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PAsCAL

Enhance driver behaviour & Public Acceptance of Connected & Autonomous vehicles

Grant agreement no.: 815098

D6.3 – Pilot implementation and evaluation

Version 1.0

Authors and affiliation:

Friederike L. Kühl – Etelätär Innovation

José F. Papí – Etelätär Innovation

Marcin Seredynski – E-Bus Competence Center

Sune Nielsen – E-Bus Competence Center

Valerio Vella – Automobile Club D'Italia

Marco Scotti – Automobile Club D'Italia

Elena De-La-Peña – Asociación Española De La Carretera

Joanne Wirtz - LuxMobility

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List of contributors		
Section	**Author(s)**	**Reviewer**
Section 1	Friederike L. Kühl (ETE)	José F. Papí (ETE) Luc Vandenabeele (LIST) Mohsen Zare (UBFC)
Section 2	Friederike L. Kühl (ETE)	José F. Papí (ETE) Luc Vandenabeele (LIST) Mohsen Zare (UBFC)
Section 3	Marcin Seredynski (EBUS) Sune Nielsen (EBUS)	Friederike L. Kühl (ETE) Luc Vandenabeele (LIST) Mohsen Zare (UBFC)
Section 4	Valerio Vella (ACI) Marco Scotti (ACI)	Friederike L. Kühl (ETE)

		Luc Vandenabeele (LIST) Mohsen Zare (UBFC)
Section 5	Friederike L. Kühl (ETE) Elena De-La-Peña (AEC)	José F. Papí (ETE) Luc Vandenabeele (LIST) Mohsen Zare (UBFC)
Section 6	Joanne Wirtz (LUXM)	Friederike L. Kühl (ETE) Luc Vandenabeele (LIST) Mohsen Zare (UBFC)
Section 7	Friederike L. Kühl (ETE) José F. Papí (ETE)	Luc Vandenabeele (LIST) Mohsen Zare (UBFC)
Section 8	Friederike L. Kühl (ETE)	José F. Papí (ETE) Luc Vandenabeele (LIST) Mohsen Zare (UBFC)

Version History		
Version	**Date**	**Summary of changes**
01	26 July 2021	First draft table of contents. Completion of Sections 1,2,7 by ETE.
02	10 November 2021	Revision by EBU. Expansion of pilot 5 dissemination activities section
03	14 January 2022	Completion of first draft for section 3 by EBUS and section 5 by ETE.

04	04 March 2022	Completion of first draft for section 4 by ACI and section 6 by LUXM.
05	14 March 2022	Final corrections by ETE of all sections for content and format. Completion of Annexes by ETE.
06	28 March 2022	Review by LIST and UBFC project partners, implementation of their comments.

List of acronyms	
Acronym	**Meaning**
ABS	Automatic Breaking System
ACC	Adaptive Cruise Control
ADAS	Advanced Driver-Assistance System
AP	Automatic Parking
AV	Autonomous Vehicles
CAV	Connected and Autonomous Vehicles
ELD	Elderly person
ERTRAC	European Road Transport Research Advisory Council
FAIR	Findable, Accessible, Interoperable and Reusable
FDG	Focus Discussion Groups
FOT	Field Operational Test
GHG	Green House Gas
KPI	Key Performance Indicator

LiDAR	Light Detection and Ranging
LK	Lane Keeping
MaaS	Mobility as a Service
PAsCAL	Enhance driver behaviour and Public Acceptance of Connected and Autonomous vehicLes
SCI	Spinal Cord Injuries
SUMP	Sustainable Urban Mobility Plan
TMC	Temporary Mobility Constraints
UI	User Interface
UX	User Experience
WP	Work Package

Legal Disclaimer

This project is co-funded under the European Framework Programme for Research and Innovation Horizon 2020 as part of the Mobility for Growth call 2018 “Driver behaviour and acceptance of connected, cooperative and automated transport”.

Notice

This document was drafted based on the European Blind Union’s guidelines (http://www.euroblind.org/publications-and-resources/making-information-accessible-all) in order to be accessible to anyone, including visually impaired and partially sighted people, and at the same time and at no additional cost.

PAsCAL
Enhance driver behaviour & Public Acceptance of Connected & Autonomous vehicles

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Executive summary

The PAsCAL project aims to address all the issues and concerns that may delay the wide market uptake of Connected and Autonomous Vehicles (CAVs) and to enhance the general public's acceptance of these vehicles. At the same time, the project also studies questions relating to the role of humans within the system, with special attention to vulnerable users, ranging from real-time driving control to long-term training needs for professional drivers.

Five different real-world pilots have been carried out to validate the project's findings and explore the acceptance of CAVs under real-world conditions. This document details how these pilots were carried out, and the conclusions that can be extracted from the information collected during the pilots. It can also serve as a guide on the structure and execution of pilots or Field Operational Tests (FOTs) of connected and/or automated vehicles, including various different kinds of user groups and further the management of such pilots during the COVID-19 health crisis.

Finally, it contains a brief overview over the data collection processes as well as a short data analysis and the most interesting preliminary conclusions derived from the pilots, which will be further extended in WP7.

1 Introduction

The PAsCAL project aims to address all issues and concerns that may delay the wide market uptake of Connected and Autonomous Vehicles (CAVs) and to enhance the general public's acceptance of these vehicles. At the same time, the project also studies the questions relating to the role of humans within the system, with special attention to vulnerable users, ranging from real-time driving control to long-term training needs for jobs. In order to facilitate the research process, the consortium partners have collected user-related data, as well as the public opinions and acceptance via a variety of channels. The results will be used to design the Guide2Autonomy (G2A) in the subsequent WP8, providing a rich set of recommendations, tools, and insights for a variety of stakeholder groups. The G2A will be presented and assessed with relevant stakeholders.

Five different real-world pilots have taken place to validate the project's findings. This document details how these pilots were carried out and provides a first-line assessment of their results which will be deepened within the subsequent WP7. The pilots ran under unique conditions and each pilot manager faced different challenges throughout the process – from conceptualisation, to planning, execution and reflection.

1.1 Purpose and organisation of the document

This document details the actual execution and the outcome of the pilots held throughout the PAsCAL project. This deliverable is composed of the following sections:

- **Section 1** serves as an introduction for this document.
- **Section 2** describes the document's objectives and includes an overview of the pilots.
- **Sections 3 - 7** present each pilot and their findings following the FESTA methodology proposed in deliverable D6.1.
- **Section 8** contains a summary on the pilot implementation and evaluation.

The overall objective of the document is to detail the pilot execution, map obstacles, share lessons learnt and report on deviations from the original pilot plan if there are any.

1.2 Intended audience of this document

The main audience for this document is the consortium members of the PAsCAL project, specifically partners responsible for analysing the datasets and information collected during the execution of these pilots. They can profit from the context in which the datapoints were gathered and potentially measure the impact of deviations of any kind on the responses participants gave.

Furthermore, this document can be understood as a guideline for future research involving mobility or CAV pilots, which require feedback from users. The lessons learnt during this process are invaluable for the future design, planning and execution of pilots.

Finally, the results of the pilots can be of interest to the following professional groups:

- Manufacturers of CAVs and developers of CAV technologies;
- Researchers and academic bodies;
- Organisations of focus groups (vulnerable persons including persons with mobility constraints or the blind and partially sighted);
- Policy makers and legislative bodies;
- Public transport planners and -operators;
- Developers of Information & Communication Technology (ICT), Human-Machine Interfaces (HMIs), Intelligent Transportation Systems (ITS).

2 Overview of the PAsCAL pilots

2.1 Objectives

In PAsCAL, all research Work Packages - from WP3 to WP8 - need a high degree of interaction and feedback information, both during planning and execution. The PAsCAL pilots have been designed to provide validation of the previous WPs findings, in particular WP4 and WP5. In addition, they have been aligned with WP3. At the same time intermediate results of the pilots have provided periodical feedback to those WPs.

Also including ethics and data protection handbooks from WP2, and in compliance with the data analysis and impact assessment plans defined in WP7, the pilot results and data collected have been directly transferred to WP7 for evaluation. Tester responses and observed behaviours will be analysed in task 7.3.

The objective of the work performed in WP6 is to gather datasets.

2.2 Pilots' summary

2.2.1 High-capacity autonomous bus operations

This pilot addresses the perception of high-capacity CAV buses in urban public transport (PT) operations from the point of view of a set of testers as well as PT stakeholders involved in the operations. The goal is to analyse the main concerns and worries of the passengers, which may negatively impact acceptance of such vehicles. In particular, the pilot studies the impact of a lack of human assistance that is normally provided by drivers during various types of incidents. One of the specific goals of the analysis is to specify and test Information and Communication Technology (ICT) -based solutions that allow to partially replace the perceived role of a human driver. Simplified versions of the tools are designed and implemented for the pilot. The considered passengers are comprised of a diverse group, including those with special needs for (human) support and partially sighted as well as blind user groups. The pilot is designed with the input from several different PT stakeholders. It is composed of six batches split into two waves.

2.2.2 Autonomous driving training

In this pilot the training methodology created in WP5 is assessed through the use of a L2 CAV in the “protected” and equipped environment at the Lainate safe driving centre in Milan, Italy. 70+ drivers test a number of different scenarios ranging from everyday interactions with CAVs to the most critical situations, including the solutions previously identified in WP5. Moreover, the pilot assesses if there is any difference in the acceptance of CAVs between simulated conditions at a testing facility and a real situation in active traffic networks.

2.2.3 Autonomous bus line

In this pilot, a fully autonomous and connected electric bus with autonomy level 4 is tested. The system has already been implemented under real life traffic conditions in Spain. The vehicle is fully operative and commercial and is used by hundreds of active users monthly, integrating into the multi-modal transport network of the wider Madrid area. Both reactions and attitudes of external road users, who are confronted with these vehicles, and the passengers of the vehicle, including some vulnerable passengers, are studied and asked to fill out a survey. A special focus is laid on the level of success concerning the multimodal integration of the bus line. The pilot takes place in collaboration with several key shareholders, including associations, governmental bodies, commercial operators as well as the manufacturer of the vehicle.

2.2.4 Shared connected transport

Roadmaps on automation (such as the one published by ERTRAC[1]) put a lot of emphasis on shared mobility technologies. However, still little is known about the attitudes towards future sharing schemes. This pilot studies attitudes and perception of “drivers” and passengers toward different kinds of shared connected vehicles including small- and medium-size passenger cars, sport vehicles, vans, electric vehicles and vehicles with autonomous features. This study allows operators of shared fleets to optimally design and operate fleets of shared vehicles and design well-suited incentive mechanisms to increase public acceptance and improve attitudes towards different kinds of shared vehicles. Furthermore, the pilot

[1] https://www.ertrac.org/uploads/documentsearch/id57/ERTRAC-CAD-Roadmap-2019.pdf

includes an autonomous bus, which operates in the same area in Luxembourg.

2.2.5 Experience of vulnerable travellers with connected transport environment

The last pilot focuses on the acceptance and behaviour of vulnerable travellers, such as the elderly, pregnant women, disabled, with sensory impairments, travellers with heavy luggage, and parents with a baby stroller when travelling with CAVs. A digital platform is used, which advises specifically vulnerable travellers in real-time on the best routes to take, removes non-accessible routes and transfers, and alerts them of possible obstacles which may be encountered. This platform has already been tested in Madrid, Spain, but in this pilot the new challenges of a more connected transport environment is addressed and the potential of CAV vehicles for a more inclusive public transportation network, can be assessed. Furthermore, Focus Discussion Groups (FDGs) shall be prepared specifically for people with sensory impairments to better understand their needs and the potential aid CAVs could represent in their lives and how these technologies could enable them to travel more independently.

2.3 Pilot timetable

In order to give a good overview over all pilot deployments and in order to keep track of any deviations of the initial plan, a common timetable has been created to structure and document the pilot deployment and subsequent development of documentation and conclusions. As the pilots take place in parallel over 8 months, the constant communication between the partners and an overall tracking of the project's process is of high importance in order to avoid any possible delays. The timetable has been designed and agreed upon by all partners and has been shared with the entire consortium in advance. During the planning and execution of the pilots, this timetable has been updated continuously. As defined in the Grant Agreement, the months are counted starting from the beginning of the Agreement in June 2018, therefore Month 20 of the PAsCAL project corresponds to January 2021. The pilots were conducted between March 2021 and February 2022.

Table 1 - Timetable of all pilots and deliverables

Year	2021												2022		
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar
	M20	M21	M22	M23	M24	M25	M26	M27	M28	M29	M30	M31	M32	M33	M34
Pilot 1															
Pilot 2															
Pilot 3															
Pilot 4															
Pilot 5															
D6.1															
D6.2															
D6.3															

Throughout the deployment of the pilots, the progress of each partner is checked continuously to ensure a seamless and unproblematic progression and a timely delivery of the Work Package's deliverables. Furthermore, possible delays can be anticipated or spotted quickly, and strategies or pilot changes can be implemented to avoid the overall delay of the project.

Due to several different reasons and circumstances, the pilot timetable had to be adapted in May 2021. This was partly due to the ongoing Covid-19 pandemic, because of which changes needed to be implemented quickly to adapt the timetable to local and national lockdowns or mobility restrictions. Another important factor was delays in WP5 and the subsequent extension of the project over 6 months, the delivery of the Deliverable D6.3 has been shifted to March 2022 (M34).

2.4 Data collection

During each of the pilots, different kinds of data were collected using a range of tools. To ensure that data protection standards have been kept for all the collected data, a common General Data Protection Regulation (GDPR) form has been created which has been signed by all participants either on paper or digitally. Furthermore, to render the findings comparable across all pilots, a common strategy and a set of tools have been defined from the beginning in Deliverable D6.1.

The quantitative data from the questionnaires and other tools are complemented with the qualitative information gathered through the observations of PAsCAL staff and video recordings.

All of the data collected in the pilots can be found in full in the Annexes:

1. Annex I GDPR form: A common form used either in paper form or digitally, and which is kept on file by each pilot manager. The GDPR forms were always collected separately from the surveys to guarantee anonymity;
2. Annex II Incidence Report Forms: For each pilot wave and pilot batch, a separate Incidence Report Form has been filled out to document any technical issues or external influences during the pilot;
3. Annex III Survey Results from Pilots: Contains all data gathered by each respective pilots from participant surveys.

3 Pilot 1: High-capacity autonomous bus operations

3.1 Introduction

Introduction of high-capacity automated or autonomous buses into conventional public transport (PT) operations not only will make bus travel safer and smoother, but also will allow to reduce Green House Gas (GHG) emissions and energy usage. Furthermore, it will enable deploying a cooperative and coordinated PT mobility system that not only further reduces energy consumption and emissions but also makes bus travel faster. This allows indirect decrease of GHG emissions from urban mobility by supporting a modal shift to PT. However, despite clear societal and environmental benefits there are still several challenges to be addressed. Especially, related to the fact that a driver – whose role in PT goes beyond driving (e.g., customer support or an emergency contact in case of incidences) – is not present on board of an autonomous bus. Passenger acceptance of driverless buses is not only linked to perceived vehicle safety (crash risk) but also to perceived security (risk of crime or harassment). This first pilot addressed these two aspects, as well as the ability of Information and ICT to mitigate safety and security concerns. A high-level pilot overview is given in Figure 1 below:

Figure 1 - Pilot 1, Overview

Whether or not a vehicle is perceived as automated or autonomous was not scope of the project as differences between the terms are not common knowledge. The key investigated aspect (and a common denominator for future automation and autonomy) is the impact of the lack of a driver present on board of a bus.

To analyse the passenger attitude towards automated (driverless) PT operations, a total of 51 participants took part in 5 batches and 2 waves of experiments executed in the period of May-November 2021. All experiments took place in the Truck & Bus Centre in Livange, Luxembourg. In each batch, a specific scenario was simulated with the aim to provoke different viewpoints and reservations towards PT automation. After each experiment, participants' experiences were collected via questionnaires and discussion. In addition, a special wave involving a total of 8 participants were carried out. Due to COVID-19 the number of participants being simultaneously in buses and meeting rooms was kept low (maximum of 14 persons), while social distancing was implemented as per official guidelines and all persons involved were wearing a face mask at all times. To the best of the pilot managers' knowledge, such study using real experience of driving full-size buses at higher speeds has not been reported earlier in the literature (except the KRABAT project) [2]. Past research has focused on low-capacity autonomous shuttles that travel at much lower speeds (below 20 km/h), often as last mile connections.

3.2 Pilot execution, Observations & Deviations

This section describes in detail how the pilot was prepared and executed as planned in Deliverable D6.2 [5] along with reports on the outcome.

3.2.1 Pilot objectives and methodology

During the pilot preparations, EBUS representatives observed the KRABAT project experiment that took place on 2nd June 2021 in the AstaZero test facility (Sandhult, Sweden). The experiment involved 22 daily PT users experiencing an automated driverless 12m bus in 9 different traffic situations. The main finding of the project – passengers' acceptance towards automation technology (safety aspect) – shaped the objectives and design of the PAsCAL pilot in Luxembourg. That is, while this PAsCAL pilot was also looking into acceptance linked to the safety aspects, its main goal was to examine passengers' security perception due to the lack of a driver (or PT personnel) present on board of the vehicle. Furthermore, the

[2] https://www.drivesweden.net/en/projects-5/krabat

pilot investigated how ICT technologies (such as voice and video communications) can address any identified safety and security concerns arising on board. Special focus was laid on the needs of vulnerable passengers specifically those with visual impairment.

For the experiment, the same vehicle type was used as in the KRABAT project (Volvo 7900 Electric Hybrid[3], in electric mode). However, in the PAsCAL pilot the bus was not actually automated. Instead, a Wizard of Oz experiment methodology [7] was used. That is, the bus was prepared in a way that passengers believed they were travelling with a fully automated vehicle without driver/personnel being present on-board of the bus. This allowed to execute more advanced scenarios that would not be feasible using today's status of automation/autonomy. In addition, the manoeuvres could be done without restricting activities near the bus (e.g., pedestrians walking, other cars, trucks and buses driving next to the bus without safety bounds).

To validate the Wizard of Oz approach, after the experiments, the passengers were asked about the perceived level of automation they personally had. Only a single person (transportation professional/academic) suspected that the vehicle might not have been automated due to execution of scenarios, which were too complex given today's state of automation.

3.2.2 Pilot organisation

The pilot was organised and conducted by EBUS, while recruitment of participants was done jointly by EBUS, LIST, LuxMobility and EBU, making use of their respective networks and outreach in Luxembourg and beyond. Pilot invitations (Figure 2a) were intentionally designed to not reveal that the experiments were focusing on PT automation. Upon arrival at the test location, the participants were guided to a conference room where they were offered refreshments in the form of coffee, drinks, and pastries. With enough time to fill in the GDPR forms (Figure 2b) and get their refreshments they then listened to a 15-minute presentation (Figure 2c). The presentation stuck to a generic focus on the future of transportation, which combines electrification, connectivity, digitalisation and automation.

[3] https://www.volvobuses.com/gb/city-and-intercity/buses/volvo-7900-electric.html

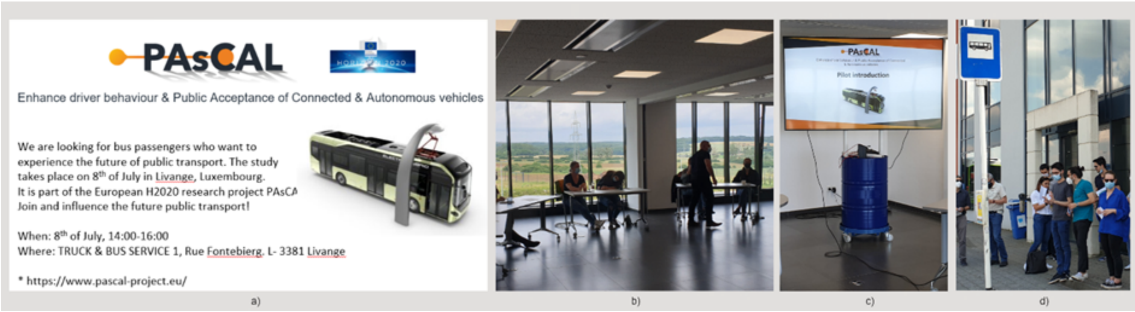

Figure 2 - Pilot 1, Invitation (a), conference room (b), pilot introduction presentation displayed on a screen (c), participants waiting for a bus (d)

The presentation had three main aims:

1. Introduce the participants to the PAsCAL project and detail its' objectives and activities;
2. Explain how the emerging technologies applied together can improve attractiveness of PT (Figure 3). Clarifying the background is important not only to make a distinction between the impact and the role of connectivity, digitalization, and automation, but also to explain environmental aspects and mitigate misconceptions about these technologies;

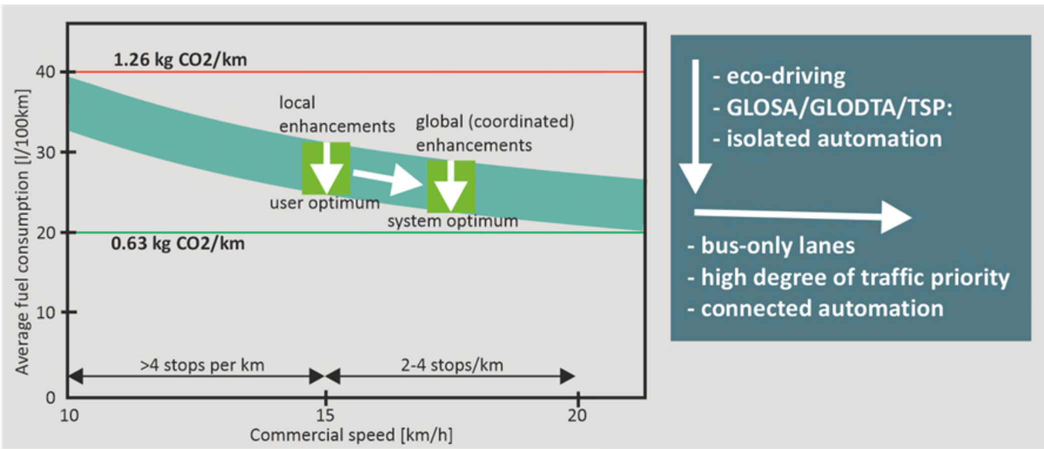

Figure 3 - Pilot 1, Example of slide explaining the impact of future applications combining connectivity and automation

3. Third and last presentation goal was to inform the passengers about the experiment plan (using the graphical explanation shown in Figure 4. That is, they were told that during the experiment they will

drive two distinct buses, and after the two rides they will be asked questions about the second ride.

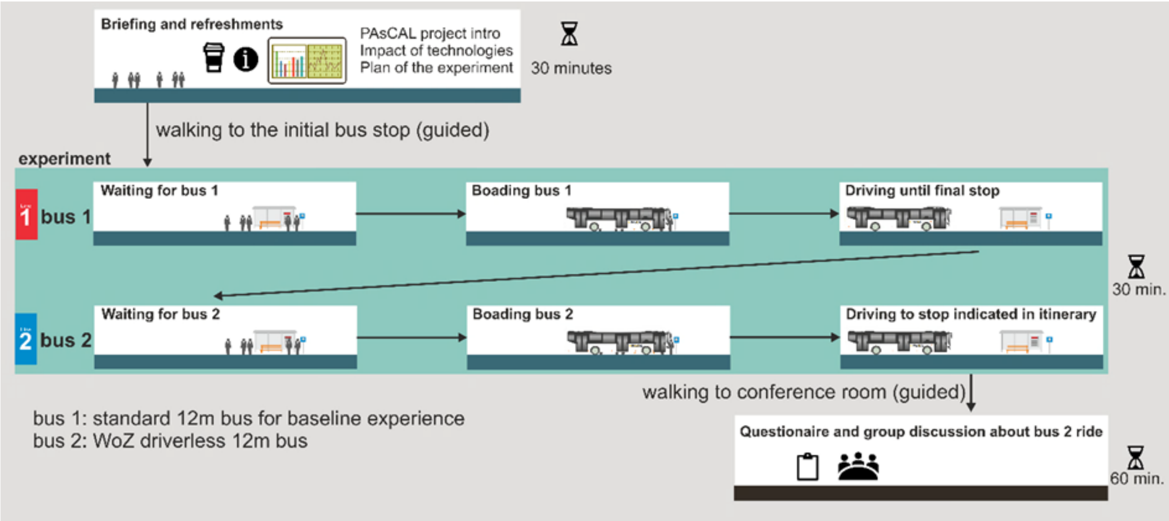

Figure 4 - Pilot 1, Explanation of the experiment to the participants

Each participant received a personal itinerary related to the second bus drive (Figure 5). The itinerary differed in the destination stop (two options were prepared). Each participant received itinerary printed in a different colour to suggest uniqueness of the plan.

