 7.
- Number of all rides: 387.
- Number of shared rides: 9.
- Functionalities used: 11.
- Result/Feedback: in general, testers reported that they found the application easy to use and did not encounter any technical issue or particular problems when using it. Some people were very pleased with the application as it facilitated connections to the rural areas of the demo as well as the fact that several travel solutions were available. On the other hand, in some cases there was some redundancy in the questions or disappointment in not being able to purchase a ticket once it had been selected, leading to unnecessary additional steps, The overall received feedback was quite positive. The Padua demo team, in its interaction with users, could also have the possibility to understand better their feeling about the application and the ecosystem, getting some recommendations for improvement (ex using a more easy and less technical vocabulary, make some improvements in the look and feel of the app to make them more appealing, extend the time frame/duration of the demo, improve the way to make the driver “visible” to the traveller using ride-sharing).

6.4 Conclusions

As a result of the demo the following suggestions are proposed to improve the apps and the execution of the demo:

- Improve the vocabulary of the apps so that user-application interaction can be made more intuitive.
- Improve the graphics of applications so to make them more appealing.
- Having to attach a poster as the DC's identifier can be inconvenient within a 7-day demo, it would be desirable to find an easier way of identification (the easiest and only way to make the driver visible to the traveller at the meeting point was to print and attach a Ride2Rail sticker on the vehicle. Absence of the possibility to a one-to-one communication and GDPR issues made this as the only way to handle this interaction).

In general, despite the training event held on 14/04/2023 did not attract too many users, in the following days, thanks to the reminder emails that were sent to students, a fair number of downloads were recorded, especially for the Travel Companion application. Afterwards, the number of actual testers was rather low, recording only 9 users of the application. As it

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is true that this might be seen as a low number, it is also true that the people who downloaded and actually used the tools, really used them a lot (see: number of trips). Several reasons can be found behind the relatively low number of participants: the complexity of the process (even if largely simplified by the demo leader), the unavailability of the app via a common platform for downloading (the only way to participate and download the TC was to do it via a previously distributed .apk link), the Android-only nature of the TC, the reduced time window for executing the demo (1 week, this was the only option considering the integrations calendar and the impossibility for CFMs to run more than 1 pilot in parallel). Despite all the above, it is important to focus on the number of trips and on the overall feedback received, wich has been very positive.

7 FINAL CONCLUSIONS

If we had to give an opinion on the execution of the Ride2Rail project we could say that it was a success paid dearly, especially for the organisers of the demos. As can be read from their reports, the execution of the demos encountered technical and organisational difficulties which from time to time had to be resolved close to the demo. In this chapter we offer a compendium of the collected observations divided into the three moments that mark a demo: before, during and after.

7.1 Pre Demo

7.1.1 Local partners

Ride2Rail was a project that proposed innovative mobility services based on an already existing public transport offer. The involvement of local transport companies was therefore necessary and, in many cases, the reference subjects were also "obligated", i.e. they were institutional subjects. The need to relate to subjects who are not part of the project partnership and at the same time essential for the success of the demos has meant that, in some cases, the Ride2Rail project has undergone timing and decisions from other subjects.
Lesson learned: subjects external to the project but essential for carrying out the activities should be involved by means of tools that allow managing times and methods in line with those of the project. Therefore, depending on the case, one should be able to choose between a loose relationship (of non-dependence) or a contractual relationship (for which duties and responsibilities are clear).

7.1.2 Timing

Not all times of the year are the same. Running a demo during the holidays for most users certainly doesn't help participation. It is evident that this situation occurred due to a combination of external causes that was impossible to manage, fortunately the management skills of the local demo leaders allowed the foreseen activities to be carried out in any case.

7.1.3 User recruitment and GDPR

The involvement of users in testing the services offered by the Ride2Rail project was a vital activity. The demo leaders have very carefully managed this aspect ensuring the participation of an adequate number of users on all sites. However, observing the different situations, it is clear that the most important elements that have allowed us to achieve useful results have been:

- **Correct selection of the user target**: Users had to use services in an experimental context, therefore it was necessary to involve users with some technical skills to use the apps not yet in a market-level state of use and by making it very clear from the beginning that they were involved in a research project with a certain TRL.
- **Communication carried out in time**: This type of activity should be carried out with all the criteria of a marketing campaign because in fact it is.
- **Possibility of communicating directly with users**: The direct relationship has proved to be very useful for intercepting misunderstandings on the use of the Apps or clarifying the context. Online or on-site trainings have been proven to be very useful

for people to understand better what is expected from them, and simplified the complexity of (by nature) very technical user guides.