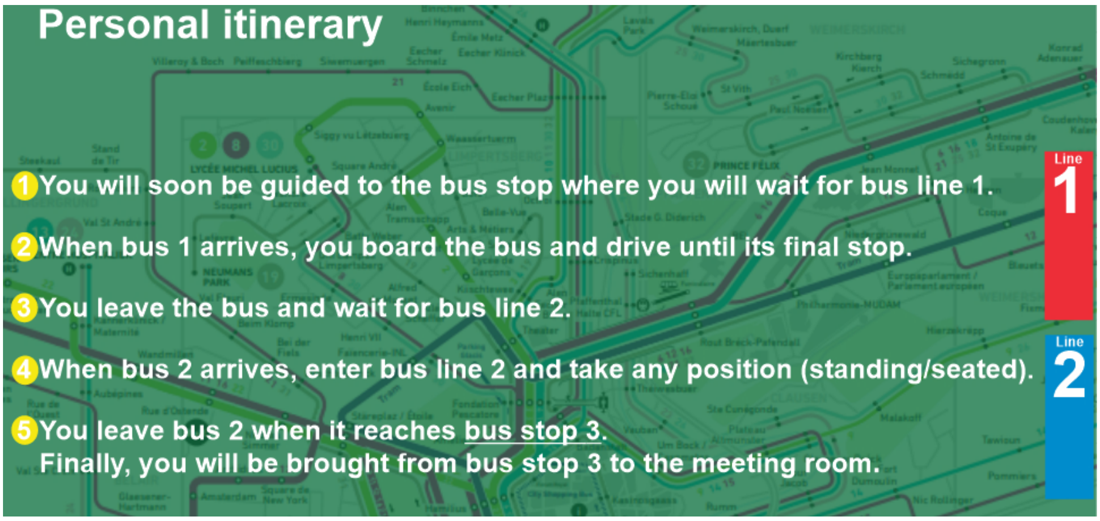

Figure 5 - Pilot 1, Example of personal itinerary

3.2.3 Scenario and wave design

Two types of scenarios were tested – a "control scenario" and an "event scenario". The former consisted of a simple trajectory, on which it was not planned that the bus would experience any incidences. The latter included technical and operational simulated malfunctions, referred to as events of which three were tested: "long idling", "doors issue", and "car blocking the path of the bus". Initially an additional "harsh braking" event was planned but eventually it was discarded due to potential issues with passenger safety. Following preliminary tests, the route of the bus and event locations were slightly adapted when compared with initial assumptions presented in Deliverable D6.2 [5]. The final route together with events is shown in Figure 6.

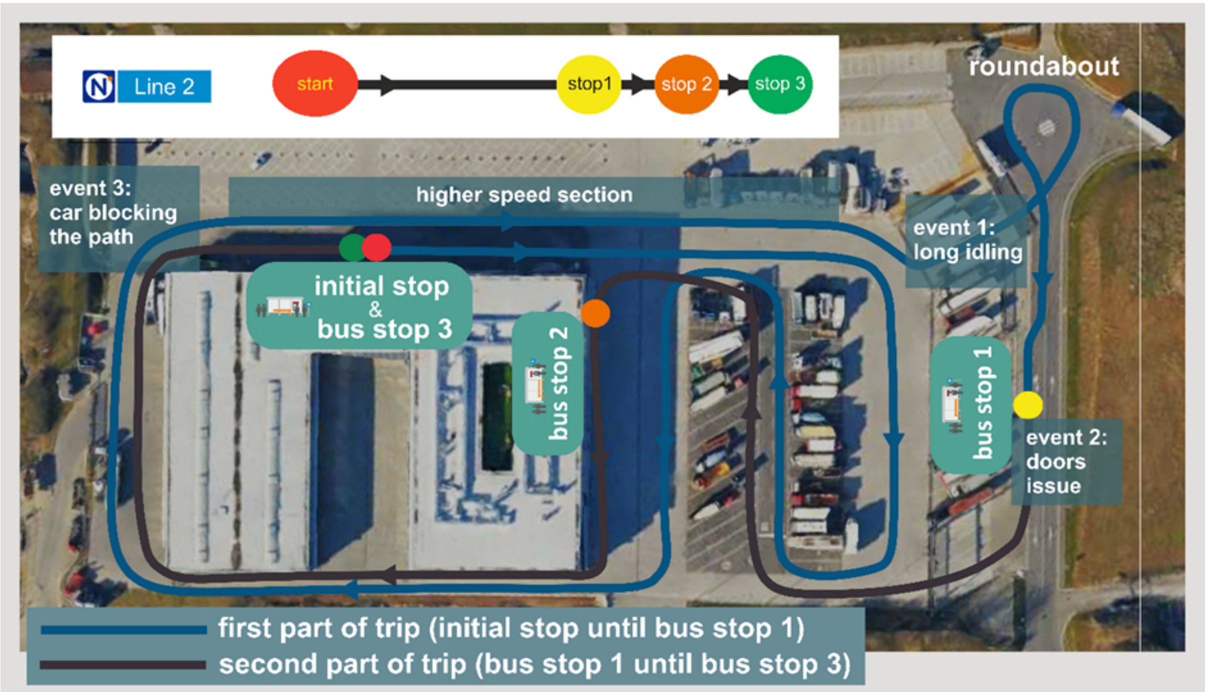

Figure 6 - Pilot 1, Test route overview and location of special events

In addition to both the control and the eventful scenarios, the plan was to alternate between basic and extended ICT passenger support on top of exposing the participants to different scenarios. Two types of support were offered:

1. Basic support referring to acoustic announcements, when the doors open/close, the vehicle departs or approaches the next stop;

2. Extended support was prepared for the "eventful scenario". It allowed to launch an incoming videocall from the control centre informing the passengers about the long idling event.

In case of the "eventful scenario" with basic support, the passengers are left without information in case of incidences. Likewise, in the doors issue event, the doors opening is announced, but they do not open and a staged passenger outside cannot enter. The bus then leaves seemingly unaware that a person was left behind. With extended ICT support however, the staged passenger travels in the bus and attempts to leave it at stop 1 when the doors do not open. He then launches a video-call with the control centre to report the problem. It is swiftly resolved, and he can leave the bus. The blocking car was staged by a project member parking their car with the trunk open seemingly unloading some things on the road.

The final setup of the batches is summarized in Table 2. The first two batches tested the control scenario with basic ICT passenger support that consisted of voice announcements, batch 3 and 4 included the three events "long idling", "doors issue", and "blocking car". While batch 3 had basic support, batch 4 had additional ICT support in the form of staged video-calls with the control centre. Wave 3 had three special batches – batch 1 with invited professionals working at an investment bank. Batch 2 involved driving alone in a bus, while batch 3 was about driving alone without daylight – all without events.

Table 2 - Pilot 1, Overview of batches

Wave	Batch	No. of participants	Scenario No.	Scenario Number	Passenger ICT support
1	1	13	1	control	basic
1	2	8	1	control	basic
1	3	14	2	event	basic
1	4	11	3	event*	extended*
2	1	5	4	event*	extended*
3	1	5	1	control	basic
3	2	2	1	control	basic

3	3	1	1	control	basic

**Event and ICT support adapted to visually impaired participants*

One needs to note that batch 1 of wave 2 (visually impaired participants) did not include the blocking car event or malfunctioning doors as it may not have been perceived by the participants and lead to confusion among them. For the same reason, video calls with the control centre were removed from this batch.

The interactions with the participants were first described in an excel sheet, which is later interpreted by a text-to-voice software. Table 3 displays an excerpt of the scenario description. The scenarios were linear and could not react spontaneously on deviating participant behaviour, which is a design choice that also forced the scenario setup and process to be the same across pilot waves. As the scenario advanced step by step, position, announcements and sound on all devices is updated simultaneously.

Table 3 - Pilot 1, Scenario design: welcome, departure and announcement messages (excerpt)

Step	Longitude	Latitude	Message	Sound Name	Speed	busStop	Video
1	6.10424042	49.5316341	Welcome to the "Autonomous Bus Experience"	Welcome	0	FALSE	null
2	6.10424042	49.5316341	Welcome to the "Autonomous Bus Experience"	Welcome	0	TRUE	null
3	6.10424042	49.5316341	The bus departs shortly!	Departs_shortly	0	FALSE	null
4	6.10424042	49.5316341	Doors closing	Closing	0	FALSE	null
5	6.10424042	49.5316341	Bus is departing	Departing	5	FALSE	null
6	6.10430747	49.5316516	Bus is departing	null	11	FALSE	null
7	6.10439867	49.5316742	Bus is departing	null	15	FALSE	null
8	6.10453278	49.5317125	null	null	18	FALSE	null
…							
38	6.10572368	49.5319753	null	null	22	FALSE	null
39	6.10565394	49.5319823	We will arrive at the first stop in a few minutes	First_stop_in_minutes	22	FALSE	null

40	6.10558152	49.5319719	We will arrive at the first stop in a few minutes	null	22	FALSE	null
41	6.10552252	49.5319457	We will arrive at the first stop in a few minutes	null	22	FALSE	null
42	6.10549033	49.5319057	We will arrive at the first stop in a few minutes	null	22	FALSE	null

In the case of video calls the video is determined by name in the last column - if preceded by an exclamation mark it will be played automatically, if not it will start when a user presses the blue assistance button, as can be seen in Table 4 below.

Table 4 - Pilot 1, Scenario design: stops and video calls (excerpt)

Step	Longitude	Latitude	Message	Sound Name	Speed	busStop	Video
83	6.10577196	49.5321024	null	null	17	FALSE	null
84	6.1059168	49.5321198	null	null	12	FALSE	null
85	6.106067	49.5321163	null	null	5	FALSE	null
86	6.10613406	49.5321233	The bus is doing an unscheduled stop	Unscheduled_stop	0	FALSE	null
87	6.10620648	49.5321442	Incoming video call from control centre	null	0	FALSE	!Videocall_halt.mp4
88	6.10626281	49.5321825	null	null	5	FALSE	null
…							
96	6.10660613	49.532602	null	null	11	FALSE	null
97	6.10653103	49.5326281	Approaching stop 1	approaching_stop_1	12	FALSE	null
98	6.1064452	49.5326247	Approaching stop 1	null	12	FALSE	null
…							
110	6.10664636	49.5321129	Approaching stop 1	null	7	FALSE	null
111	6.1066705	49.5320676	Approaching stop 1	null	3	FALSE	null
112	6.10670001	49.5320171	Bus arrived at stop 1	Arrived_stop_1	0	FALSE	null
113	6.10673487	49.5319562	Doors open	opening	0	TRUE	Videocall_doors.mp4
114	6.10673487	49.5319562	Doors close	closing	0	FALSE	Videocall_doors.mp4
115	6.10673487	49.5319562	Started video call with control centre	null	0	FALSE	Videocall_doors.mp4

116	6.10673487	49.5319562	Bus departs	departing	3	FALSE	null
117	6.10677242	49.531897	null	null	8	FALSE	null
118	6.10680461	49.5318413	null	null	12	FALSE	null

3.2.4 Vehicle preparation

The overall aim of the preparation is to present a vehicle that is part of a scientific experiment and that is seemingly autonomous and automated in complex ways. Disguising the driver and installing ICT applications and screens among other modifications add to this illusion. Major modifications are illustrated in Figure 7.

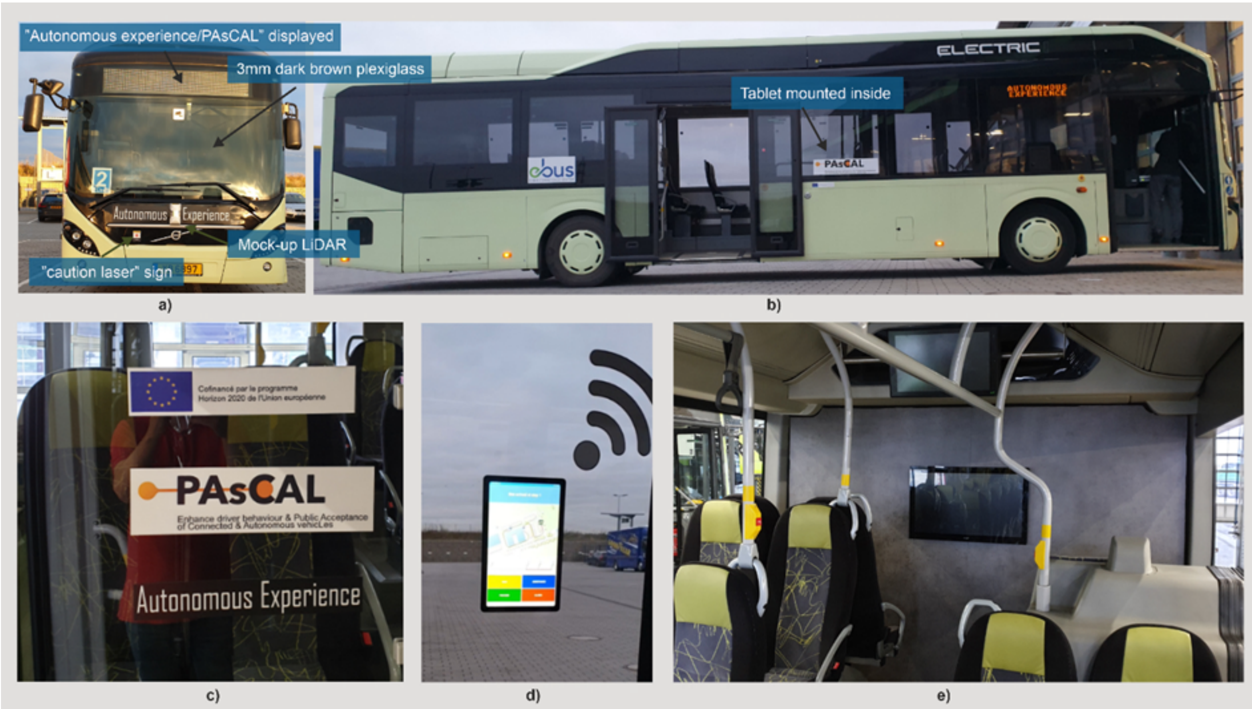

Figure 7 - Pilot 1, General overview of vehicle preparation: bus front (a), bus side (b), glass separation next to bus entry (c), tablet interface to control centre (d), front wall separating the passenger cabin from driver cabin with screen showing live front-view feed (e)

Vehicle preparations included:

1. Several stickers placed inside and outside of the bus to give the impression of a high density of sensors and other detection

technologies to aid a fully autonomous bus and align with the visual identity of the PAsCAL project;

2. A fake Light Detection and Ranging (LiDAR) has been mounted to the front of the bus;
3. Obstruction of the driver seat to prevent participants from spotting the bus driver by:
    a. Completely separated front part (including the drivers' seat) by a solid wooden wall from floor to ceiling and side to side;
    b. Windows in the front of the bus were covered with 3mm smoky dark plexiglass cut-to-shape;
    c. Dark curtains have been installed hanging on both sides of the driver to prevent people from seeing the driver's silhouette through the side window.

It can be mentioned that even very curious test participants going very close to the windows and using their hands for shade were not able to see the driver as they at this moment tugged themselves in the seat and held their arms low, while sitting still. Figure 8 shows the result along with the customised PAsCAL message on the display above the bus front.

Figure 8 - Pilot 1, Vehicle exterior preparation and display message

In addition, a tablet providing an interface to control centre was mounted on the window next to middle passenger doors. Outside on the front of the vehicle a dummy lidar was mounted along with laser and camera warning stickers, see Figure 9 below.

Figure 9 - Pilot 1, Mock-up LiDAR and laser warning stickers

Inside the passenger cabin, two bright yellow and red emergency push buttons have been installed to add to the impression that the bus was indeed fully automated. Finally, a 30-inch TV was installed (see Figure 10). It displayed a live feed of the obscured forward view with the current status message along with a centrally placed tablet showing current position and messages to offer some additional orientation to the participants.

Figure 10 - Pilot 1, Forward facing screen and an emergency button

Details on this equipment are provided in the following sub-sections.

3.2.4.1 Onboard Hardware

Several devices have been installed inside the bus to convey the impression of a fully automated autonomous vehicle. the complete setup is summarized in Figure 11 along with interconnection and communication between the individual devices. It can be added that any device connected to the Wi-Fi and with the mobile app installed would receive the same information. To advance the scenario as precisely as possible according to the actual location of the bus and its' passengers, the GPS location of a mobile phone was used just to see the location of the scenario.

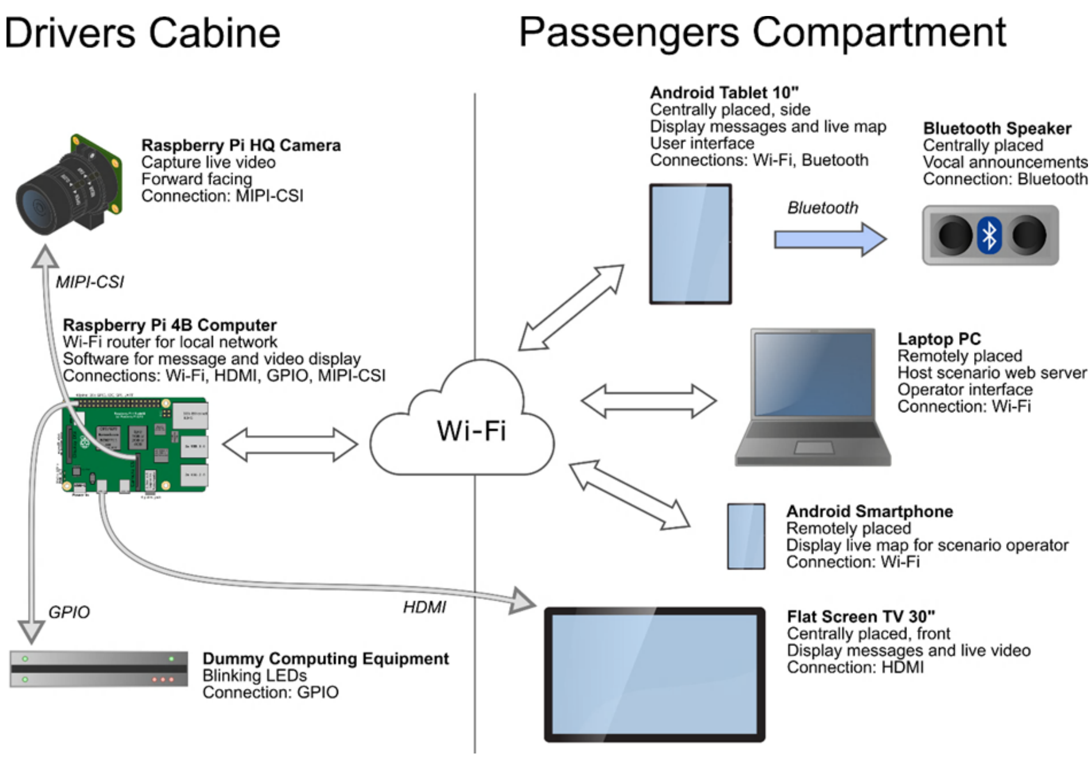

Figure 11 - Pilot 1, Onboard hardware overview

3.2.4.2 Scenario web application

The core of the scenario control is a C# (Microsoft .NET) web application served on a web server running on the Laptop PC.

While exposing a RESTful web service[4] consumed by the mobile app and the information desktop application described in the following, it also provides a web interface to the person who advances the scenario steps.

Any sequence of movement, events, messages and sound can be defined in an Excel spreadsheet for the particular scenario as described previously and can be modified as needed. Sounds are also downloaded from the web server, so it was possible to create a scenario displaying German messages and playing German media for example. The scenario conductor operating the laptop then advances in the scenario step by step through the web interface manually. Each step includes updated information on location, messages displayed and voice messages as well as what video call will be simulated. Naturally, this produces a one dimensional steadily advancing story line that cannot branch out and have different outcomes. This design choice has not been limiting, but it does require the (hidden) driver of the bus to perform the manoeuvres exactly as planned, and react timely according to the voice messages announcing departures, doors, etc.

3.2.4.3 Scenario mobile app

The mobile app is also written in C#, though using the Xamarin framework[5] allowing to produce apps for all major mobile platforms. While displaying live information including position, progress and speed of the vehicle, the app also allows users to call for assistance. Figure 12 shows the mobile app while running on the tablet on-board the bus. The three stops and the completed part of the journey are shown in green. Layout and configuration of the scenario is completely loaded through the web service provided by the web server on the laptop. During the project, it was decided that the app would only run on the tablet installed in the bus, to avoid installation and usage issues that would divert attention from the actual experience. Many users playing with the app features could potentially interfere with the scenario execution, and the mobile app is not to be understood as a proposed solution, but rather an instrument to simulate that the bus is in fact intelligent and connected. When interaction with the app was required by the scenario, a designated person of the EBUS staff would act accordingly.

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[4] https://en.wikipedia.org/wiki/Representational_state_transfer
[5] https://dotnet.microsoft.com/en-us/apps/xamarin

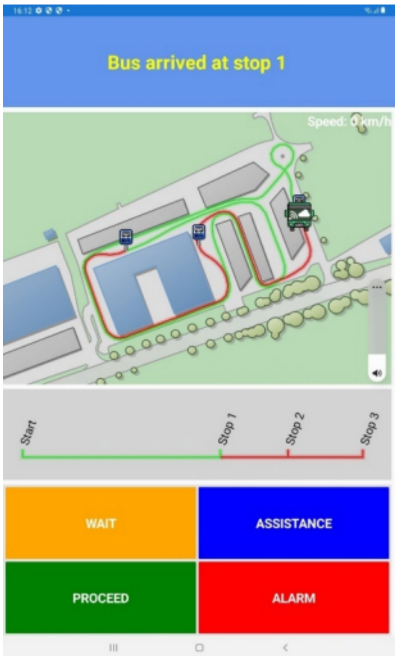

Figure 12 - Pilot 1, Mobile app on tablet

3.2.4.4 Information desktop application

The Raspberry PI computer is running Linux, so this application was developed in Qt Creator[6] using C++. When launched, this application will run the command line tool raspistill[7] with appropriate arguments to display a live preview image of the front-facing camera. At the same time, it displays a self-refreshing web page at the top of the screen that is served by the laptop where the current message and button statuses can be seen, see Figure 13.

[6] https://www.qt.io/product/development-tools
[7] https://www.raspberrypi.com/documentation/accessories/camera.html

Figure 13 - Pilot 1, Status message and live forward view

3.2.4.5 LED controlling script

This very basic Python script was used to control a series of LED lamps over the General-Purpose Input/Output (GPIO) port of the Raspberry PI to emulate advanced computing equipment in the event someone would try to make out the driver in the bus through the darkened windows. Figure 14 shows the cardboard box prepared with tape and how it appears through the tinted front window screen.

Figure 14 - Pilot 1, Mock-up computing equipment

3.2.4.6 Scenario preparations

Several things needed to be executed before a scenario could begin. Hours before, it was necessary to ensure that the bus was fully charged to remain in full electric operation throughout the experiment. A gate at the testing facility (which is usually closed), needed to be opened and otherwise blocking obstacles or vehicles had to be removed from the itinerary. Bus stop signs were placed, and the two buses fitted with line 1 and 2. The first bus was a standard 12-metres long bus, and only required the second driver to be ready. On the test vehicle itself, the technical preparation consisted of a number of tasks, see Table 5.

Table 5 - Pilot 1, Equipment checklist

Equipment	Status to be checked
Raspberry Pi	Power switched on
	Script to control lamps is launched
	Application to play back live video on tv and status messages launched
Bluetooth speakers	Power switched on
Mounted tablet	Power switched on
	Stable connection between tablet and Bluetooth speaker established
	Stable connection between tablet and Wi-Fi signal of Raspberry Pi established
	Mobile application launched
Laptop	Power switched on
	Stable connection between laptop and Wi-Fi signal of Raspberry Pi established
	Web server launched
	Functional open scenario administration web-interface
	Relevant scenario launched and loaded
	Verification that voice and status messages function correctly
Mobile phone	Power switched on

	Stable connection between mobile phone and Wi-Fi signal of Raspberry Pi established
	Mobile application launched
	Device muted as to not disturb the pilot
Action camera	Power switched on
	Recording started

3.2.5Pilot 1 Wave Reports

Overview of waves is given in Table 6. The first three batches followed a standard plan given in Section 3.2.2. Batch number four consisted of participants with visual impairments coming from Germany. The group arrived the day before the experiment. Therefore, the experiment started in the morning and included a lunch.

Table 6 - Pilot 1, Waves overview

Wave Number	Batch Number	Number of Participants	Scenario Number	Date	Time
1	1	13	1	10/06/2021	14:00-16:00
1	2	8	1	24/06/2021	14:00-16:00
1	3	14	2	01/07/2021	14:00-16:00
1	4	11	3	08/07/2021	14:00-16:00
2	1	5	4	20/09/2021	09:00-13:00

Weather conditions for the pilot days are shown in Figure 15.

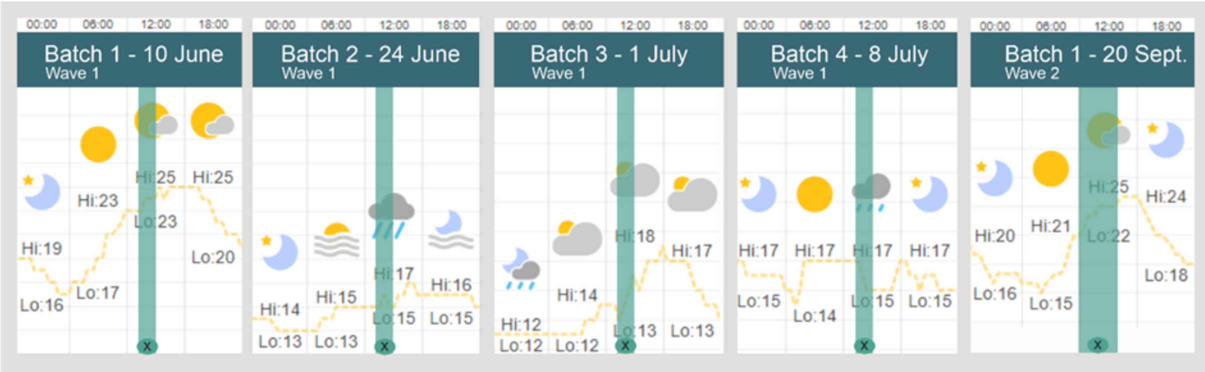

Figure 15 - Pilot 1, Weather conditions during the two waves (in C° Celsius)

Some pictures from the pilot are shown in Figure 16.

Figure 16 - Pilot 1, Group waiting for a bus (a), vehicle driving in mixed traffic - another bus driving simultaneously behind (b), event 3 - vehicle blocking the path of the bus (c), joint photo after vehicle inspection after completion of surveys (d)

3.2.5.1 Pilot 1 Scenario 1 report

The batches 1 and 2 covering scenario 1 took place on 10th and 24th June 2021. They were typical summer days with the first being sunny and slightly warmer with 24°C and the other rather cold for summer with 16°C. There were clouds on both days and there had been some prior rain the second day, but all-in-all pleasant ambient temperature. The experiment followed the scenario as intended with no scenario events. During discussions following the experiment, the participants remarks revolved around safety and the lack of support from a driver in different situations. The following concerns were shared during the discussion:

- Children or other helpless persons would need a driver to look after them;
- Safety concerns during night drives, e.g., the bus is currently perceived to be a safe place at night due to the driver – no driver means less safety;
- Several participants were under the impression that the vehicle was moving slowly. This was because the acceleration and braking were much softer than in a conventional bus;
- Some participants were worried about reaching the doors in time before they close, and the bus departs since they could not make eye contact with a driver or alert them quickly;
- No additional information about environmental information for the route that would normally be available from a driver when visiting unknown areas could be potentially an issue for some passengers;
- One person was also worried about possible attempts to break the automated system, like blocking the doors or to keep interacting with the bus in a malicious manner.

Additional comments were made during an open discussion:

- Most participants claim that they do not interact with bus drivers on a regular basis themselves, though they do believe it would be required in certain situations;
- Vulnerable users should be able to check-in to the bus and set their destination for extended assistance. Such check-in could possibly happen through voice command as it was suggested by one participant;
- Response time of the control centre or emergency personnel is critical as some emergency situations may escalate and a prioritisation of incidents with the autonomous bus should be considered in the emergency response planning.

3.2.5.2 Pilot 1 Scenario 2 report

Batch 3 of Wave 1 took place July 1st 2021 that though dry was only 17°C. In this scenario the vehicle first performed an unannounced stop (extended pause) and then at the first stop a person was unable to enter the bus as the doors did not open. The passengers were left with no information and no means of intervention. One participant tried to open the doors using the usual stop buttons. Finally, the bus made a pause when another vehicle was blocking the route.

During discussions there were some very sceptical remarks towards automated/autonomous buses from two participants. That is, they claimed that automation does not bring any improvements, neither to passengers nor to traffic. Once again, the lack of a driver concerned the participants especially as she/he would have been the immediate point of contact during the unforeseen events. Driver importance was emphasised in the context of security issues like not letting threatful people in or for reassurance when riding alone at night. The following concerns were shared during the discussion:

- Some people believed that automation will not solve any problems, and moreover might add some unknown issues (a comparison to “dirty” batteries of electric vehicles was made by one person);
- One claimed that mixing automated and human driven vehicles does not make traffic smoother and safer;
- At first, a handful participants did not think that the driver is important for safety, while others thought the opposite. After some discussion however, the general opinion seemed to support the importance of the driver;
- One female participant mentioned that for safety reasons she would sit right behind the driver when riding alone at night. This would not be possible in a driverless bus;
- Drivers also act like doormen by not letting sinister or homeless people in that could pose a threat to other passengers, or who just look for shelter;
- One participant felt tense and was closely monitoring the behaviour of the bus. Had it been a human driver she would be more inclined to relax and not watch the road.

Additional comments made during the discussion:

- Drivers are already partially isolated from passengers (do not sell tickets, do not announce stops), hence their role is diminishing in a typical commuting experience;
- Proper announcements and information about journey progress are important. The comment was made by the person who did not notice the tablet showing position and progress at all times;
- A participant argued that traffic must consist of autonomous vehicles only or have dedicated lanes to be smooth and safe, because mixing typical human driven vehicles with very defensive driving automated vehicles of today produces slow-down situations;

- Autonomous buses will allow better services as they could have flexible routing based on real-time demand and not be limited by a driver's working schedule. Thus, automation can improve PT;
- There was general agreement that an emergency button is a must. Inspired by the ones in elevators, suggested one participant, except that response time must be shortened.

3.2.5.3 Pilot 1 Scenario 3 report

Scenario 3 concluded wave 1 with its fourth and last batch on 8th of July 2021. Though conditions were dry and rather agreeable this was yet another non-typical day of late summer with only 16°C and some prior rain. The participants experienced the same "unforeseeable" events as in scenario 2, except that this time an incoming video-call would explain the unscheduled stop and an EBUS staff member was able to initiate a video-call to help the participants when the doors didn't open.

The discussion was very similar to previous discussions, though this time there was more focus on the potentially bad behaviour of passengers and abuse of automated systems in the absence of the human driver. The following concerns were shared during the discussion:

- The lack of a driver can be a problem when too many people try to board and can eventually block the doors;
- A camera may not provide enough security as it can easily be cheated by covering one's face wearing a balaclava, and in an emergency the operator contact is not fast enough;
- There is also the possibility that someone would abuse the emergency stop to get off the bus in some unmapped locations that are situated in-between official bus stops;
- One participant mentioned that in larger cities there are sometimes fights on buses and the driver needs to get involved, acting also as a security guard for uninvolved passengers;
- Besides aggressive behaviour, there may be other irritation or inappropriate behaviour, like playing loud music and harassing passengers, which could be more likely without a human driver in the eyes of the participants;
- Similarly, other misbehaviour, such as smoking or vandalization, would also be difficult to prevent in an empty bus with no-one to notice and report it;
- It is important to prepare fully automated services also for disabled people and accommodate especially their needs for security and boarding, as they may need more time or assistance from the driver.

Additional comments made during discussion:

- One participant said they prefer to see the human driver and be able to ask questions directly;
- Another said that the driver is not as important in a city as in long-haul or interurban coach travel. On the highway with high speeds, they explicitly shared that they would much prefer a human driver;
- Another person claimed that in certain situations an emergency stop is more efficient than calling a control centre. For instance, it can automatically send GPS coordinates;
- Generally, participants agreed that automation is a good thing and that it will allow for smoother and more efficient traffic conditions;
- A participant thought the TV with live camera view was a good idea, mostly because the front view was obscured;
- To another participant, the driver is not so important in general, except for passengers that are travelling in an unknown area.

3.2.5.4 Pilot 1 Scenario 4 report

The first batch of wave 2 took place the 20th September 2021 and conditions were again dry with some prior rain, but it was only 14°C, and therefore a little cold. A few experts in accessible transportation and electronic devices were present among the participants. Many of the concerns raised by participants of wave 2 had been covered in discussions of the previous pilot wave. However, from the perspective of the visually impaired persons there appears to be the need of a driver for security aspects and information accessibility. That is, being able to ask a driver for help is a basic requirement.

Issues that may seem minor can become a real challenge, such as when the bus does not stop exactly where it is supposed to or if people or things block the doors. Touch displays without tactile feedback or voice over functionality cannot be used by visually impaired people, and with cane in one hand and smartphone in the other there is no way to find hold on-board a moving bus.

Another take-away to highlight is, that the barriers mentioned above in combination with a lack of advanced accessibility functionality, effectively exclude some vulnerable groups from participating within society. To them, it would be perceived as a failure in supporting inclusion efforts.

The following concerns were shared during the discussion:

- A visually impaired person usually needs someone to ask questions to, e.g., is it the right bus, is it the right bus stop, etc. If acoustic assistance fails, such a person may be left uninformed and practically without orientation on-board a moving vehicle;

- Smartphone apps, that in theory can help, are problematic to use with a cane in one hand, and the phone in the other. Finding a place to hold on to while on-board or walking may become very difficult;
- Smooth driving enabled by automation is an advantage especially for vulnerable passengers. Sudden emergency breaking of autonomous buses can on the other hand be a real issue for seeing impaired who cannot anticipate emergencies and cannot catch their fall;
- It proved especially problematic for the seeing impaired when the bus leaves too early, the doors do not open, one does not make it out in time, in the event of a fall or in case of bad or endangering behaviour from other passengers;
- There could be misuse and abuse of emergency stop and operator contact;
- Passengers or luggage blocking the exit doors are often a struggle with normal busses, a challenge that would not be solved through automation;
- When a bus does not stop exactly at the expected stop location (e.g. due to roadworks) it is very problematic for a visually impaired person as they are effectively lost without access to the tactile pavement of the bus stop.

Additional comments made during discussion:

- Access to advanced information (e.g., a modified route due to roadworks) from the vehicle is important when a driver is not available;
- When a bus arrives to a bus stop, it should announce line number, and make a sound so that it is perceived by visually impaired to help them find the door and know if it is the correct bus before boarding;
- The door open/close announcements during the experience would be annoying in the long run, they should be replaced with signal sounds;
- Such sounds have been standardized in different efforts, though as noted standards are not always unified across borders, which would be key in enabling persons with disabilities also to travel internationally with ease;

- Any unusual behaviour or manoeuvre should be announced to give visually impaired passengers the opportunity to brace themselves in case of impact or unstable steering;
- A fast contact to a very responsive central unit is required, especially for vulnerable passengers (see concerns) as calling individual, responsible driving assistants for help is not a reliable option;
- Assistance must overall be easily accessible. One person suggested two buttons on each seat, or only at special, dedicated seats. The vocal announcements of such a system should be local (limited to seat area) at a low volume to not disturb other passengers:
  - One to play back announcements on next stops and the current route information;
  - The second would allow contact with a control centre;
- In response to the fears of misuse of accessibility functions the participants agreed that it will always exist and it is difficult to prevent these kinds of vandalism and abuse. In the opinion of the participants, it cannot be a reason to not offer any support at all, since it is a question of respect, worthiness and ethics, not to punish/discriminate vulnerable passengers but to help them as best as possible;
- If a passenger is alone in the bus and experiences a problem an immediate response is needed. Simply recording a video does not help, an operator needs to monitor the bus and be able to intervene in real-time;
- Permanent video that is monitored by a central unit can allow immediate and proactive operator announcements: “move out of the way, you have been recorded!” and other warnings if needed;
- Another suggestion was that of having safety guards at certain stops or traveling on buses. These could also be first-responders when an emergency situation arises;
- Automatically detected obstacles, or feedback of what the vehicle is doing could be announced to visually impaired on-demand. This environmental information could be accessible through the buttons suggested earlier.

3.2.5.5 Pilot 1 Wave 3 special batches

Three additional special experiments not specified under any of the scenarios defined in D6.2 [5] were carried out, see Table 7 and no incidences occurred during the ride. The first batch consisted of transportation professionals involved in financing projects. The goal was firstly to see the perception of the professionals towards automation, and secondly to disseminate the key lessons from the project and pilot. A short and simplified questionnaire was applied. What did stand our form the previous batches was that security perception was generally not an issue, and the need for an on-demand/proactive contact with a control centre was not critical to the participants. One interesting comment came up during a discussion which a participant compared riding alone on-board of an autonomous bus with using an elevator alone.

Table 7 - Pilot 1, Special wave overview

Wave No.	Batch No.	No. of participants	Scenario No.	Date	Time
3	1	5	1	27/10/2021	10:00-14:00
3	2	2	1	15/01/2022	17:00-18:00
3	3	1	1	15/01/2022	18:00-19:00

The goal of the last two batches was to investigate claims made during discussions in the two main pilot waves regarding perceived safety in case of riding on-board of the bus alone and/or during the night-time.

Figure 17 - Pilot 1, Bus ride alone at night

In batch 2, two participants rode the bus alone during the day, while in batch 3 the participants were alone in the bus, when it was dark outside (see Figure 17). In the interviews, all participants confirmed that driving alone in the driverless bus raised several security questions that require special attention and further investigation. Particularly, whether passengers can receive help fast enough in case of an emergency, or stop the bus themselves and exit the vehicle after an accident.

3.3 Data collection

All the data collected has been received from natural persons who have read and agreed to sign a GDPR compliant form. The form has been collected with the rest of the questionnaire, but has later been anonymised, which ensures and anonymous data analysis. None of the persons who have filled out a survey within this pilot or have agreed to conduct an interview or participate in a FDG are identifiable through the dataset analysed. Furthermore, all participants who appear in photo- or videography footage have given their explicit consent to be recorded and for this footage to be used for analysis and communication purposes.

The data collected can be divided into two distinct categories:

1. Quantitative data, which comes from the questionnaires, which have been prepared for the two first waves as well as data regard the incidences reported during the days the tests were performed and also any data collected from the tablet on-board of the bus;
2. Qualitative data, which is gathered through additional comments of the participants, photo- and video footage and finally observations and minutes prepared by the staff.

All data has been saved in a dedicated and secured Dropbox[8] folder, which only the PAsCAL staff has access to. All data has been checked to conform to GDPR standards and be as homogenous as possible for a successful and smooth data analysis process.

3.4 Data evaluation

The questionnaires answered throughout all batches were the same except from four questions regarding events that were masked out if these events were not experienced in the batch. Below results of selected

[8] https://www.dropbox.com/es

questions of the two batches are provided, starting with participants background and concluding with attitude towards various aspects of automation.

Age distribution: There were 25 female and 26 male participants with an average age of 46 and 40 respectively. The youngest participant was 18 years old, the oldest 73, resulting in age and gender being quite well represented and distributed, though some batches showed light bias.

Occupation: participants were mostly full- or part-time employed which was the case for three quarters of all participants, see Figure 18. The largest group, with two thirds of the participants, had full-time work whereas the second largest group of one sixth were retired.

Q20: Which is...n occupation?	Count	Percent
Student	4	7.1%
Full-time work (over 30 h a week)	35	62.5%
Part-time work (30 h per week or less)	6	10.7%
Currently not employed	1	1.8%
Retired	8	14.3%
Other	2	3.6%
Total	56	100.0%

Figure 18 - Pilot 1, Participant's occupation

Commuting behaviour (Q22): As most participants were recruited in Luxembourg (the country in Europe with the highest cars per capita) it is not surprising that the most represented means of transport was by private vehicle (see Figure 19). Nevertheless, second most used mean of transportation is public transport. In addition, several participants rely on walking or light vehicles such as bikes or e-bikes.

Q22: Which sy...-19 pandemic?	Checked Percent	Check...Count
Private vehicle (car, motorcycle, etc.)	47.4%	27
Public transport	40.4%	23
Walking	24.6%	14
Light vehicles (bicycle, electric bicycle, etc.)	14.0%	8
Sharing services	8.8%	5
None of the above	0.0%	0

Figure 19 - Pilot 1, Participant's means of transport

Experience with connectivity apps and automation (Q8): All participants except one with seeing impairments had tried Navigation systems either as a driver or passenger (see Figure 20 below).

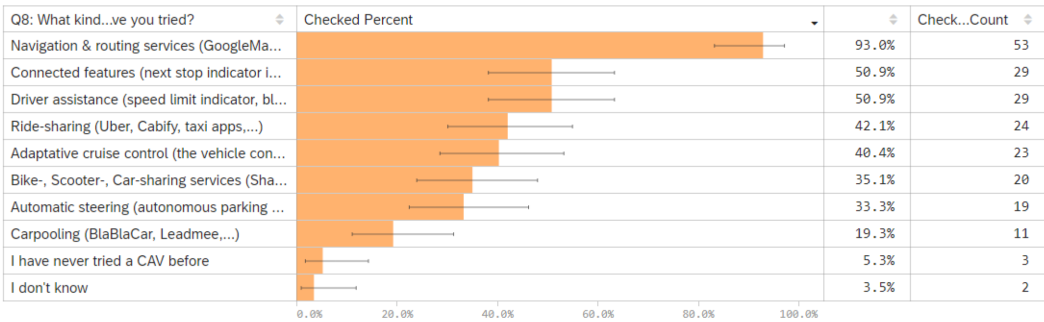

Figure 20 - Pilot 1, Participant's exposure to connectivity and automation

A large part of the participants had been exposed to driver assistance features such as speed limit indicator, blind spot detection, lane assist, adaptative cruise control indicating familiarity with technically advanced personal vehicles. At the same time more than half of the participants had used shared mobility solutions such as bike-sharing and carpooling.

Experience with autonomous vehicles (Q9+Q10): From **Error! Reference source not found.** we conclude that a large portion of the participants have tried CAVs with 14 of 51 even as a driver. 20 participants indicate that the CAV they tried was an autonomous shuttle service.

Table 8 - Pilot 1, Participant's CAV and shuttle experience

Q9: user mode	Q10: Tried an autonomous shuttle previously		
	Yes	No	I don't know
Passenger	65.2%	42.3%	80.0%
Driver	0.0%	15.4%	0.0%
Both	34.8%	42.3%	20.0%

General feeling during the experiment(Q24): When asked about their feelings related to the pilot (ride with bus 2) the dominant perception was that of curiosity (see Figure 21 below)

Trustful and safe combined were the second most represented feelings. However, insecure and nervous combined were also quite strong. One can notice that batch 3 (scenario 2 with unforeseen events and *basic ICT support*) felt more nervous/insecure (14.28% vs. 10.53%) and less trustful/safe/curious (71.43% vs. 84.21%) when compared to batch 4 (that experienced scenario 3, the same as scenario 2 except with extended ICT support). In fact, nobody who experienced the videocall assistance reported feeling nervous.

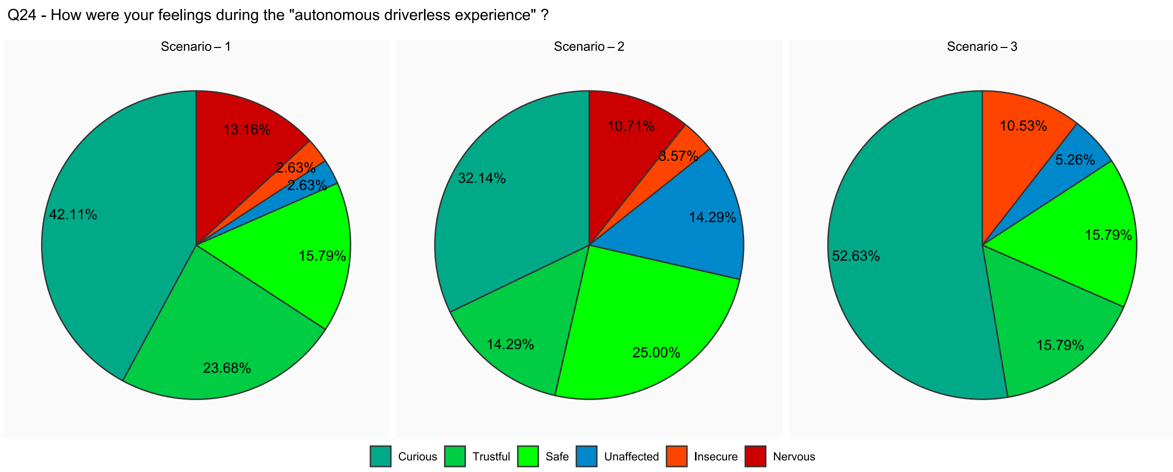

Figure 21 - Pilot 1, Participant's feelings during the pilot

Benefits and drawbacks of automation (Q27+Q28): only two persons thought there would be no benefits at all whereas 12 saw no drawbacks which all-in-all indicates a positive mindset towards CAVs. Figure 22 shows the relative importance of the different issues with lower pollution and increased safety being the most important advantages and loss of jobs and worse service the most important expected disadvantages.