- **Correct communication regarding the services offered**: Ride2Rail apps and services are to be placed in a RIA. Therefore it is "normal" to expect some technical difficulties due to the fact that the fine-tuning is in progress, as it actually has been in Ride2Rail, with lessons learnt used as baseline for improving the tools and do better in the following iteration/release. Users who were better informed about this particular condition have responded better. Incentives, in this case, have been very important, despite this really depends on the local context and was totally managed by the demo team, who knew the local specificities.

A collateral aspect but not of secondary importance was the management of privacy with regard to user data. The application/full compliance to the GDPR is stringent especially for short-term activities, thus the decision was made not to collect users' personal data and to manage them anonymously and (when possible) always in an aggregated way. If on one hand this was possible thanks to technological solutions, for example in the assignment of pre-defined anonymous access users to the apps, in other respects the possibility of success of the demo was impacted. In particular, the car sharing service was heavily penalised by the impossibility for users to communicate with each other and by not being able to recognize each other at the agreed place for the passage. This problem has been mitigated with the distribution of signs to be attached to the car windows with the Ride2Rail logo, to make it possible to recognize the driver, but surely there may be more effective and technological solutions to be developed further to make this communication easier and faster.
This experience shows that the management of aspects such as the GDPR is not secondary and a common policy must be foreseen for all project partners. Considering the circumstances, the available technologies, the time frame and the nature of the project, all partners did their best to cope with this. As an additional note, the interaction with users was handled in all cases only by the demo leader, who collected the email addresses of all volonteers (who accepted the demo leader privacy policy) and interacted with them at all stages of demo execution and follow up. Specific Terms of References have been drafted for both TC and DC and validated by CFMs. They have been uploaded on the apps and made available to all users.

7.1.4 Training

A critical aspect of the demos was that the apps needed to access the services to be tested were made available to demo leaders close to the start of the demos. Despite this was known, due to the intense calendar of integrations and the very tight schedule of CFMs concerning their activities/the improvement of the app, this caused Ride2Rail demo teams to have a very short time to get the final version of the TC, integrated with the demo site TSPs, and familiarize with it, try it, report issues and fixing them. The lack of knowledge of the Apps then led to some difficulties in interacting with user reports to distinguish what were real problems from the limitations inherent in services not yet ready for market. The training of demo leaders and users is necessary to guarantee the best execution conditions of the demos. This aspect must be taken into consideration for future projects(online and

on-site training sessions have been considered very interesting and useful by the users, and this approach was replicated in other projects, as IP4MaaS).

7.2 During Demo

During the execution of the demos, problems derived, as is normal in a Research and Innovation Action, from the use of apps and services that are not yet at market level. The technical problems have led, in limited cases, to inconveniences to the users who had relied on the proposed solutions.

One aspect to consider for the future is that when users who really rely on the services being tested are involved, the services should give a minimal service level guarantee, so that they can be expected to work at least in a minimal yet adequate form for the limited purposes of the demo. If that is not possible, users should be warned that they are using an experimental system which may not always work as expected.

Anyway, thanks to the field work of the Demo Leaders, the difficulties encountered did not cause particular problems for the users, as users have been duly informed by the demo leaders about the nature of the ecosystem and the kind of involvement required.

7.3 Post Demo

Among the necessary activities once the demo is finished, the main one is that of distributing the satisfaction survey for users and collecting the results. The method chosen to send the survey at certain fixed intervals and at the end of the demo risked reducing the response rate. A solution to be adopted is to share the survey at the beginning of the demo, with all the instructions to participate. This would allow people to know in advance what they have to do to complete the survey. This approach was adopted in IP4MaaS project as a lesson learnt, together with an improvement of the code (this was already done in all post-Athens demos in Ride2Rail).

Furthermore, some inaccuracies in the translation and some difficulties in collecting the incentives foreseen for the participants have led to further small difficulties resolved, as always, by the skill of the demo leaders, who, as said before, handled the whole interaction with users.

7.4 Conclusions

At the end of the project, for sure it is possible to witness one of the golden rules in every research and innovation action: the importance of the human factor. As said many times, it was the ability of demo leaders and their staff to solve the most tricky situations, coordinating everything with the users, instructing them, handling the communication with them, solving issues whenever possible (with technical support from CFMs and Ride2Rail technical partners).

Apart from the general comment, Ride2Rail was an important experience to allow the whole consortium to understand how to create the best possible conditions for commuters and students to share private vehicles in order to use public transport, specially trains, more and more. It's a challenge that includes several fields: accessibility to transport services, changing habits in the use of private cars, the use of user-friendly technology that is truly

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capable of solving. Acting in four different European cities, engaging more than 100 users for more than 2.300 completed trips, Ride2Rail proved to have done the job.
More accurate conclusions and a general evaluation based on gathered data will be elaborated in WP5 reports (particularly D5.3 and 5.4).

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