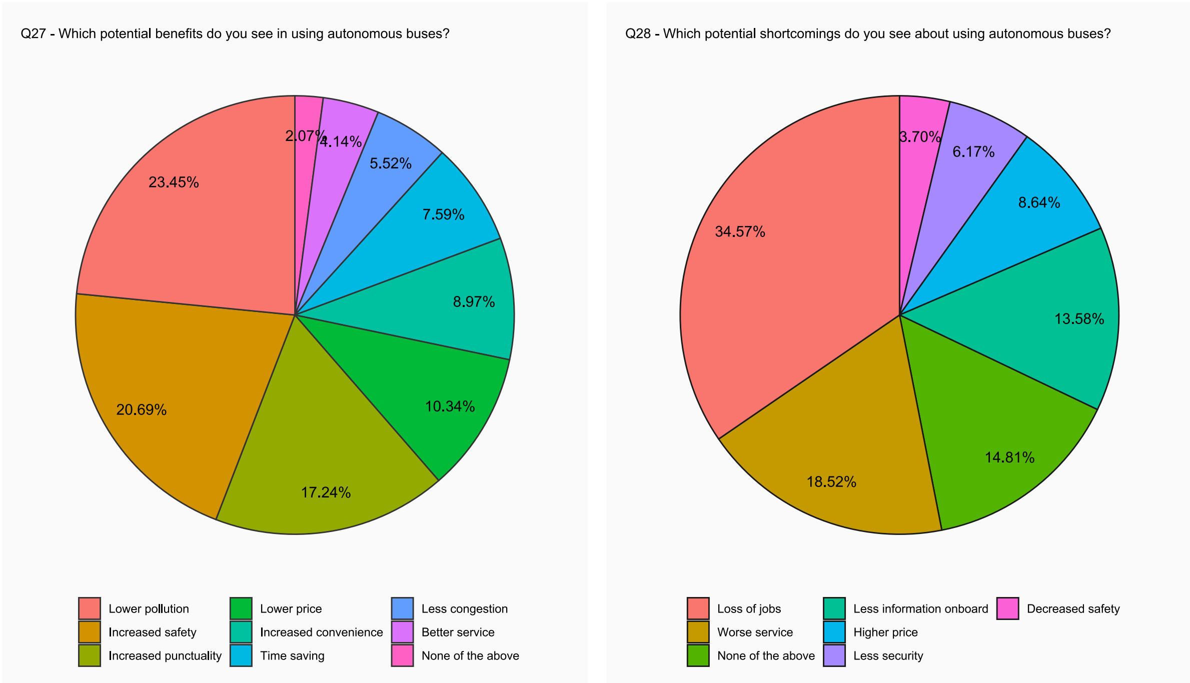

Figure 22 - Pilot 1, Participant's expected advantages and drawbacks of automated/autonomous high-capacity buses

Attitude towards using automated buses (Q29/30): an overwhelming number of participants would use automated/autonomous buses themselves and let family and close ones use them (only one negative response). Among the positive responses, 27 would certainly use such buses, 12 probably and 11 would conditionally use it (depending on how the technology evolves).

Lack of driver on board of the bus (Q32-35): As shown in Figure 23, the lack of a driver has important negative impact on perceived security of passengers in emergency situations. When it comes to information access through a driver, the responses are divided fifty-fifty among responses, the participants agree almost unanimously that on-demand contact with a control centre is important. Almost half believe that users of autonomous buses will be vulnerable to criminal behaviour, with 10 not sure and 12 thinking it will have no impact.

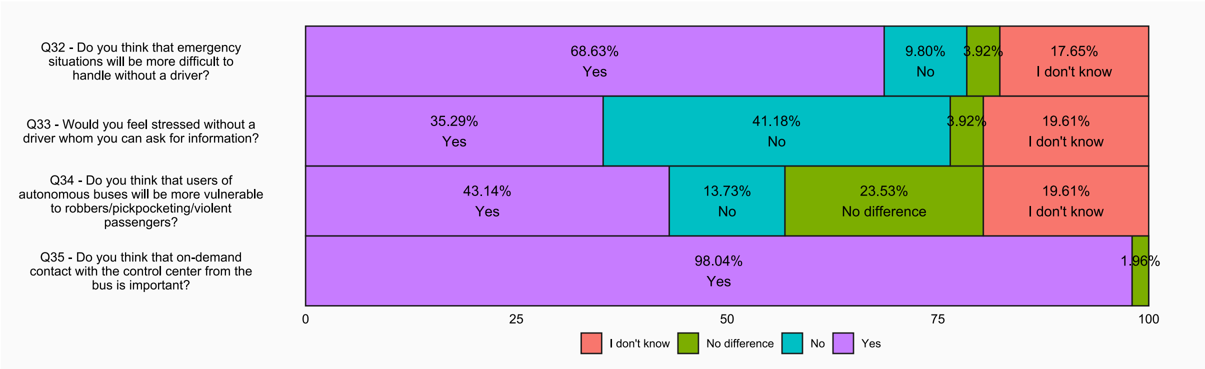

Figure 23 - Pilot 1, Various autonomous bus issues

Openness towards future CAV technology (Q44+45): When asked whether they would switch to using autonomous buses and how they would feel if a large portion of the population was using them, only five responded negatively and two of these also felt bad about the rest of the population using them. Of the remaining 46 positive respondents 27 make on-board IT support (e.g., allowing to connect to a control centre) a condition for using autonomous buses.

3.5 **Cross-fertilisation Activities Across WPs**

The outcomes of the pilot were used in WPs 7,8 and 9. Firstly, questionnaire answers were submitted to WP7. Secondly, draft recommendations were submitted to WP8. The recommendations were split in five groups:

1. The purpose of automation, connectivity and digitization focusing on science-based view of the technology and economic aspects;
2. Vehicle safety expressed in trust towards vehicle automation;
3. Vehicle security in view of lack of driver/PT personnel presence;
4. Access to information in view of lack of driver/PT personnel presence;
5. Specific needs of passengers with visual impairments.

Lastly, the analysis of the results was used in WP9 via various dissemination and communication activities.

3.6 **Dissemination activities**

Pilot goals were first announced in a presentation called “The future of e-buses” held by EBUS during the *2nd International VDI Conference* –

Future of Buses 2019[9] on 27th November 2019. A paper called "Minimising the impact of public transport on climate change" was presented at the *27th ITS World Congress 2021*[10]. Its' main goal was to illustrate the purpose and impact of the emerging technologies – electrification, connectivity, and automation – on the quality of PT services and on potentials in reducing negative externalities. The paper contains also some materials used during the pilot briefing. A presentation called "Key challenges in transitioning to autonomous public transport operations was made during UITP's *IT-TRANS International Conference 2022*[11]. It showcased the results of KRABAT and PAsCAL projects. It argued that extensive ICT developments need to be carried out in parallel to development of autonomous technologies. Two other papers were submitted for review. The first one called "Benefits and Challenges of Integration of High-Capacity Automated Buses to Public Transport Operations" was submitted to *2022 Transport Research Arena Conference*[12] (joint presentation with KRABAT). The second paper focusing entirely on PAsCAL was submitted to the *2022 EU ITS European Congress*[13]. In addition to showcasing results of the pilot it also argues that technology alone is not a silver bullet in making PT more attractive. An autonomous bus operating in mixed traffic will only be marginally more attractive than a conventional bus (potentially smoother operations).

3.7 Conclusions & Learnings

There are no doubts about societal and environmental benefits of PT automation. The degree of benefits depends on how far the automation is applied. That is, they can be low in case of "isolated automation", or very high in case of "system automation" enabling cooperative and coordinated mobility. A systematic approach can make PT an attractive mobility alternative, it can increase positive attitude of passengers towards automated/autonomous PT services. However, the first stage of automation deployment of high-capacity buses will consist of "isolated automation". To reach that stage, two necessary conditions must be met. The first one is technology readiness meaning that buses are safe and reliable. The second condition is that PT users trust and accept the new

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[9] https://www.vdi-wissensforum.de/weiterbildung-automobil/future-of-buses/#
[10] https://itsworldcongress.com/
[11] https://www.it-trans.org/en/
[12] https://traconference.eu/
[13] https://itseuropeancongress.com/

technologies. Passenger acceptance of automated/autonomous buses without safety drivers/PT personnel on board has three main aspects illustrated in Figure 24.

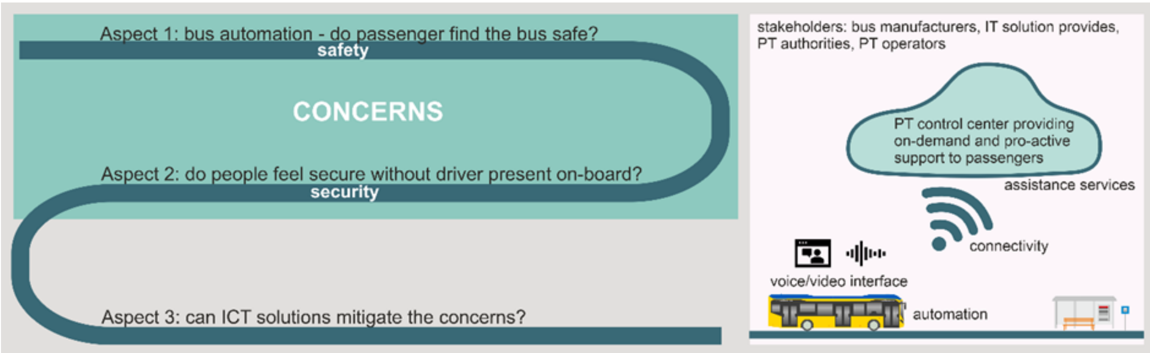


Figure 24 – Pilot 1, Towards passenger acceptance of automation/autonomy without safety driver/PT personnel on-board

The first aspect is trust towards driverless technology. That is, whether passengers believe that automated/autonomous buses without a driver on board are safe (crash risk perception). In theory, this shall not be an issue, as by the time such buses reach the market beyond trials (>2030), they will be safer than vehicles operated by humans. However, science-based evidence does not guarantee that passengers will find the buses safe as misinformation is ubiquitous in the media (one can compare it to several relatively common false claims existing today in relation to electrification). PT automation benefits need to be explained to the public by dedicated campaigns. These campaigns shall not only clarify technical and environmental aspects, but also explain societal elements such as the impact on job market that despite common believe is almost not existing in the case of PT automation. As shown in Figure 25, automation is an enabler of several new applications that with adequate policy support can make PT more attractive, and therefore lead to substantial environmental gains.

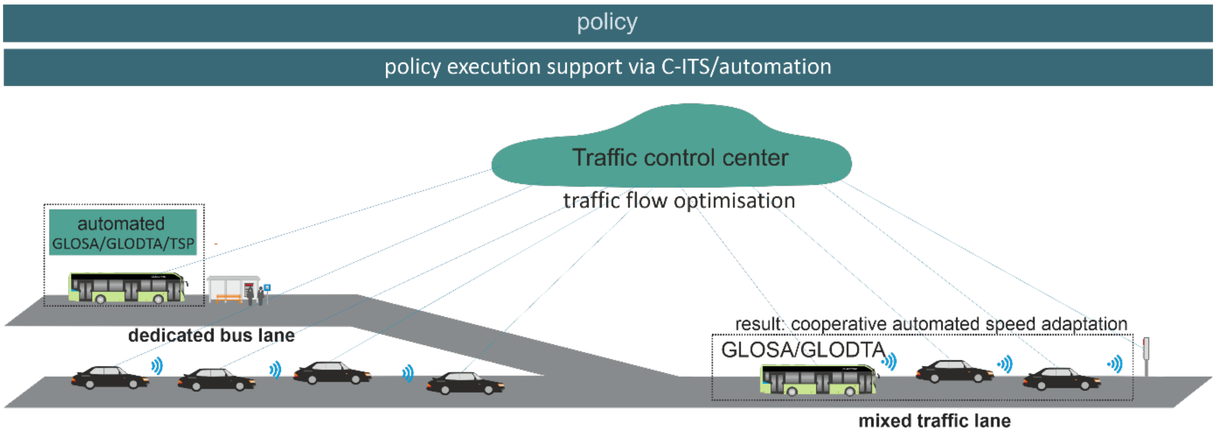


Figure 25 – Pilot 1, Connected and automated mobility

The KRABAT project was the first of its' kind to show that people generally trust the technology. The outcomes of PAsCAL confirmed this hypothesis, although, in the case of unusual behaviour/faults (e.g., long idling outside bus stops, door issues) additional assistance via ICT technologies was shown to be necessary. The assistance not only means solving the problem, but also informing what happens with a bus and supplying reliable environmental information. Therefore, a bus not only needs to be autonomous/automated, but also connected with a control centre to provide video/voice assistance (on-demand and proactive). Therefore, while bus manufacturers need to provide safe and reliable autonomous/automated buses, additional services need to be provided by the IT industry providing solutions to buses (today these are only focusing on bus tracking and monitoring). In addition, PT operators/authorities will need to extend their control centres with new roles. Moreover, PT authorities will have to play a major role in specifying the standards to be deployed by bus operators.

The second aspect is perceived security related to the fact that a driver is no longer present on board of a bus. Besides operating the bus, the driver plays a crucial role in several situations – ranging from offering on demand information, to coordinating/fixing issues and providing a feeling of security. The gaps in information provision will most likely not be an issue. Firstly, COVID-19 pandemic has already limited interactions between passengers and drivers. Secondly, advanced travel assistance applications available on mobile phones of passengers are providing very effective support. Project results indicate that passengers' perception of security will most likely not be an issue during day-time operations with several passengers on-board. However, special attention needs to be made on night-time operations where the risk of travelling alone is significant. One must keep in mind that by the time that high-capacity autonomous buses become common in PT operations, it is very probable that PT operations will be organised in different ways than today. That is, thanks to combined efforts of digitalization, connectivity and automation, PT services will be organised in much more dynamic, demand responsive ways. This implies, that high-capacity buses will operate in high-demand periods, while low-demand operations will be served by on-demand small size shuttles that will allow additional security measures such as authenticated pre-booking.

4 Pilot 2: Autonomous driving training

4.1 Introduction

The second pilot analyses the need for appropriate knowledge and training for the safe and correct use of CAVs. To test the training methodology developed in WP5, participants used a vehicle with Advanced Driver-Assistance Systems (ADAS), such as technologies, who aid the driver in their driving or parking. In particular the level 2 ADAS tested were:

- **Adaptive Cruise Control (ACC)**: A kind of cruise control, which adjusts the speed of the car according with the speed of the car which comes before;
- **Automatic Parking (AP)**: a system which checks whether there is enough space to park the car and makes all the manoeuvres necessary to park in that space;
- **Lane Keeping (LK)**: a system which aids the driver to keep the lane, avoiding crossing of the stripes;
- **Automatic Braking System (ABS)**: a system which brakes the car in case of emergency (e.g., sudden obstacle or distracted driver who don't notice that the car in front hast stopped).

The goal of this pilot consisted in measuring the influence of dedicated trainings with a particular focus on the following key aspects from the subjective participant perspective for integrated ADAS in level 2+ automated vehicles:

- Knowledge and awareness of the functionalities and their objectives;
- Trust in the functionalities;
- Acceptance of the technology as an aid to driving in everyday situations/conditions as well as during special events;
- Evaluation in global terms of reliability, convenience, effectiveness;
- Management of critical situations related to the use of ADAS (driver intervention in emergency situations, malfunction of the system, etc.).

To explore these aspects, a number of participants were split into two different groups. One group was subjected to a specialised training, educating them on the functionalities of the ADAS used in the pilot. The other group only participated in a general briefing on the objectives of the pilot but received no further training.

This allowed the pilot manager to capture not only the general acceptance of these systems but also the effectiveness and need of enhancing current training offerings to the general public by including CAV training for rising levels of automation and connectivity for driving learners.

Both groups were also given Safe Driving (SD) exercises. In particular, the exercises on Skid Control (SC) and Braking Modulation (BM) were performed. These exercises do not require the use of ADAS, but they were instead used to evaluate the participants' ability to manage emergency situations, in consideration of the fact that the malfunction or non-functioning of the ADAS often leads to a situation of this type.

4.2 **Pilot execution, Observations & Deviations**

Originally in deliverable D6.2, it was planned to carry out the pilot with CAV level 3 and CAV level 4 vehicles. Unfortunately, it was not possible to use them because they are not present on the Italian/European market. Several experimental vehicle design companies and manufacturers have been contacted to try to identify the supplier of a vehicle that can be adapted to the requirements of the WP6 test pilot 2.

In May 2021, therefore, with the support of Automobile Club Italy (ACI) Technical Professional Area, ACI began to carry out exploratory research to find partners that would allow to carry out the pilot. On 11th June 2021, ACI organised a first call with an international player of experimental vehicles who, however, informed ACI that I wouldn't be possible to carry out this pilot in Italy due to current legislation and that the hypothesis of having experimental vehicles driven by drivers other than qualified technicians wouldn't be achievable for insurance and safety purposes.

At the beginning of September 2021, ACI tried to check the availability of a prototype of a principal actor in vehicle production of CAV level 3, there seemed to be good prospects. It was proposed in the meeting to kick off an operational collaboration for 11th October 2021. The representative of the company announced that, after the verifications carried out with the Europe sales department, no CAV level 3 vehicle was available before October 2022.

At the beginning of December 2021, a company was contacted, which deals with the development of new technologies and which has created an interesting prototype of a remote-driving vehicle. This vehicle would have allowed to reproduce the cases of the Home Study Simulator directly. On 2nd December 2021, at the Turin offices of the company. Unfortunately, although this company had an interest in support ACI in the experimentation, they refused the possibility of participating as the pilot timeline would have been busy in other experiments with a third external manufacturing company.

In order to leave no chance to achieve the result, ACI also asked a French company, specialised in public transport with CAV level 4. Although they acknowledged the need for the pilot, they communicated to ACI the impossibility of setting up the pilot with their shuttle bus. This was because they are not currently active in Italy and won't be until at least June 2022, informing ACI also that the handling costs in any case would have been very high because, according to current regulations, these vehicles cannot travel freely on the road without geo-fencing and mapping an area first.

To achieve the established objectives, it was decided to carry out tests (on groups of drivers of different sex age, experience and preparation) with a level 2 CAV with integrated ADAS that could reproduce some of the typical situations of a CAV level 3 or level 4. To simulate, for example a partially automated driving, the ACC was used in combination with the LK, or the ABS, AP, etc. what had to be investigated in the pilot is in fact the effectiveness of the methodology developed in WP5 through the driving simulator made available by LIST and which provides, precisely, a purely practical part of training. As reported in D5.3: "[…] a simulator exercise alone, could create cognitive and perceptual errors in the learner, in addition to the acceptance of incorrect behaviours." [8].

Hence there is a need to compliment the training module with practical experimentation, aimed at understanding the real-world operation of on-board systems, experimenting with possible critical situations, and exercising the management of the vehicle. The opportunity to carry out this type of training in a protected areas in a first phase is linked to the risk of misreading a critical situation on the road and the probability that such situations will not occur during a limited number of hours in accompanied driving.

The objective of this phase must therefore be the achievement of a good acceptance of the CAV, as well as the experimentation of some critical situations of the ADAS devices and the training in the application of the protocols provided in the theoretical module and already tested through the simulated driving, through the practical exercise in the car.

The space intended for these exercises must be equipped in order to recreate those situations in which the automated driving systems can pass from an ideal operating situation (acceptance) to a critical situation (training). The exercises hypothesised to date have been built by virtue of the current driving aid technology, present on the most advanced vehicles on the market […]”.

The strategy adopted was to divide the participants of each wave into 2 batches in order to get an even and unbiased distribution of participants for both groups (with and without training). The first batch of each pilot wave was the one which did not receive any form of special training and was only subject to a general briefing on the PASCAL project and its’ objectives before they went directly to the execution of the pilot. In batch 2 of each pilot wave, the group was instead formed through a specific theoretical course aimed at teaching the functioning of the on-board electronic systems and the techniques for controlling the car in critical situations (e.g.: loss of grip on the rear axle) and was then subjected to the piloting.

It was decided to compare the evaluations on the execution of the exercises with reference to the points reported in the introduction, comparing the different groups with each other.

In consideration of the particular conditions of the continuing COVID pandemic during the execution of this pilot and to avoid absences due to periods of illness or precautionary quarantine, it was decided to resort to personnel from the Italian Army, mostly coming from the Logistics Departments[14]. Some of the participants were therefore in possession of professional licenses for driving heavy vehicles and special vehicles and in part, they were accustomed to driving military vehicles also equipped with advanced technologies. Another portion of the participants, however, did not have these specific licences or experience and their level of preparation could certainly be considered comparable to the level of average civilian drivers. Engaging the army made it possible to involve about 80 participants. The group of participants also included some driving instructors and civilians with a driving license level B (for motor vehicles under 3.5 tons and less than 8 passenger seats, e.g., regular cars), which added up for a total of 91 participants in this pilot.

To determine the level of information and initial theoretical preparation of the participants on the knowledge of ADAS, special questionnaires filled in anonymously were distributed. The level of preparation / information found in general on the group of participants can be described mainly as "very low". As expected, the group of instructors were fully informed.

[14] urly.it/3j86q and http://www.nrdc-ita.nato.int

4.2.1 Safe Driving Centre: features

To ensure maximum safety conditions for the participants, all tests were held at the ACI SARA Safe Driving Centre in Lainate, see Figure 26.

Figure 26 - Pilot 2, Lainate ACI SARA Safe Driving Centre

The Centre has a track and 4 areas dedicated to safe driving and equipped with the most modern technologies for the creation of controlled emergency situations and maximum safety for drivers, see Figure 27.

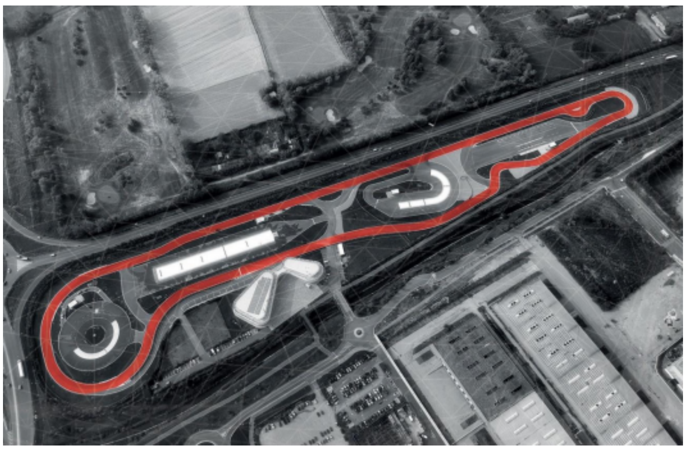


Figure 27 - Pilot 2, Lainate ACI SARA Safe Driving Centre (track)

Concretely, the following areas were used during the pilot by participants:

Track (for ACC and LK):

- Track length without both chicanes: 1,436.5 m;
- Track length with both chicanes: 1,450.5 m;
- Track length with 1st chicane: 1,447.5 m;
- Track length with 2nd chicane: 1,444.1 m;
- Maximum straight length: 437 m;
- North hairpin bend radius (c/o aquaplaning area): 14.65 m;
- South hairpin bend radius (c/o understeering area) (clockwise): 1st radius 44.5 m. 2nd radius 50.5 m;
- Track width: constant 9 m.

Safe driving areas (for Safe Driving Course and ABS):

- Slide: 1916.15 sqm, 198.5 m in total length, of which 115.5 m on resin;
- Downhill hairpin: 206.60 m of the development of which 38 m on straight resins in slope and 49.9 m on resins in curves;
- Asphalt area: 162.9 m with 6 water walls.

Plant (for AP):

- Internal parking spaces: 69.

Conference room (for theoretic sessions):

- Building 1, Room 3.

The availability of a Centre and ACI Safe Driving instructors made it possible to combine the tests on ADAS with safe driving exercises, in order to establish not only the theoretical level determined by the questionnaires, but also the level of practical preparation as drivers of the test participants, regardless of the curriculum they presented.

The driving level was detected by the instructors themselves, who compiled evaluation forms during the execution of each exercise (as reported in the sub-chapter *Data collection*).

Below is a description of the exercise areas used and the related exercises. To perform the tests, in addition to the safe driving areas already available, 3 specific ADAS test areas were prepared:

- Road lanes have been reproduced on a straight section of the track, respecting the provisions of the Italian traffic laws in terms of colour, size, characteristics of the stripes and the lanes themselves. The area was specifically prepared for the *lane keeping* test, see Figure 34.

- Within the asphalt area dedicated to emergency braking with water walls, a path with special shapes for the automatic emergency braking test was reproduced, see Figure 32.
- An area dedicated to automatic parking has been prepared in the real parking area of the structure, using cars from the Centre to simulate the real situation found on public roads, see Figure 33.

4.2.2 Safe Driving Centre: Exercise and Test

Six distinct exercises were prepared, which can be split into safe driving tests, which can be conducted with any car (no matter its' level of automation) to assess the driving skills of the participants and ADAS driving tests, which were specific to vehicles with autonomous features, see Figure 28.

Safe driving exercises, see sub-chapter *Safe Driving Exercises*:

1. "Slide" AREA Safe Driving Exercise 1
2. "Downhill Hairpin" AREA Safe Driving Exercise 2

ADAS tests, see sub-chapter *ADAS Test Exercises*:

1. "Asphalt area" AREA test ADAS 1 "Automatic Emergency Braking"
2. Straight test ADAS 2 "Lane Keeping"
3. Complete circuit test ADAS 3 "Adaptive Cruise Control"
4. Parking area test ADAS 4 "Automatic parking"

Figure 28 - Pilot 2, Overview over exercises on test track

4.2.3Description of the exercises

4.2.3.1Safe Driving Exercises

The safe driving exercises were introduced to test the ability to regain control of the car in critical situations, i.e., when the on-board systems are no longer able to manage critical situations and require manual intervention. In addition, the exercises were used to assess the entry level of preparation of the test participants. The exercises described below are repeated with and without the help of some ADAS (for example Electronic Stability Programme (ESP), Anti-lock Braking System (ABS) or Anti-Slip Regulation (ASR)) to make the driver better understand how the systems intervene and their limits.

The exercises are part of the normal safe driving courses that are held in the Centre for individuals and company employees. The instructors are used to evaluating the execution of the exercises in order to determine the achievement of the course objectives. Normally, drivers repeat the exercise with the instructor's advice: at each step, the quality of the execution normally increases until they reach the level of driving skill expected.

It is important to consider that in these exercises the instructor is not in the car with the drivers but observes from the outside and does not speak to them via radio. This is to ensure maximum realism in the exercise to simulate a real-world incident.

During the execution of regular testing outside of the pilot, there are normally drivers who are better at following the instructions of the instructors and more inclined to carry out emergency manoeuvres than others. This type of classification, by the instructors, was applied to the test participants as well. Thanks to the marks given to each individual driver, it was possible to establish an initial average level of practical driving preparation for each group.

Exercise 1 – Skid control

This first exercise consists in driving a car on a straight line at about 45 km/h. At a certain point, the vehicle passes on a special platform (slide, Figure 29) which, reading the passage of the vehicle thanks to sensors (magnetic loops), moves sideways in a random manner, causing the rear axle of the car to move. This displacement causes the car to slip. In addition, the platform is located at the beginning of a straight strip formed by low-adhesion resin, which is artificially wetted at each passage of a vehicle. The driver is thus on a surface that reproduces the friction of compacted snow, with the car skidding due to the loss of grip of the rear axle, at a speed between 40 and 50 km/h. At this point, following the instructions in real time that arrive via radio from the instructor, the driver had to carry out the appropriate counter-steering manoeuvres to regain control of the car and the consequent straight direction.

Normally, it takes at least three to four attempts to master a technique sufficient to perform the exercise correctly. A measure of the driver's skill is given by the ability to realign the car in the shortest possible time and space. The correct execution of the exercise is certainly an index of how much an individual is gifted for driving, how sensitive they are to the behaviour of the car and how effectively they can solve an emergency situation.

Figure 29 - Pilot 2, Lainate ACI SARA Safe Driving Centre (slide)

Exercise 2 – Downhill hairpin

The test area is located on a curvilinear downhill with low adherence resin, which is artificially irrigated. The exercises aim to teach the participant the correct approach to a curve, steering techniques, braking modulation and control of any loss of grip and safe trajectories. The driver learns how to modulate the braking. Normally, unlike the pilots, the drivers brake slowly and then increase the braking force, once they realize that it is not enough. The correct approach is exactly the opposite, participants should brake harder first and then modulate. The exercise carried out downhill on a low-grip resin to maintain the speed necessary to finish the curve without stopping. At the same time, the cornering technique and the interaction between brake, steering and accelerator are illustrated.

Figure 30 - Pilot 2, Safe Driving Centre (downhill hairpin)

4.2.3.2ADAS Test Exercises

The ADAS test exercises on the other hand are created to test specific technologies and features of autonomous vehicles. The designed tests have been created taking into account that the testing vehicle is a level 2 advanced car. The autonomous features of such a vehicle are limited and apply only to specific situations, such as automatic parking or aid to keep the lane automatically.

Exercise 1 – Adaptive Cruise Control

For this exercise, an instructor drove a car at variable speed using the entire 1500 m circuit, also making stops and restarts while the participant followed him driving a separate car equipped with an integrated adaptive cruise control feature. By activating the system only in straight sections, the car driven by the participant had to maintain the same distance from the instructor's vehicle. With ACC, it’s possible to set the distance to keep by choosing between three levels:

- Safe: Keeps the longest security distance between the vehicle and the car in front;
- Normal: Keeps a medium distance;
- Sport: Keeps shortest security distance in a safe way.

In the pilot, Sport ACC mode was used in the cars to exploit the length of the track as best as possible. The ADAS of the cars used for the test also managed the restart after a possible stop. In Figure 31, the green areas are those with an activated ADAS system.

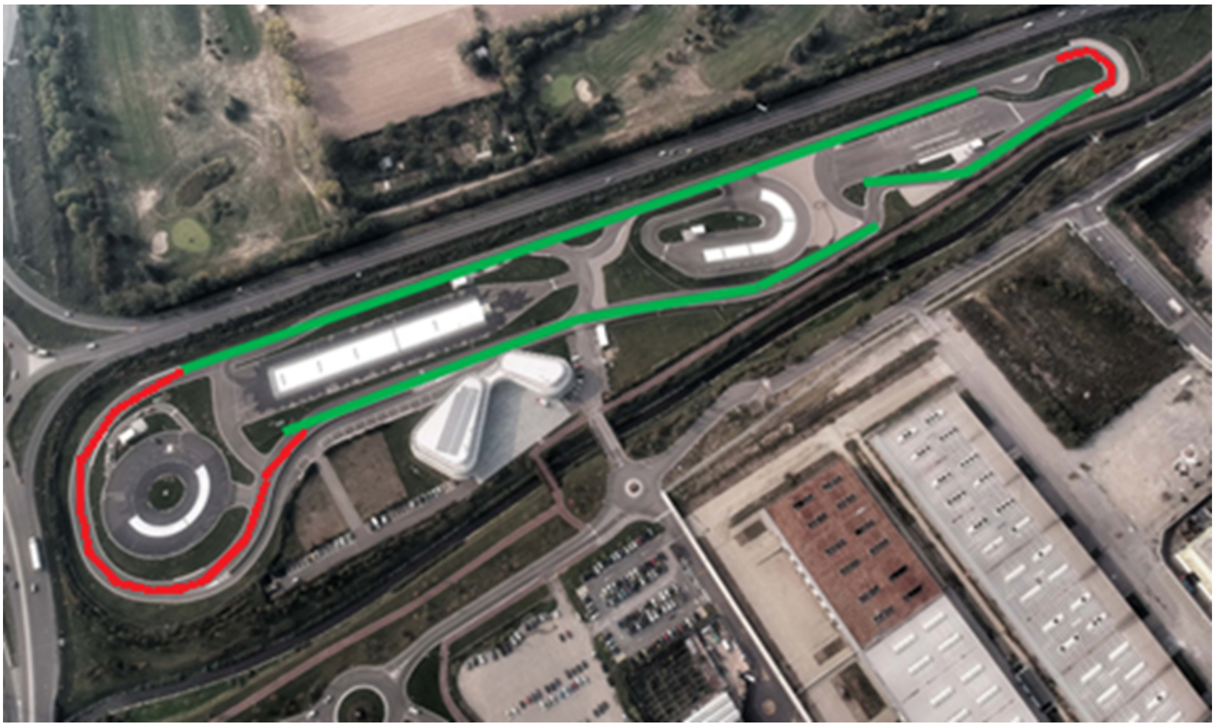


Figure 31 - Pilot 2, Safe Driving Centre (ACC track path)

In the red areas it was possible to experience the limits of the Adaptive Cruise Control, since the car in front often left the observation "cone" of the ACC of the pursuer and could no longer detect the vehicle in front. The participant subsequently disengaged the feature and reached the maximum speed and not that of the vehicle in front. It is a typical critical case that is absolutely normal, but if not properly addressed can lead to a dangerous situation: the on-board system in fact, autonomously, could accelerate to bring the car to the maximum set speed, not taking into account that the vehicle is entering a curve (accelerating while entering a curve can lead to a loss of grip and subsequently a deadly road exit).

Exercise 2 – Automatic braking

This exercise took place in the area dedicated to emergency braking on asphalt, which has no resins. A path has been created within the area along which drivers encounter special shapes that reproduce obstacles, which must not be run over. The silhouettes are made of special reflective materials and show the rear of a car and the image of a child, see Figure 32. It is important that real images are present on the template, otherwise they would not be able to deceive the ADAS video analysis algorithms. The template also contains a light metal surface for response to the Radar systems the cameras interact with. Not all ADAS related to automatic braking work with this kind of double action but the shapes are structured for each type of system to ensure its' proper functionality.

Figure 32 - Pilot 2, Safe Driving Centre (automatic braking shapes)

The participants are subjected to a simulated and distracting driving situation and the system intervened in the drivers' stead by stopping the car before impact. Failures of the automatic braking system were also simulated by simulating obstacles with water walls made available by the safe driving system, see sub-chapter Safe Driving Exercises, Exercise 2. Furthermore, in some cases the systems did not intervene, because it did not detect the shapes.

In this situation, the participant was forced to intervene to regain control of the vehicle and drive safely through an obstacle avoidance emergency braking manoeuvre. For expert drivers, professionals and trainers, a higher level of difficulty was introduced into the pilot, consisting of a car arriving from behind. The drivers, which before had to choose only a direction to avoid the obstacle now also had to watch the mirror to control from which direction the car is arriving.

Exercise 3 – Automatic parking

In the parking area dedicated to the test (regular parking area with white stripes and some cars already parked) the participants used cars equipped with self-parking ADAS. With this system, the car recognizes a suitable area for parking and helps the driver park the car by managing the manoeuvre almost completely automatically. Basically, once the system was activated, the user only had to communicate to the system in which side it has to find the place and in which direction it has to park (forward or reverse). This is a feature, which is very close to level 3 automation. This exercise is aimed at the acceptance of the vehicle's self-driving systems.

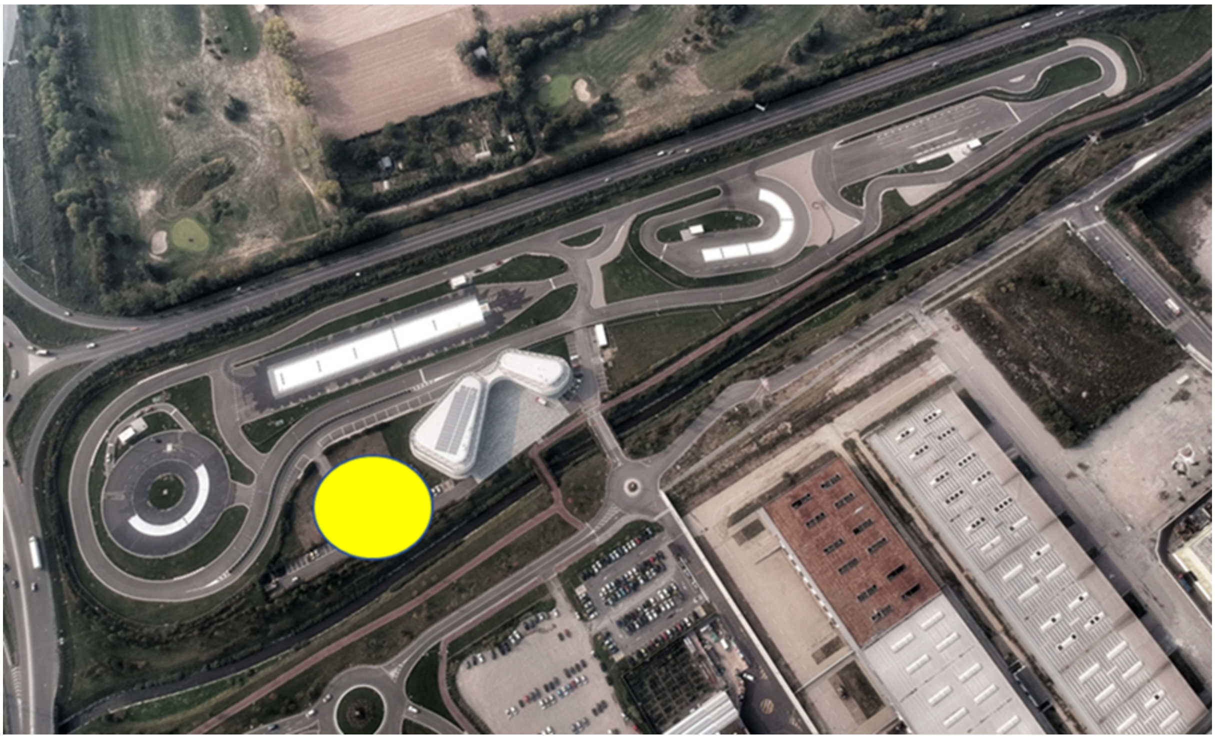


Figure 33 - Pilot 2, Safe Driving Centre – Automatic Parking Area

Exercise 4 – Lane keeping

A three-lane carriageway on the straight track has been reproduced in accordance with Italian laws and regulations. The participant was asked to rely on the ADAS, letting the system follow the slight curves, but having to intervene when the ADAS deactivated and lost the automatic detection of the trajectory. Furthermore, a failure of the system was simulated, by positioning cones along the route, creating a narrowing of the carriageway like a road construction site and forcing the driver to make a rapid correction.

Figure 34 - Pilot 2, Safe Driving Centre – Lane keeping Straight

4.2.3.3 Pilot execution – Organisation

Table 9 - Pilot 2, Waves overview

Wave	Batch	Test	No. of participants
1	1	ADAS 1,2,3,4 and SD 1,2	15
1	2	ADAS 1,2,3,4 and SD 1,2	16
2	1	ADAS 1,2,3,4 and SD 1,2	16
2	2	ADAS 1,2,3,4 and SD 1,2	15
3	1	ADAS 1,2,3,4 and SD 1,2	11
3	2	ADAS 1,2,3,4 and SD 1,2	6
4	1	ADAS 1,2,3,4 and SD 1,2	4
4	2	ADAS 1,2,3,4 and SD 1,2	8

As seen in Table 9, all of the participants completed the tests and all the exercises. In case of the participating instructors and organisers (8 participants), the test was of little significance, as they were already informed about the type of test, the execution and the objectives of the tests themselves, but it was still carried out for completeness.

At the beginning of each day, all participants filled and signed the disclaimer for the activities, the adhesion to the project and the authorisations for data processing. Then they were asked to fill in a questionnaire to assess the level of information of the participants.

Then, the participants were randomly divided into two groups. Professional users, with a truck license, were equally randomly distributed in groups, as were participants of different genders.

For the organization of the day, two programs were created to run from each batch: one relating to the safe driving activities, the other relating to the ADAS tests, of equal duration, in order to ensure that they were performed simultaneously in the different practice areas and they could be exchanged at the end, without waiting.

Batch 1 Agenda

Once the practices and the questionnaire were completed, execution of the ADAS test program started in collaboration with the instructors on the tracks. The time frame of the exercises for the ADAS Test program was as follows:

1. Adaptive Cruise Control;
2. Automatic Braking;
3. Automatic Parking;
4. Lane Keeping.

At the same time as tests 1 to 4 were carried out, the participants, were invited to try the Home Study Simulator to validate the developments of WP5, see Figure 35. During the tests it emerged that as the testers, in the presence of the "public", tended to underestimate the training and to mistake the didactic simulator of the simulator for game purposes. They were also not very careful in filling out the questionnaires as they preferred the practical test in the car.

Figure 35 - Pilot 2, Safe Driving Centre – Simulator Session

The answers related to the simulator reported in the closing questionnaire refer to this test. During the ADAS tests, an instructor sat next to the driver at all times. Furthermore, the instructors were assigned one specific test over the 4 pilot waves, in order to give uniform subjective judgments on all users from each instructor.

In fact, at the end of each test, before the driver change, each instructor on a special evaluation form reported the judgments on the aspects taken into consideration, with a score from 1 (very bad) to 5 (excellent).

Once the ADAS tests were completed, the group was taken to the classroom for a one-hour theory lesson on safe driving and the use of ADAS. At the end of the theory lesson the group participated in the safe driving mini-course carried out by batch 1 in the morning. The Safe Driving program provided, as mentioned, the execution of two exercises, each coordinated by an instructor. Therefore, the group was divided into two subgroups, each of which participated in an exercise, between skid control and downhill hairpin. After about an hour the groups exchanged exercise areas: those who had worked on the skid control switched to the hairpin and vice versa.

Figure 36 - Pilot 2, Training

Also, during the safe driving exercises, the dedicated instructors assessed the behaviour of the drivers in emergency situations caused by the systems in the safe driving areas and the ability and general level of preparation of the driver was assessed, regardless of the interaction with the ADAS. This made it possible to assess the quality of the drivers' entry and the interaction between the quality of the driver and the use and effect of the ADAS. This type of intrinsic assessment of the drivers' skills, which proved to be very interesting in the data evaluation phase, was only possible because it was carried out on a test field by professional instructors.

To make the driver understand the operation of the on-board electronic systems and simulate situations of high critical value (for example an emergency braking to avoid collision with a pedestrian), it is essential to have a protected area, equipped and closed to traffic. This in itself, guaranteeing the maximum safety conditions, ensured the necessary concentration also due to the psychological tranquillity deriving from the absence of dangers or distractions.

At the end of the safe driving exercises, the participants were brought back to the classroom for the completion of the closing questionnaire and the final discharge.

Batch 2 Agenda

The participants of the second batch, after the practices and the completion of the questionnaire at the beginning of the day, followed the reverse program compared to the first batch. In fact, they remained in the classroom and immediately attended a theory lesson on safe driving and in particular on the use of ADAS that they would then use in the afternoon.

At the end of the theory lesson, they performed the safe driving exercises 1 and 2, being evaluated by the instructors in charge, the same ones who then evaluated the drivers of batch 1 in the afternoon, with the same methods described above, i.e., division into two subgroups, execution exercise for about one hour and area exchange with the other subgroup. After the mini safe driving course and a lunch break, the participants started the ADAS tests, which the users of batch 1 had already completed.

Also, the same program was followed in this case, with the same succession of tests and the evaluation by the instructors who had evaluated the participants in the morning on the same test. In this way, here too, perfect comparability between the evaluations of the two batches was guaranteed.

4.2.3.4. Pilot execution: observations

During the development and execution of the entire pilot, no accidents occurred. The participation of users, both from the Italian Army and from the ACI R2G Driving Schools was enthusiastic. Sincere appreciation was noted from the participating military personnel and their officers in command, both for the PAsCAL project and for having had the opportunity to learn safe driving techniques and an in-depth knowledge of ADAS and their functioning not only at a theoretical level.

Figure 37 - Pilot 2, Safe Driving Centre – Final Discharge

The cars used, supplied by a German premium brand sponsor of the Safe Driving Centre, were of the latest generation, including plug-in electric cars and no particular problems were found.

Failure of the ADAS to work during the tests, in particular in the automatic breaking exercise (exercise 2), are to be considered normal especially when using the obstacle simulation templates. In reality, the failure, which occurred only in some cases, was useful for carrying out the test, to detect the readiness of the drivers to intervene in case of a failing system. In case of failures, the final judgment of the user and their perception of ADAS in general was heavily affected. It was therefore necessary in these cases to explain why the system did not work under the specific conditions of the pilot and that the designers increasingly refine these systems to avoid incorrect operations, which in the case of automatic braking they could generate a rear-end collision. Undoubtedly, having a proper explanation of why decision support systems choose not to intervene in some cases improves confidence in the systems and reinforces the concept that ad hoc training is important for both the use of decision support systems and their perception by users.

The weather conditions were generally favourable, except during wave 1, where a very strong wind (90 km/h) made it very difficult to position and keep the templates in position for the automatic braking test. The problem was solved by using soft weights close to the shapes, which allowed the test to be carried out without lowering the safety level for the participants, see Figure 38.

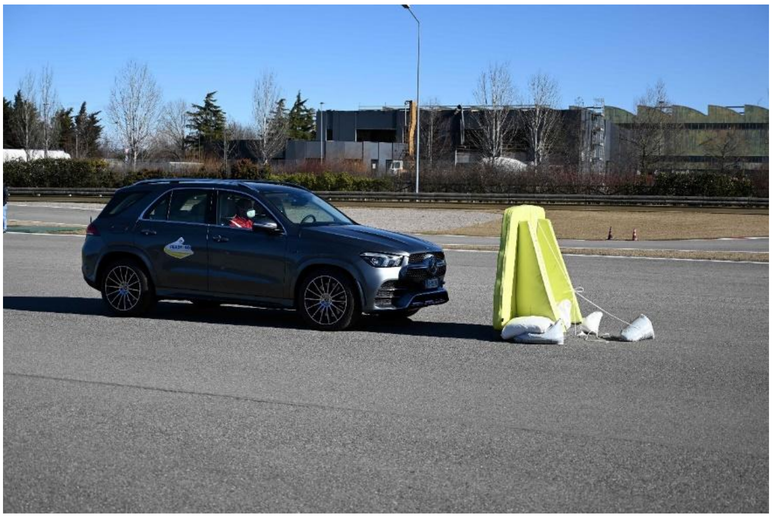


Figure 38 - Pilot 2, Safe Driving Centre – Automatic Braking

4.2.3.5 Pilot execution: Pilot report

As in all of the other pilots, a common Incidence Reporting Form was filled out for each pilot wave, it can be found in full in Annex II.

4.3 Data collection

The data was collected through special evaluation forms for instructors and questionnaires to be filled in by the participants.

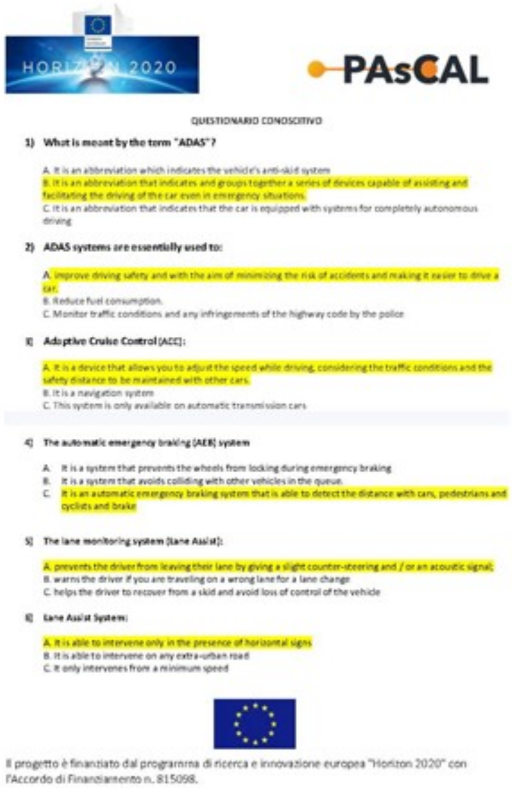
4.3.1 Data Protection Agreement

The following complies with the GDPR authorisation and adhesion to PAsCAL project. The form was signed by all of the participants and is kept on file by ACI Vallelunga in the Safe Driving Centre, see Figure 39 and Annex I.

4.3.2 Initial evaluation survey data collection

Upon arrival of the participants, both the form for the processing of personal data and the evaluation questionnaire were submitted to them. The questionnaires were done on paper, because there were not enough tablets or PCs available for data entry without congestion or delays and it was preferred to avoid that the entry was left to the will of the participants once they left the centre.

By filling in the paper forms upon arrival and the greetings, ACI obtained 100% of the completed questionnaires, see Figure 39.



QUESTIONARIO CONOSCITIVO

1) **What is meant by the term "ADAS"?**

A. It is an abbreviation which indicates the vehicle's anti-skid system
B. It is an abbreviation that indicates and groups together a series of devices capable of assisting and facilitating the driving of the car even in emergency situations.
C. It is an abbreviation that indicates that the car is equipped with systems for completely autonomous driving

2) **ADAS systems are essentially used to:**

A. improve driving safety and with the aim of minimizing the risk of accidents and making it easier to drive a car.
B. Reduce fuel consumption.
C. Monitor traffic conditions and any infringements of the highway code by the police

3) **Adaptive Cruise Control (ACC):**

A. It is a device that allows you to adjust the speed while driving, considering the traffic conditions and the safety distance to be maintained with other cars.
B. It is a navigation system
C. This system is only available on automatic transmission cars

4) **The automatic emergency braking (AEB) system**

A. It is a system that prevents the wheels from locking during emergency braking
B. It is a system that avoids colliding with other vehicles in the queue.
C. It is an automatic emergency braking system that is able to detect the distance with cars, pedestrians and cyclists and brake

5) **The lane monitoring system (Lane Assist):**

A. prevents the driver from leaving their lane by giving a slight counter-steering and / or an acoustic signal;
B. warns the driver if you are traveling on a wrong lane for a lane change
C. helps the driver to recover from a skid and avoid loss of control of the vehicle

6) **Lane Assist System:**

A. It is able to intervene only in the presence of horizontal signs
B. It is able to intervene on any extra-urban road
C. It only intervenes from a minimum speed

Il progetto è finanziato dal programma di ricerca e innovazione europea "Horizon 2020" con l'Accordo di Finanziamento n. 815098.

ADESIONE VOLONTARIA AI TEST PREVISTI PER IL PROGETTO EUROPEO PAsCAL (WP6)

Io sottoscritto/a ______________________________

nato/a a ______________________________ il ___/___/______

titolare del documento d'identità ______________________ n° ______________

DICHIARO

di voler prendere parte in forma anonima e volontaria ai test effettuati attraverso l'effettuazione, a bordo di autovetture del Centro di Guida Sicura ACI di Lainate, di esercizi previsti nel progetto europeo PAsCAL, finalizzati ad offrire uno strumento di conoscenza ulteriore delle modalità di guida dei veicoli del prossimo futuro a livello di automazione CAV 3 e CAV 4 e ad accertare il grado di accettazione da parte dei guidatori di sistemi avanzati di guida autonoma (CAV3 – CAV4) e alla definizione di una metodologia di insegnamento dei suddetti veicoli. Sono altresì consapevole di avere la facoltà di poter interrompere i suddetti in qualsiasi momento.

Come previsto dall'attuale normativa per la tutela della privacy, i dati sensibili qui rilasciati verranno conservati da codesto Centro e cancellati entro 2 anni dal ricevimento degli stessi, fatta salva espressa richiesta del Consorzio Europeo per consentire verifiche puntuali della Commissione Europea.

Data ___/___/______

Firma del dichiarante ______________________ Timbro e Firma Centro Guida Sicura ______________________

Il progetto è finanziato dal programma di ricerca e innovazione europea "Horizon 2020" con l'Accordo di Finanziamento n. 815098.

Figure 39 - Pilot 2, Initial Evaluation Survey (left) and Privacy Protection Disclaimer (right)

4.3.3 Instructor evaluation survey data collection

Although the test itself is anonymous, in order to avoid errors and incorrect attributions, the instructors still reported the name of the users in the evaluation forms, which were then deleted at the end of the day. The evaluations included a numerical grade from 1 (very bad) to 5 (excellent).

For each exercise of each batch, one of these forms has been compiled by the instructor in charge. Only the last column, relating to the evaluation in safe driving situations, was filled in only once per batch and reported on only one of the 4 sheets.

ISTRUTTORE:			ESERCIZIO:			
GRUPPO: ____	Esercizi - Punteggi da 1 a 5					
NOME COGNOME	Conoscenza	Fiducia	Accettazione	Valutazione sistemi ADAS	Gestione situazioni critiche ADAS	Gestione situazioni critiche GS

Figure 40 - Pilot 2, Instructor evaluation form

4.3.4 PAsCAL survey data collection

Also, the PAsCAL survey was printed on paper forms, for the same reason seen in Data *Protection Agreement* and with the same result (100% of the forms were completed). This survey was conducted at the end of every day.

4.4 Data evaluation

As seen, three different kinds of surveys were collected and are analysed in their respective sub-sections:

- Initial evaluation survey, to assess each individual participants' abilities and experience at the beginning of the day;
- Instructor evaluation survey, which assessed the actual individual driving abilities after on-site tests;
- PAsCAL survey, containing comparable KPIs across all pilots.

Batch 1 included participants who have not been trained previous to the ADAS exercises, while batch 2 included those who received a specific training before the tests. This order is always the same for each wave.

4.4.1 Initial evaluation survey

As said, most of the participants showed a low knowledge of ADAS, see Figure 41. A minor part showed an average knowledge, while only the instructors and organizers obviously had a complete knowledge of the subject.

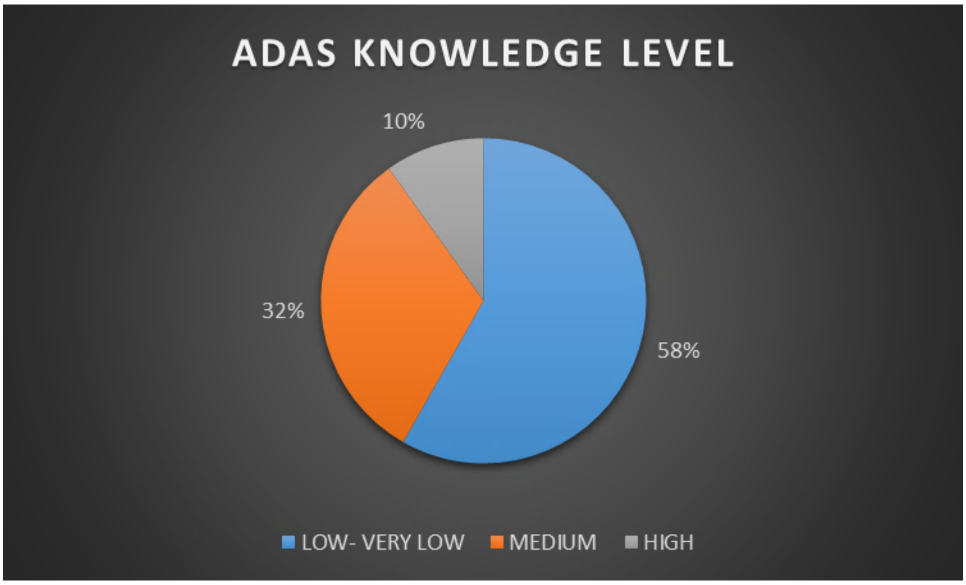


Figure 41 – Pilot 2, ADAS knowledge self-assessment (initial evaluation survey)

4.4.2 Instructor evaluation survey

This section contains the summary tables of the assessments given by the instructors on the participants of each pilot wave and batch. As previously stated, batch 1 includes participants who have not been trained, batch 2 those who instead had training before the pilot tests. This order is always the same for each wave. The range of the scale is from 1 (very bad) to 5 (excellent).

Wave 1 Batch 1 Not Trained		Knowledge					Trust					Acceptance					ADAS Valutation					ADS Critical Situations Management					General Driving Critical Situation Management
Drivers		Brake	Cruise	Park	Lane	Average	Brake	Cruise	Park	Lane	Average	Brake	Cruise	Park	Lane	Average	Brake	Cruise	Park	Lane	Average	Brake	Cruise	Park	Lane	Average	
Driver 1		2	2	2	3	2,25	1	3	4	3	2,75	1	4	5	3	3,25	4	4	5	4	4,25	1	4	5	4	3,5	4
Driver 2		1	2	2	1	1,50	2	2	4	2	2,50	2	4	5	1	3,00	4	5	5	4	4,50	2	4	5	3	3,50	3
Driver 3		3	2	2	3	2,50	2	2	3	2	2,25	2	3	4	3	3,00	4	4	5	4	4,25	2	4	4	4	3,50	3
Driver 4		3	1	2	3	2,25	3	4	4	3	3,50	3	4	4	3	3,50	4	5	5	4	4,50	3	4	4	4	3,75	4
Driver 5		1	2	1	4	2,00	1	4	2	4	2,75	1	4	4	4	3,25	4	5	5	4	4,50	1	4	4	4	3,25	5
Driver 6		1	2	1	4	2,00	3	2	2	4	2,75	3	3	3	4	3,25	4	4	4	4	4,00	3	4	3	2	3,00	4
Driver 7		3	3	3	4	3,25	4	4	3	4	3,75	4	4	4	4	4,00	4	5	5	4	4,50	3	4	4	4	3,75	4
Driver 8		1	1	2	3	1,75	2	2	2	4	2,50	3	4	4	3	3,50	4	4	5	4	4,25	2	4	4	2	3,00	3
Driver 9		2	2	2	3	2,25	3	2	4	2	2,75	3	3	4	3	3,25	4	4	3	4	3,75	3	4	4	3	3,50	3
Driver 10		1	2	3	3	2,25	2	3	4	3	3,00	3	4	5	3	3,75	4	4	5	4	4,25	3	4	5	4	4,00	4
Driver 11		2	2	1	4	2,25	3	3	3	2	2,75	3	3	4	4	3,50	4	4	5	4	4,25	2	4	4	3	3,25	3
Driver 12		1	2	2	1	1,50	3	3	2	2	2,50	2	4	4	1	2,75	4	5	5	4	4,50	2	5	3	3	3,25	3
Driver 13		3	4	4	2	3,25	4	3	4	2	3,25	4	4	5	2	3,75	4	4	4	4	4,00	3	4	4	3	3,50	3
Driver 14		1	1	1	4	1,75	2	2	2	4	2,50	2	3	3	4	3,00	4	4	5	4	4,25	3	4	4	2	3,25	4
Driver 15		2	2	2	2	2,00	2	3	2	1	2,00	2	4	3	2	2,75	4	5	5	4	4,50	2	4	3	3	3,00	3
Averages	3,19	1,80	2,00	2,00	2,93	2,18	2,47	2,80	3,00	2,80	2,77	2,53	3,67	4,07	2,93	3,30	4,00	4,40	4,73	4,00	4,28	2,33	4,07	4,00	3,20	3,40	3,53

Figure 42 - Pilot 2, Wave 1 batch 1 results (initial evaluation survey)

Wave 1 Batch 2 Trained		Knowledge					Trust					Acceptance					ADAS Valutation					ADS Critical Situations Management					General Driving Critical Situation Management
Drivers		Brake	Cruise	Park	Lane	Average	Brake	Cruise	Park	Lane	Average	Brake	Cruise	Park	Lane	Average	Brake	Cruise	Park	Lane	Average	Brake	Cruise	Park	Lane	Average	
Driver 1		2	2	2	3	2,25	5	4	5	5	4,75	5	5	5	5	5,00	5	5	5	5	5,00	5	5	5	4	4,75	4
Driver 2		3	5	3	4	3,75	3	5	4	3	3,75	4	5	4	5	4,50	5	5	5	5	5,00	4	5	5	2	4,00	4
Driver 3		3	3	5	3	3,50	4	4	4	4	4,00	4	5	4	4	4,25	5	5	4	5	4,75	4	5	5	3	4,25	4
Driver 4		4	3	3	4	3,50	5	3	5	5	4,50	5	4	5	5	4,75	5	5	5	5	5,00	5	4	5	3	4,25	5
Driver 5		2	2	2	3	2,25	5	5	5	3	4,50	5	5	5	4	4,75	5	5	5	5	5,00	5	5	5	4	4,75	4
Driver 6		4	3	3	4	3,50	5	4	5	4	4,50	5	5	5	4	4,75	5	5	5	5	5,00	5	5	5	4	4,75	4
Driver 7		2	3	2	4	2,75	5	4	5	5	4,75	5	5	5	5	5,00	5	5	5	5	5,00	5	5	5	4	4,75	4
Driver 8		4	2	2	3	2,75	5	4	5	5	4,75	5	5	5	5	5,00	5	5	5	5	5,00	5	5	5	2	4,25	4
Driver 9		2	4	3	4	3,25	5	5	5	4	4,75	5	5	5	4	4,75	5	5	5	5	5,00	5	5	5	3	4,50	4
Driver 10		2	2	2	3	2,25	4	3	5	5	4,25	5	4	5	5	4,75	5	5	5	5	5,00	5	5	5	3	4,50	4
Driver 11		3	4	2	4	3,25	5	5	5	5	5,00	5	5	5	5	5,00	5	5	4	5	4,75	5	5	4	5	4,75	4
Driver 12		2	2	2	3	2,25	3	3	4	3	3,25	3	4	5	4	4,00	3	4	5	5	4,25	3	4	5	4	4,00	4
Driver 13		2	2	2	4	2,50	5	4	5	5	4,75	5	4	5	5	4,75	5	5	5	5	5,00	5	5	5	4	4,75	4
Driver 14		3	3	2	3	2,75	5	5	5	4	4,75	5	5	5	4	4,75	5	5	5	5	5,00	5	5	5	3	4,50	4
Driver 15		3	3	3	4	3,25	5	4	5	4	4,50	5	5	5	4	4,75	4	5	5	5	4,75	3	5	5	4	4,25	3
Driver 16		3	3	2	4	3,00	5	5	5	4	4,75	5	5	5	4	4,75	5	5	5	5	5,00	5	5	5	4	4,75	4
Averages	4,30	2,75	2,88	2,50	3,56	2,92	4,63	4,19	4,81	4,25	4,47	4,75	4,75	4,88	4,50	4,72	4,81	4,94	4,88	5,00	4,91	4,63	4,88	4,94	3,50	4,48	4,00

Figure 43 - Pilot 2, Wave 1 batch 2 results (initial evaluation survey)

From the analysis of the assessments of the first day, the data that emerges clearly is that the assessments of those who have been trained through a specific course on safe driving and ADAS achieved much better performance than untrained participants, see Figure 44.

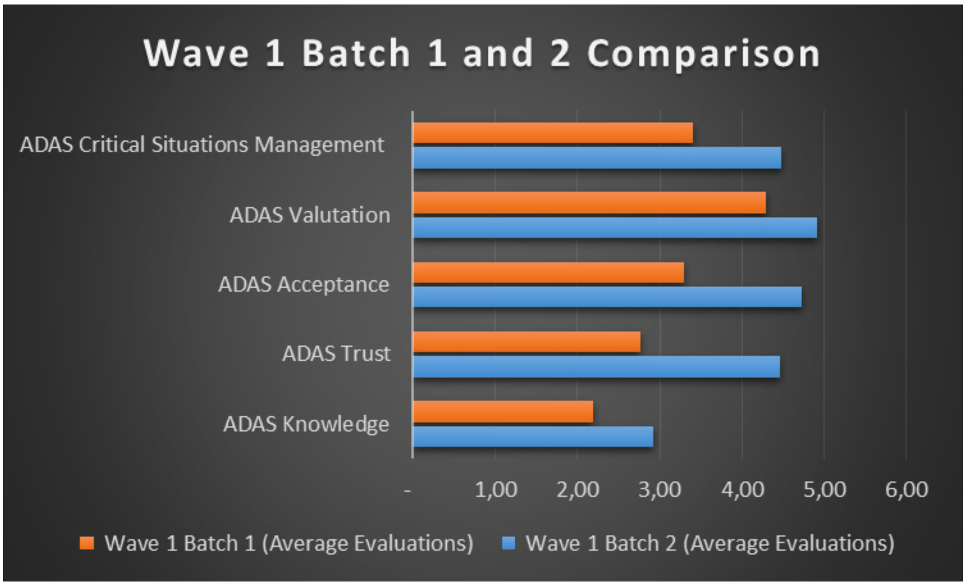


Figure 44 - Pilot 2, Wave 1 comparison (initial evaluation survey)

In particular, it proved useful to compare the average scores obtained by participants in the ADAS critical situations management test with that of the critical situations management of safe driving exercises (these values are related to technical skills of driving). Interestingly, trained users improved their assessment of critical situations in normal driving by switching to critical ADAS situations, while untrained participants performed worse, see Figure 45.

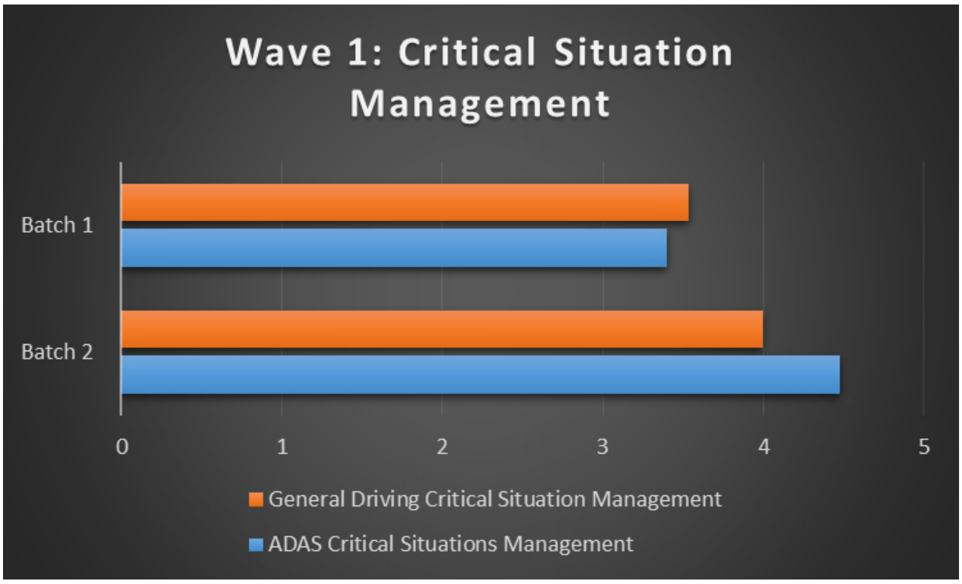


Figure 45 - Pilot 2, Wave 1 comparison (critical situation management skills)

The results of wave 2 confirmed the same trend, with the difference that the management of critical situations, the ADAS management was better in both groups, see Figure 46.

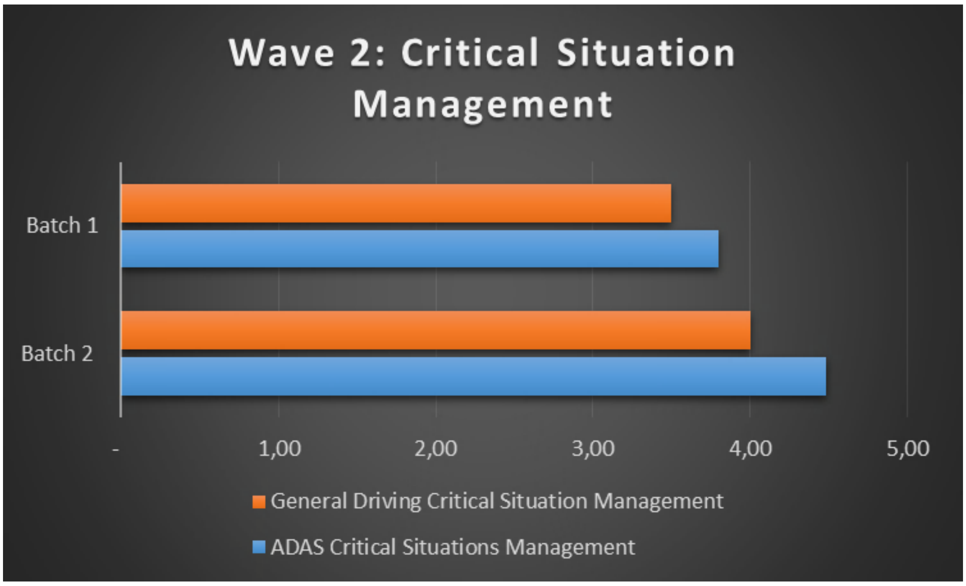


Figure 46 - Pilot 2, Wave 2 comparison (critical situation management skills)

In Wave 3, where the sample was less numerous, but equally representative and homogeneous compared to the previous waves, it is interesting to note how, while the general trend follows the trend of the previous waves, the indicator relating to the Management of Critical Situations records an improvement of approximately 50% for those who have been trained, while it signals a slight deterioration for those who have tested without training, see Figure 47. In practice, the trend of Wave 1 is confirmed.

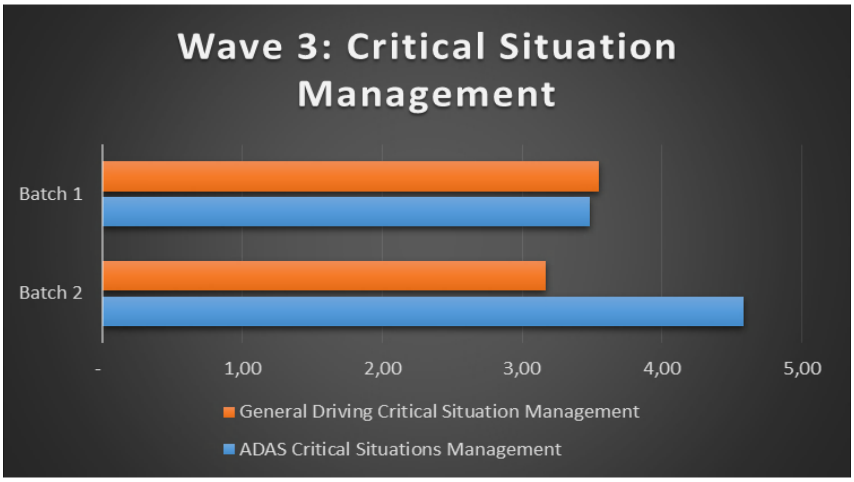


Figure 47 - Pilot 2, Wave 3 comparison (critical situation management skills)

Concerning the analysis for wave 4, the participants are no longer members of the Italian Army, but staff of the ACI Vallelunga Safe Driving Centre, instructors of the ACI Ready2Go Driving Schools, staff of ACI Informatica and ACI Vallelunga Safe Driving instructors.

It is important to state that in this case the comparison between groups is of little significance, because a group, corresponding to Batch 1, was made up of personnel not assigned to driving nor belonging to the organisation that dealt with the PAsCAL Project, therefore not informed about ADAS nor particularly skilled in driving. The second group, on the other hand, corresponding to Batch 2, was made up of instructors and organizers. Therefore, they were all experienced and trained on ADAS and safe driving in general.

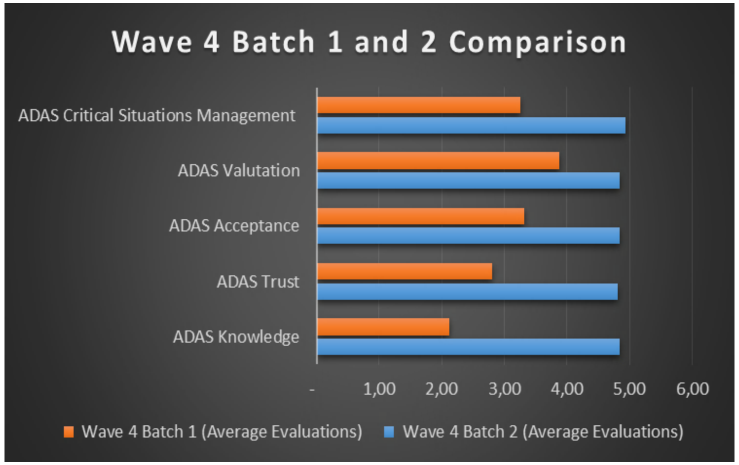
We report the graphs for completeness and consistency with the rest of the project, but as mentioned it makes little sense to compare the data, see Figure 48, Figure 49, and Figure 50.

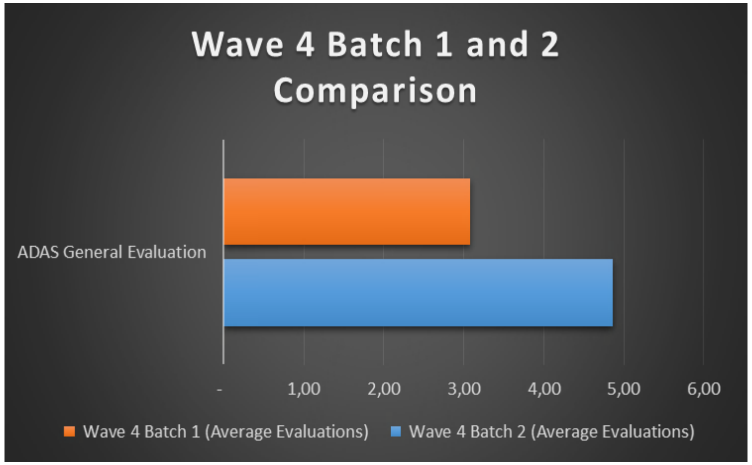
Wave 4 Batch 1 Not Trained		Knowledge					Trust					Acceptance					ADAS Valutation					ADS Critical Situations Management					General Driving Critical Situation Management
Drivers		Brake	Cruise	Park	Lane	Average	Brake	Cruise	Park	Lane	Average	Brake	Cruise	Park	Lane	Average	Brake	Cruise	Park	Lane	Average	Brake	Cruise	Park	Lane	Average	
Driver 1		4	3	3	2	3,00	4	3	3	2	3,00	4	4	4	3	3,75	4	3	4	3	3,5	4	3	4	2	3,25	1
Driver 2		2	2	1	1	1,50	3	3	2	2	2,50	3	3	3	3	3,00	4	3	4	3	3,50	2	3	4	3	3,00	1
Driver 3		3	2	4	1	2,50	3	4	3	3	3,25	4	3	4	3	3,50	4	4	4	4	4,00	4	3	4	4	3,75	2
Driver 4		2	2	1	1	1,50	2	3	2	3	2,50	3	3	3	3	3,00	3	5	5	5	4,50	2	3	4	3	3,00	3
Averages	3,08	2,75	2,25	2,25	1,25	2,13	3,00	3,25	2,50	2,50	2,81	3,50	3,25	3,50	3,00	3,31	3,75	3,75	4,25	3,75	3,88	3,00	3,00	4,00	3,00	3,25	1,75

Figure 48 - Pilot 2, Wave 4 batch 1 results (initial evaluation survey)

Wave 4 Batch 2 Trained		Knowledge					Trust					Acceptance					ADAS Valutation					ADS Critical Situations Management					General Driving Critical Situation Management
Drivers		Brake	Cruise	Park	Lane	Average	Brake	Cruise	Park	Lane	Average	Brake	Cruise	Park	Lane	Average	Brake	Cruise	Park	Lane	Average	Brake	Cruise	Park	Lane	Average	
Driver 1		5	5	5	5	5,00	4	5	5	5	4,75	5	5	5	5	5,00	5	5	5	5	5,00	5	5	5	5	5,00	4
Driver 2		5	5	5	5	5,00	5	5	5	5	5,00	5	5	5	5	5,00	5	5	5	5	5,00	5	5	5	5	5,00	4
Driver 3		5	5	5	5	5,00	5	5	5	5	5,00	5	5	5	5	5,00	5	5	5	5	5,00	5	5	5	5	5,00	5
Driver 4		5	5	5	5	5,00	5	5	5	5	5,00	5	5	5	5	5,00	5	5	5	5	5,00	5	5	5	5	5,00	5
Driver 5		5	5	5	5	5,00	5	5	5	5	5,00	5	5	5	5	5,00	5	5	5	5	5,00	5	5	5	5	5,00	5
Driver 6		5	5	5	5	5,00	5	5	5	5	5,00	5	5	5	5	5,00	5	5	5	5	5,00	5	5	5	5	5,00	5
Driver 7		4	5	4	5	4,50	4	5	3	5	4,25	4	5	4	5	4,50	4	5	5	5	4,75	4	5	5	5	4,75	5
Driver 8		5	5	3	4	4,25	5	5	4	4	4,50	5	5	3	4	4,25	5	4	3	4	4,00	5	5	5	4	4,75	4
Averages	4,86	4,88	5,00	4,63	4,88	4,84	4,75	5,00	4,63	4,88	4,81	4,88	5,00	4,63	4,88	4,84	4,88	4,88	4,75	4,88	4,84	4,88	5,00	5,00	4,88	4,94	4,63

Figure 49 - Pilot 2, Wave 4 batch 2 results (initial evaluation survey)





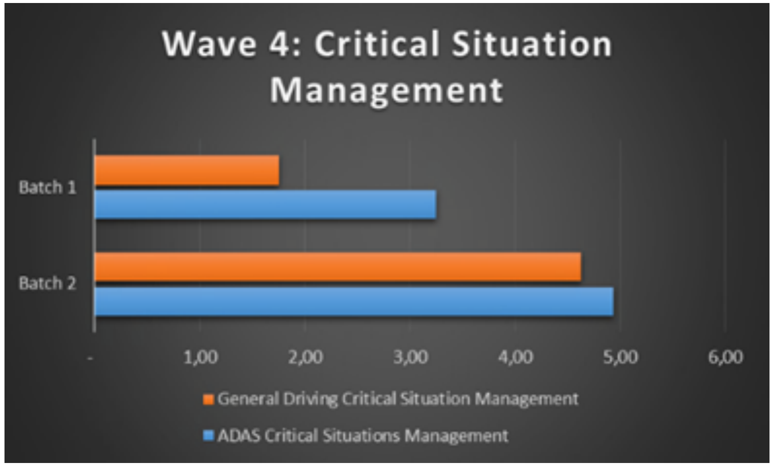


Figure 50 - Pilot 2, Wave 4 comparison (initial evaluation survey above & critical situation management skills below)

4.4.3 PAsCAL survey

ACI also analysed the answers to the final survey, with focus on the questions concerning the opinions on the training received during the Pilot and reported some answers relating to the acceptance of ADAS.

Perceived effectiveness of training (Q21): When participants were asked, whether they thought that the training they received has contributed to improving their reactions, 2/3 of them said “yes”, while only one participant responded with “no”, see Figure 51.

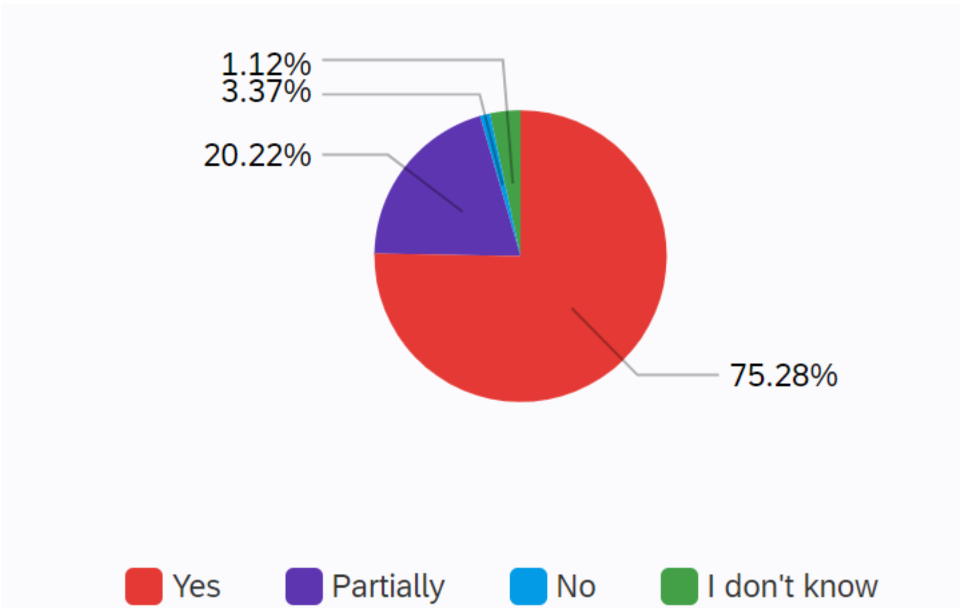


Figure 51 - Pilot 2, Perceived effectiveness of training (PAsCAL survey)

Perceived effectiveness of training (Q22): When participants were asked, whether they thought that the training they received was adequate and matched their training needs, 91% of them thought that it matched their needs totally or partially, see Figure 52.

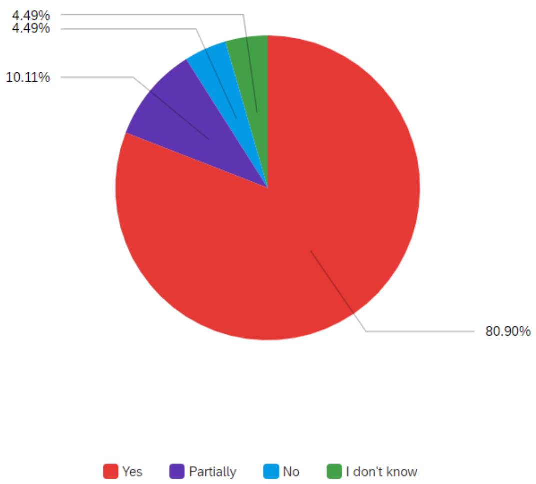


Figure 52 - Pilot 2, Perceived adequacy of training (PAsCAL survey)

Willingness to let others use of training (Q25): When participants were asked, whether they would recommend others to follow the training they had received, many said "yes", though a large portion of the participants was not sure about it either, see Figure 53. This is probably due to the uncertainty concerning the wider uptake of CAVs in the future and the resulting usefulness of the training for everyday situations.

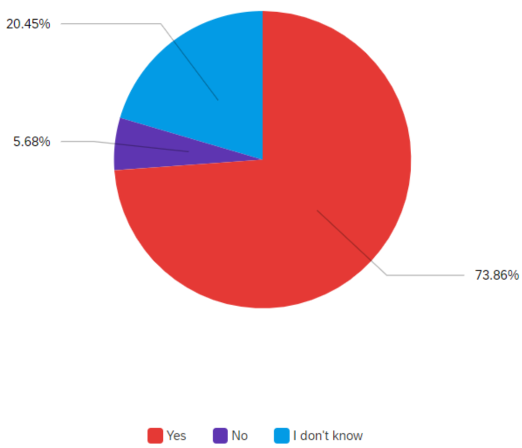


Figure 53 - Pilot 2, Recommendation of training (PAsCAL survey)

Finally, it is important to highlight also the response of the participants to the ADAS technologies themselves, going beyond the acceptance of the training methodology and focusing on the acceptance of technical aspects.

Willingness to adopt ADAS (Q23): Most of the participants (73 out of 89 participants) would certainly or probably use a vehicle with ADAS functions on a very regular (daily) basis. 12.4% of the participants prefer to wait and observe how the technology evolves and only 5.6% are less inclined or absolutely refuse to adopt them, see Figure 54.

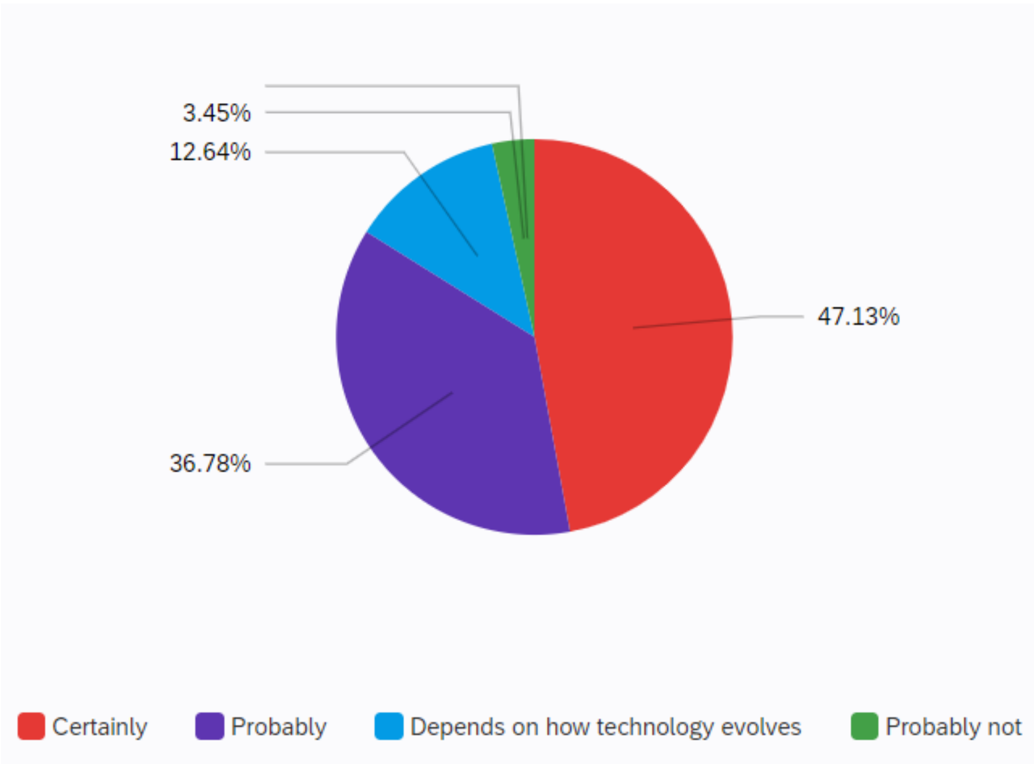


Figure 54 - Pilot 2, Willingness to adopt ADAS (PAsCAL survey)

Perception of societal adoption of ADAS (Q28): In the case of wide-spread CAV uptake by larger parts of the general population, 70% believe it would be a good idea. A considerable part of the participants (27.8%) believe that it would be bad and are critical of the wide-spread integration of these technologies, which is probably due to the fact that most of them were soldiers, who perceive the availability of ADAS to civilians as critical, see Figure 55.

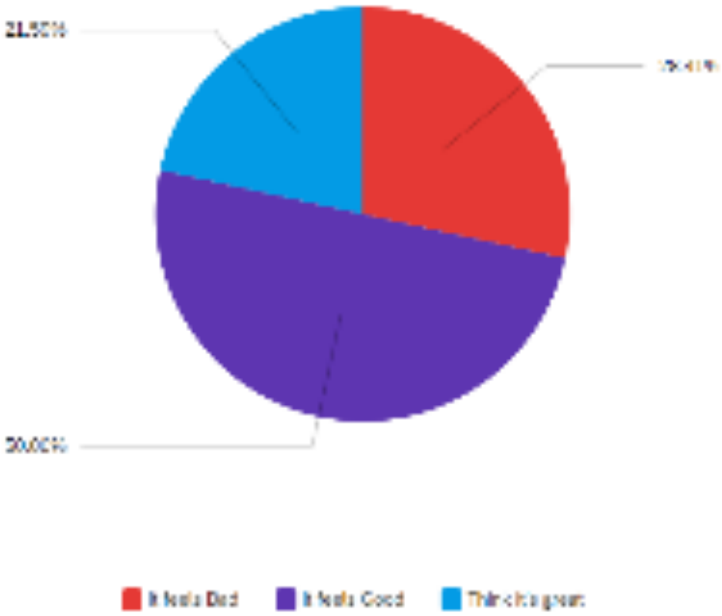


Figure 55 - Pilot 2, Perception on societal adoption of ADAS (PAsCAL survey)

4.5 Cross-fertilisation Activities Across WPs

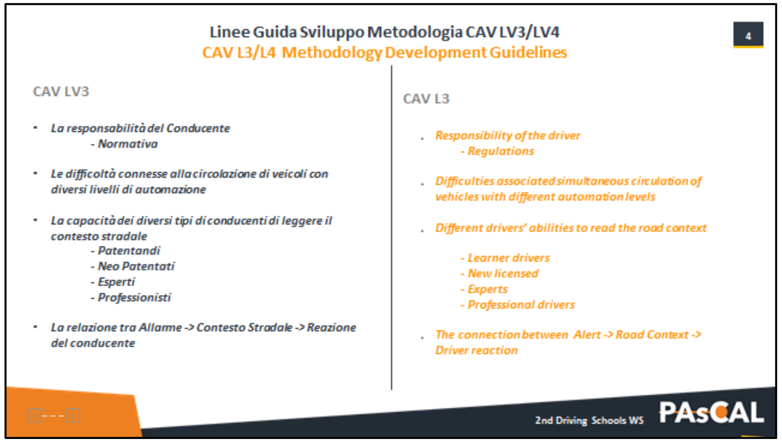
The tests conducted in this pilot were structured using the same approach used by the RED and Ready2Go driving schools for testing with the simulator developed in WP5. First, the participants were split into two broad groups:

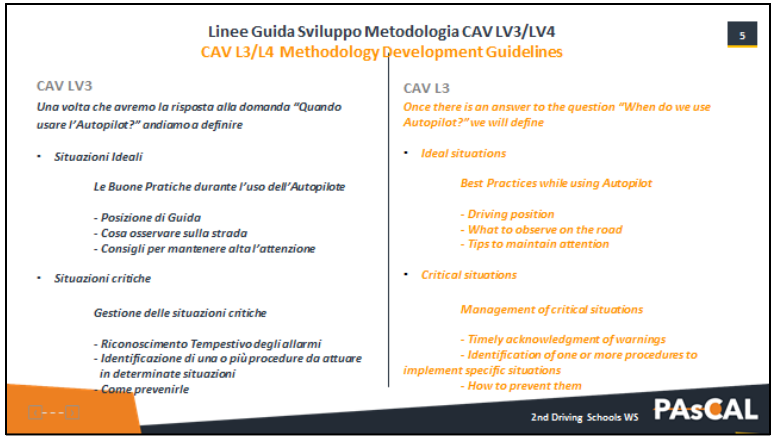
1. Non-trained individuals;
2. Trained individuals.

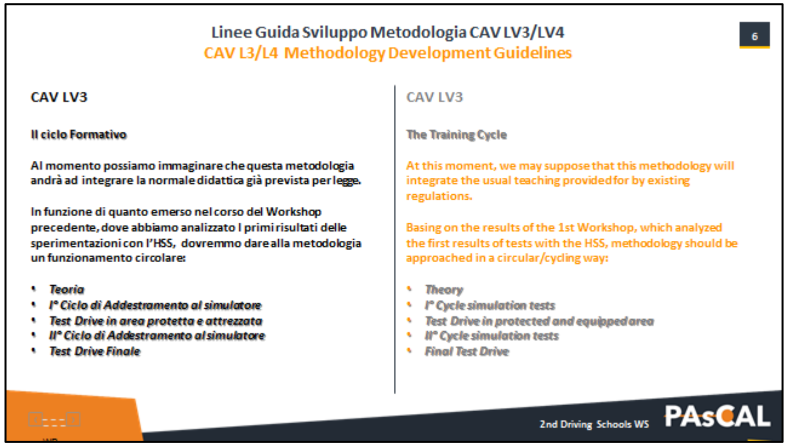
Both received a briefing on the task and the basic controls of the vehicle (see *Research Boundaries* in D5.3) [8].

The pilot setup served on a practical level in understanding whether the methodology developed in WP5 was suitable and corresponded to the needs of actual drivers. A WP5 workshop took place in October 2021 and it was also taken as a reference in the design and execution of the pilot. During the pilot, the incontrovertible need emerged to prepare a practical part of exercises to which the drivers should be subjected, see Figure 56.

It is interesting to note that the need for practical tests emerged not only among the soldiers who tested the simulator at the safe driving centre of Lainate, but this mood was also found during the simulator tests carried out in the ACI Ready2Go driving schools and during which the driving instructors noted that both the drivers and the professionals showed a deep interest in carrying out practical exercises in the car [8].







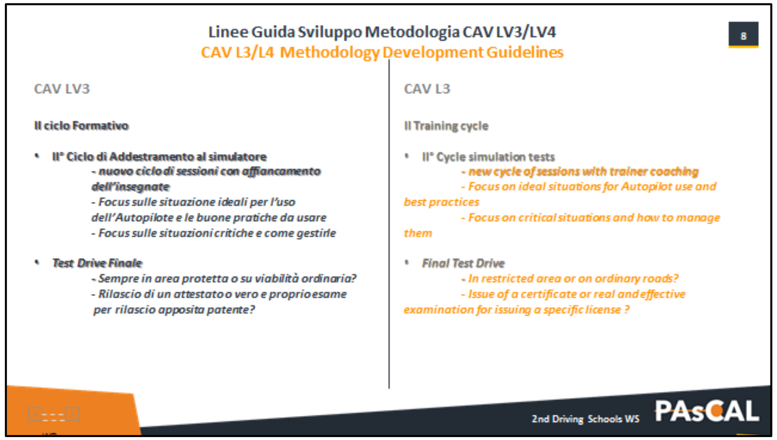


Figure 56 – Pilot 2, Slide from workshop on training methodology (WP5)

4.6 Dissemination activities

The narration of WP5 and WP6 faithfully followed the construction in two phases of the project, therefore, the communication activities told both work packages but with constant references from one to the other. Various information materials were produced for the online and offline dissemination of the tests and results: photographs, graphics, vertical videos, horizontal videos.

The storytelling began with a news article on the PAsCAL website, accompanied by a photo gallery, concerning the construction of the simulator and the tests carried out in the ACI Ready2Go and Red driving schools. This was followed by the online event presenting the results of WP5 and WP6, which took place on March 17th 2022. The event was attended by all the partners involved and started with a general introduction of the project to get to the individual work packages. The event closed with the projection of a video made during the days of Lainate which summarized all the work done, from classroom training to that on simulators, to end with track tests, where 85 people have experienced the impact with driving range. At the end of the event, the video was sent to the Italian and international press, together with the press release describing the project and its results.

The social networks PAsCAL, ACI, ACI Ready2Go and ACI Vallelunga saw the simultaneous publication of video stories and posts, in graphics and images, to tell the Lainate tests with a link to the press release published on the PAsCAL website.

4.7 Conclusions & Learnings

From the analysis of the results, both in terms of numerical data and of appreciation witnessed by the results of the questionnaire, but also by what was expressed orally by the participants, it emerges clearly that there is an excellent degree of acceptance by the testers of the car autonomous or semi-autonomous connected, but equally it emerges that a dedicated training session is required.

From the tests conducted, both a theoretical and practical "training gap" emerges that needs to be filled with the introduction into the market of CAV 3 and CAV 4 vehicles with specific courses like those tested during the pilot, aimed at obtaining the qualifications for driving this type of vehicle.

In fact, by analysing the data collected during the tests, those participants who did not receive any training either on on-board systems (ADAS) or on the basic principles of safe driving techniques performed worse in real driving. It's interesting to observe that in ADAS tests, on-board systems improved drivers' performance anyway. Conversely, for those who have carried out the tests following the training, it demonstrates a much more performing ability in the management of critical issues, demonstrating that electronic systems and technology not only help, but improve their performance.

In general, during the tests in semi-autonomous and autonomous mode, the safe driving instructors, found that those who had not received any specific training more often took back control of the commands than trained drivers. Vice versa, the trained tester showed greater awareness and safety in relying on on-board systems, allowing the system to intervene, but also the ability to take back the commands in the critical situation with firmness and speed and carry out the necessary manoeuvre. According to the instructors, this behaviour is due not only to the knowledge of the systems, but also the awareness of its' limits.

The observation of the tester on the autonomous driving simulator developed by LIST is also interesting. In fact, it has been noted that the tester, with only the driving instructor close by, paid attention to the instructions given, unlike those testers who carried out the simulation in the presence of their colleagues, who most of the time disregarded the rules to demonstrate ability to driving worthy of a video game. Randomly, the testers were asked what they thought of the simulator and the meaning of the answers was: "maybe with more advanced graphics it is useful for approaching autonomous driving, but in the car, that's another story". This mood was also found during the simulator tests carried out in the ACI Ready2Go driving schools and during which the driving instructors noted that both the drivers and the professionals showed a deep interest in carrying out practical exercises in the car [8].

For the above it is clear that:

- Both theoretical and practical training is required for all categories of motorists, whether they are novices, drivers, professionals;
- Compared to a novice driver who starts driving with these systems, greater attention must be paid to those who have already obtained a license and have been driving for years, because habits and beliefs must be "unhinged" that do not coincide with the needs of CAV 3 vehicles and CAV 4;

- That the driving simulator turns out to be an excellent tool for approaching autonomous driving, but in itself not sufficient to achieve appropriate preparation;
- It is necessary to carry out a lot of practice for the in-depth knowledge of the main behaviours typical of a semi-autonomous or autonomous car, such as to not create stress in the driver, but at the same time it is necessary that the driver is informed on the behaviours to adopt to deal with critical situations. In this regard, it should be noted that the practice must necessarily foresee two different and distinct moments:
    - **Driving in the Reserved Area**: in this context, the driver can safely test all critical situations without distress. It is believed that these exercises must be carried out in plants with areas and technologies dedicated to safe driving. These systems are now the teaching standard of safe driving in several European countries. They could, in fact, allow not only training in the use of ADAS but also training to manage non-intervention. It is not unrealistic to think that once this type of technology is introduced, users will unlearn manoeuvres that are now or should be well known. In safe driving courses there are still drivers who do not know how to properly perform emergency braking and who are not yet familiar with the functioning of ABS, which is a technology introduced more than 20 years ago;
    - **Driving in the Urban Area**: in this context the driver, supported by a trainer, will be able to approach semi-autonomous or autonomous driving, in a real-world context, with advanced technical preparation and which allows him to lower stress levels.

It should be noted that trust in ADAS and their success in terms of diffusion, which in a long period will lead to great benefits for road safety, pass through an in-depth knowledge of the systems and their functioning.

In conclusion, the recommendations set out in WP5 at a regulatory level are also considered correct, as reported below and relating to WP8.

The new legislation will also have to consider that if a participant who will take the practical driving test with a CAV level 4 vehicle, they will also eventually be qualified to drive CAV level 3 and CAV level 2 vehicles and vice-versa. If a driver already holds a lower-level license, they would only need to attend a refresher course for the theoretical part to be carried out at authorised centres (such as driving schools) and repeat the practical test with the higher-level automated vehicle for which they want to be licensed to driver or they must repeat the exam in full for the next CAV level.

The evolution of technologies could probably also change the concept of training, providing for periodic compulsory reminders at authorised centres (such as driving schools or safe driving centres). Consequently, the law must provide for penalties for non-compliance of the obligations prescribed on the driving license. Autonomous driving and the application of artificial intelligence to driving systems will also result in the current system of civil and criminal liability and responsibilities in the following areas:

- Vehicle manufacturers and ADAS components and software;
- Owners and/or conductors of the road infrastructure;
- Telecommunications infrastructure managers;
- Authorised workshops for maintenance personnel;
- Drivers of vehicles.

5 Pilot 3: Autonomous bus line

5.1 Introduction

Pilot 3 explores the role of highly automated vehicles in the context of multimodal trips and in particular their adequacy in bridging gaps between existing public transport modes. The deployment of an electric level-5 autonomous bus on the campus of Universidad Autónoma de Madrid (UAM) offered a unique opportunity to test such scenarios. The bus line is integrated into the public transport system and consists of several stops, which are connected to an important suburban train network as well as long-haul interurban bus lines. The bus, an EZ-10 model from manufacturer EasyMile, runs in a 3.7km long circuit in mixed traffic situations and can react to unexpected obstacles. This deployment is one of the only L5 deployments in open traffic and has been made possible by a complex collaboration between numerous different stakeholders (namely the UAM, CRTM, Madrid City Council, Madrid Regional Government, ALSA and DGT). All activities were conducted from May 2021 to February 2022, including the entire preparation of the pilot.

This pilot has been conducted in close collaboration between Etelätär Innovation, the WP6 leader as well as task leader and the subcontractor for this task, the Spanish Road Association, Asociación Española de la Carretera (AEC) in Madrid. Both organisations hold quality relationships with all of the involved stakeholders of this deployment, which allowed for the privileged opportunity to integrate the commercial and fully autonomous shuttle into the PAsCAL project. The recruited participants consisted of a mixture of university students (who were unfamiliar with the shuttle service on-site) and professionals of nearby business parks as well as some few vulnerable travellers (in this case a wheelchair user and elderly persons).

5.2 Pilot execution, Observations & Deviations

Due to the modification of the original pilot 3 in May 2021, several preparatory activities had to take place in the months leading up to the actual pilot execution, including the following meetings:

- Initial inspection of the bus and route on the UAM campus on 14th May 2021, including an informal conversation with the bus line operator (ALSA);
- Meetings with Consorcio Regional de Transportes (CRTM), regional transport authority of the wider Madrid Region held on 16th June 2021, resulting in a formal agreement between CRTM and AEC, which served as a basic framework for the development of the pilot;
- Formal meetings with ALSA, the bus operator on-line on 21st June 2021, with the participation of the Director of Research and the Director of the Central Unit;
- Communication to Dirección General de Tráfico (DGT) of the Spanish Government, to ensure legal compliance with local law;
- Meetings with UAM, to ensure specific permissions during the different pilot waves. The meeting was held on-line on 8th September 2021, ahead of the first pilot wave.

Once all stakeholders were informed and expressed their consent of the pilot, the actual pilot execution could begin. As defined in Deliverable D6.2, three different scenarios were defined, two on-board the bus and one taking place outside the vehicle. The pilot took place in three different pilot waves and included a total of 204 participants in total.

It is important to highlight that due to the COVID-19 pandemic, the total capacity of the bus was limited to 7, and in the second wave only 5 passengers at a time, who had to wear chirurgical or FFP-2 facial masks on-board the bus and also during the pilot briefings for hygienic and safety reasons. Although the participants were already very used to wearing the masks, this restriction might also have influenced their experience on-board the autonomous bus (low capacity, restricted breathing).

To ensure that the initial goal of 200 participants for this pilot could be reached, the circular itinerary of the bus was used to fit two batches of users per completed trajectory and therefore maximise the number of participants per pilot wave as much as possible. The bus itself leaves once an hour and takes 45 minutes to complete its' trajectory.

Apart from a technical check-up before each pilot wave was conducted, AEC staff also checked the weather conditions due to sometimes cold and rainy weather during the winter months in Madrid, which could have significantly lowered the commitment of participants to attend the pilot. The full procedure before planning and recruiting for any of the pilot 3 waves was as follows:

1. Inform all stakeholders (CRTM, ALSA, UAM, DGT) about the upcoming pilot wave dates and size of the wave;
2. Recruit a sufficient number of participants, following these principles:
    a. Most participants are expected to be by default university students. For this reason, AEC made an effort to identify possible participants corresponding to other age ranges;
    b. Research centres of the campus and companies' members of AEC based in Madrid were contacted as well as staff from public governments and other bodies, in order to enlarge the profile of participants in the survey;
    c. The registration was open to the public and was also advertised on several social media channels, such as Twitter, LinkedIn and Instagram to attract also registrations beyond the networks of involved partners;
    d. Further participants were also recruited on the spot, in the case that single pilot batches were not completely booked;
    e. Registrations were completed via an online form, in which they were asked to provide some personal information and their contact details. This information was used to confirm their participation and arrange the meeting with some time in advance before the trip in the bus (e.g., a participant would book for 13.00, but he/she is asked to be on the spot at 12.45 for the briefing and will travel at 13.15, providing the team with time enough for delays, questions, etc.).
3. Briefing and training the staff, who is present on-site during the pilot, including one pilot manager (who conducts the briefing and welcomes the participants), one assistant (who supports the pilot manager), two shadowing persons (who accompany the pilot batches secretly to record any incidences) and one videographer;
4. Preparation of the briefing through:
    a. A poster was designed and used for a short briefing for participants, providing them with the relevant information for their involvement in the pilot;

b. Potential modifications of the briefing depending on feedback and observations of previous pilot waves;

5. Reminders and confirmation of the participants the day before the pilot wave takes place to ensure their awareness and participation.

This setup process ensured that the stakeholders are informed but also that the recruited participants were of a diverse background and that they would show up on the day of the pilot execution.

The participants were asked to meet a few minutes before their pilot batch started to ensure that they would arrive on time. During the briefing, which took place next to the pilot poster the participants were informed of the PAsCAL project, its' objectives and activities and also the concrete research questions and aspects of the pilot they take part in.

Following the briefing, the groups were either divided into two sub-groups (who would follow scenario 1 or 2 respectively) or all participants of a batch were asked to experience scenario 3. Each sub-group was then accompanied by a staff member of AEC on-board the bus, who tried to blend it and shadow the group. This was done to note and record the unbiased opinions and behaviours of participants on the bus. This member of staff also completed the Incidence Report Form for each batch.

Regarding behaviour of participants in the bus, it is important to note that most of them showed initially a slightly negative perception to the autonomous bus, as they were aware of the technical problems that the bus had suffered in the failed previous waves, see sub-chapters 5.2.1 and 5.2.2. On the contrary, once they tried the autonomous bus, their perception seemed to improve.

For most of the participants it was the first time to travel in the autonomous bus, and most of them had a positive reaction on that; in spite of this, the fact that the service is only available on an hourly-basis and the relatively slow speed of the bus was, in general, perceived negatively.

In general, the majority of participants in scenarios 1 and 2 were quite silent in the bus, although the supervisor was open to facilitate information on the autonomous mobility technology and service performance. Once the supervisor started to provide additional information to occupants proactively, they were more likely to ask questions and make comments than to seek information by themselves.

Questions from participants were focused on how the bus was able to circulate without a driver, if it was possible for it to distinguish between a vehicle and a person and if the presence of the supervisor was essential to start the trip. In addition, there were also questions on the frequency and times of the service, how long were the doors of the bus opened at each stop and if an accident has happened at any time (some remarks were done about the initial trip, when an accident, not related to the autonomous mobility technology happened).

Participants in scenario 3 (co-users), which knew the autonomous bus although they were not using it to travel, did not ask any particular question apart from time, departure or frequency of the service.

Regarding the survey, some participants had some problems to properly understand the wide range of CAVs they could use, apart from the autonomous bus; it was explained by AEC staff, not only in the initial briefing, but also during the filling of the survey in the participants' smartphones.

Figure 57 - Pilot 3, Briefing materials

Each group of participants travelled in the bus and after experiencing the pilot trip, walked back to the initial meeting point, where they connected to the survey using a QR code. After completing the survey, each participant received their compensation for their involvement in the pilot (which consisted of a voucher).

5.2.1 Pilot 3 Wave 1 report

Wave 1 was initially programmed for 30th September and 1st October; 80 participants were recruited but, after a first trip with 2 participants, the bus broke down and it was not possible to continue with the pilot. However, the organisation of the pilot was positive for the optimisation of the processes for the following attempts. The staff of Etelätär and AEC could better understand how to improve the organization the following waves. Since ALSA informed that the service would be suspended during some days, it was decided to cancel the wave and organize it later again.

The wave was planned again for 21st & 22nd October, with 130 participants confirmed, but additional problems appeared with the vehicle and it was necessary to reprogram it again. 18th & 19th November were designed as new dates but, again, the vehicle suffered technical problems and it was necessary to cancel before starting the recruiting process. Following a detailed inspection, it appeared that one of the proximity sensors on the left front wheel malfunctioned, which blocked all automated features and required the steward of the bus to take manual control over the vehicle, which was slowed down to only 5 km/h for safety reasons.

Finally, the first pilot wave tested all scenarios detailed in the D6.2, which take place both on-board the bus and, in its' surroundings, and simulate multimodal trips for commuting and transit respectively. Approximately 15% of the participants who registered, ended up not attending the appointment, which means the attendance was a little lower than expected.

Following a maintenance service break for some days, the bus restarted service again and the first pilot wave was finally successfully completed on 30th November and 1st December 2021, including also some of the PAsCAL consortium partners (automation experts, who constitute batches 8.1 and 8.2). In total, 84 persons responded to the survey and attended the pilot, with 36 participants from scenarios 1 and 2, and 48 participants from scenario 3:

Table 10 - Pilot 3, Wave 1 participants

Date	Time	Batch Number	No. of participants	Scenario Number
30/09/2021	9:15	0.1	2	1
30/11/2021	9:15	1.1	5	1
30/11/2021	9:15	1.2	4	2
30/11/2021	10:15	2.1	6	1
30/11/2021	10:15	2.2	4	2
30/11/2021	11:15	3.1	4	1
30/11/2021	11:15	3.2	4	2
30/11/2021	12:00	4	14	3
30/11/2021	13:00	5	11	3
30/11/2021	14:00	6	11	3
30/11/2021	14:15	7	12	3
01/12/2021	11:15	8.1	3	1
01/12/2021	15:15	8.2	4	2

The participants took part in a briefing of 15 minutes before boarding the bus, as illustrated in Figure 58.

Figure 58 - Pilot 3, Wave 1 meeting point and briefing setting (left) and wave 1 participants boarding the vehicle (right)

As a general conclusion of wave 1, it was very positive to conduct surveys for scenarios 1 and 2 on the first hours of 30th November, although some telecommunications problems, which left the entire campus area without GPS signals, did not allow to continue the pilot wave during the entire day. This unexpected situation was used by the team to conduct scenario 3 surveys, in order to take advantage of the participants already present in the contact point.

5.2.2 Pilot 3 Wave 2 report

Pilot wave 2 took place on 16th December, with a restricted occupancy of 5 passengers only (including one AEC staff member) on-board the bus due to the growth of the impact of the Covid-19 pandemic. In spite of this, it was possible to collect only 34 answers: 30 for scenario 1 and 2 (users of the bus) and 2 for scenario 3 (road co-users). Again, around 15-20% of participants confirmed did not finally attend the appointment and ended up not showing up.

Since the last pilot wave went smoothly and the timing of the wave had already been ameliorated following the initial cancellation of the pilot wave, it was not necessary to modify the briefing, timetable or pilot setup in general for the second pilot wave.

Table 11 - Pilot 3, Wave 2 participants

Date	Time	Batch Number	No. of participants	Scenario Number
16/12/2021	9:15	1.1	4	1
16/12/2021	9:15	1.2	2	2
16/12/2021	10:15	2.1	4	1
16/12/2021	10:15	2.2	2	2
16/12/2021	11:15	3	1	1
16/12/2021	12:15	4.1	2	1
16/12/2021	12:15	4.2	2	2
16/12/2021	12:45	5	2	3
16/12/2021	13:15	6.1	3	1
16/12/2021	13:15	6.2	3	2
16/12/2021	14:15	7.1	2	1
16/12/2021	14:15	7.2	3	2
16/12/2021	15:15	8	2	1

In spite of the low number of participants due to the impact of Covid-19 and the requirements to limit the occupancy of the bus, wave 2 resulted very positive for the optimization of the pilot organization between scenarios 1 and 2, trying to take advantage of the hours available of the bus. In addition, 2 surveys for scenario 3 were also done, in order to complete the 50 surveys required for co-users.

Figure 59 - Pilot 3, Pilot vehicle on-site

5.2.3 Pilot 3 Wave 3 report

After the Christmas break and the subsequent interruption of the bus service until the end of the 1st term exams at the University, the bus started its operation on the 31st of January 2022. After checking the proper performance of the bus, wave 3 of the pilot was organized for 3rd and 4th of February, with the ambition to conclude the pilot. A strong effort was done by Etelätär and AEC to collect as many participants as possible, while incorporating different range of ages. For this last wave, it was possible to travel with the initial occupancy of the bus (7 participants including one AEC staff member). A total number of 89 answers were collected for scenario 1 and 2. As in previous waves, approximately 10% of participants confirmed finally did not attend, but most of them called or emailed to inform. It was not necessary to modify the briefing, timetable or pilot setup in general for the third pilot wave, except for the participation of the wheelchair user (Friday 4th of February at 9.15): for that occasion, the team and the poster for the briefing was moved to the first bus stop, in order to facilitate the process for the participant. The rest of the briefings were similar to previous waves.

Table 12 - Pilot 3, Wave 3 participants

Date	Time	Batch Number	No. of participants	Scenario Number
3/2/2022	9:15	1.1	2	1
3/2/2022	9:15	1.2	4	2
3/2/2022	10:15	2.1	4	1
3/2/2022	10:15	2.2		2
3/2/2022	11:15	3.1	3	1
3/2/2022	11:15	3.2	2	2
3/2/2022	12:15	4.1	4	1
3/2/2022	12:15	4.2	3	2
3/2/2022	13:15	5.1	4	1
3/2/2022	13:15	5.2	6	2
3/2/2022	14:15	6.1	2	1
3/2/2022	14:15	6.2	4	2
3/2/2022	15:15	7.1	6	1
3/2/2022	15:15	7.2	6	2
4/2/2022	9:15	8.1	1	1
4/2/2022	9:15	8.2	2	2
4/2/2022	10:15	9.1	2	1
4/2/2022	10:15	9.2	2	2

4/2/2022	11:15	10.1		1
4/2/2022	11:15	10.2	3	2
4/2/2022	12:15	11.1	5	1
4/2/2022	12:15	11.2	4	2
4/2/2022	13:15	12.1	5	1
4/2/2022	13:15	12.2	6	2
4/2/2022	14:15	13.1	5	1
4/2/2022	14:15	13.2	4	2

As an important point to highlight, the pilot incorporated the vision of CRTM, with 4 participants from the public body. Also 2 members of ALSA staff, which were in the campus for training reasons not linked to the pilot could participate. In addition, as mentioned, the point of view of a particular vulnerable user in a wheelchair was included on the 4th of February.

Figure 60 - Pilot 3, Wave 3 meeting point and briefing setting

Figure 61 - Pilot 3, Wave 3 participants in the vehicle

5.2.4 Stakeholder Interviews

Within the pilot, three separate stakeholder interviews were held: one with the operator of the bus, ALSA, one with the Universidad Autónoma de Madrid campus and one with the regional transport authority of the wider Madrid metropolitan area, CRTM. All interviews were prefaced by a short presentation to highlight the focus and objectives of the PAsCAL project and introduce concrete questions or topics of interest.

5.2.4.1 CRTM Interview

The first interview with CRTM was coupled with the interview for pilot 5 (see Chapter 7.2.3). Thought it was focused mostly on connected transport environments, the special case of the autonomous bus line was also discussed in the context of multimodality. The authority confirmed that though the bus does currently not significantly increase the efficiency of the overall public transport system, it serves as a sample case for multi-governmental cooperation. Further, it provides a great set-up for the authority to test the perception of CAVs in a multi-modal context. CRTM has included the bus line into its offering and users with a monthly pass for the public transport network can access the bus free of charge.

5.2.4.2 ALSA Interview

The second interview with ALSA focused more on the practical deployment of the autonomous bus line. The representatives confirmed, that for the manufacturer of the bus, this pilot deployment has evolved into their 'landmark' pilot worldwide.

When asked, how the automated service improves the user experience of travellers, the representatives highlighted that though the speed of the vehicle is limited, the user support has remained as high as in a conventional bus line. Though the bus is restricted to urban and mapped areas, the application of AI has proven useful to ameliorate the bus itinerary after each trip the shuttle takes. ALSA has found that safety is the most important factor to passengers, a concern they try to mitigate by applying both ADAS and highlighting the absence of the biggest safety risk to traffic safety – human error. In general, the operator believes that automated services will be deployed only in specific and limited cases, instead of becoming the norm across an entire network.

Another question raised was whether or not an automated transport environment will eventually raise the number of public transport users and encourage a shift from individual to public transport. ALSA reported that no additional users have been attracted by the bus line and that the operation of the line is not economically profitable, but rather an investment in future trends and an attempt to lead a new emerging market segment. Two main improvements need to be made in order for the autonomous bus line to be truly competitive: better service (e.g., punctuality, more frequent trips) and enhanced multimodality (e.g., on-demand trips, flexible routing). Overall, the key issue is the trip experience and not so much the technologies and systems used – passenger care more about a clean and functional environment than a technologically advanced one. Eventually, new insights could emerge from comparing 'regular' trips to 'automated' trips (analysis of the removal of the human factor).

Interchanges and multimodality are one of the main areas that autonomous transport could influence the way, traffic is currently being organised. The current trend is that users seek out routes with the least number of interchanges possible. This demand could be met by on-demand transport and flexible routing – two offers which could also meet the needs of aging populations and persons with disabilities to travel more independently (though it is vital to pay close attention to the impact that missing human support might have on these user groups in the future). However, this would also require to rethink and replan entire transport networks to accommodate autonomous transport and a sound regulatory framework.

The main challenges to replicate the pilot deployment and eventually to scale it up are non-adapted infrastructure, a missing legal framework, a complex multi-layered stakeholder involvement (in this case, 4 large organisations had to cooperate) and the increase of user acceptance (in the case of this pilot deployment, most users are university students and professors, which is suspected to have a significant impact on their perception of the bus).

ALSA also reported, that local SUMPs can be enhanced by deploying autonomous vehicles, by contributing especially to objectives in the fields of safety conditions, system efficiency and emission reduction.

5.2.4.3 UAM Interview

A third and final meeting took place on 01 December 2021, including all PAsCAL consortium partners who attended the consortium meeting in Madrid, Spain. On the last day of the meeting, an on-site visit was organised and the partners met some representatives of the UAM campus. Following a short tour de table, UAM shared their experiences in organising, planning and hosting the autonomous bus line on their campus.

Figure 62 - Pilot 3, UAM interview

One key factor that made the deployment possible in the first place is that the street and road network on-campus is private (though it is open to the general public). This means, that the roads are not managed by the city hall of Madrid or any other public authority but by the university itself. Most of the ample parking facilities are also used by residents and workers of the surrounding neighbourhoods, in order to use the interurban train or bus to reach the centre of Madrid quickly. Part of the reason for this pilot was to provide a better connection to students who park their cars predominantly in the southern and northern parking areas, which are far away from the campus buildings.

UAM conducted some internal research amongst students of the business administration faculty and found that only less than 10% of the students had tried out the bus and very few students were aware of the service in general. This might be linked to the missing sign-posting of the bus and also missing information on the timetable of the trips.

5.3 Data collection

All the data collected has been received from natural persons who have read and agreed to sign a GDPR compliant form. The form has been collected with the rest of the questionnaire, but has later been anonymised, which ensures an anonymous data analysis. None of the persons who have filled out a survey within this pilot are identifiable through the dataset analysed. Furthermore, all participants who appear in photo- or videography footage have given their explicit consent to be recorded and for this footage to be used for analysis and communication purposes.

The data collected can be divided into multiple categories:

1. **Quantitative data**, which comes from the questionnaires, which have been prepared for three of the 4 activities as well as data collected from the vehicles' Blackbox as well as the custom HMI created by WP4 partners, logging each trip.
2. **Qualitative data**, which are gathered through additional comments of the participants, the Incidence Report Forms, photo- and video footage and finally observations and minutes prepared by the staff.

All data has been saved in a dedicated and secured *Dropbox*[15] folder, which only the PAsCAL staff has access to. All data has been checked to conform to GDPR standards and be as homogenous as possible for a successful and smooth data analysis process

5.4 Data evaluation

Two separate questionnaires were used throughout this pilot. One was answered by all participants who used the bus; the other questionnaire was answered by co-users and both of the surveys remained unchanged for the entire duration of the pilot. It is important to highlight that the area where the pilot was conducted (University campus), introduced by itself an age component in the analysis, as most of the potential participants to be recruited were students. In order to expand the range of age participants, AEC and Etelätär made a wide communication campaign among all scientific and research institutes in the campus, companies in the business areas close to the campus and additional contacts from their own networks.

5.4.1 Bus users

Age distribution for bus users: 49% of participants were below 25 years old, 28% over 40 years and 5% over 65 years (see Figure 63). The youngest participant was 18 years old, the oldest 70, resulting in a good representation of different age groups. 49% of the participants were women, so the gender balance of participants was also quite even.

[15] https://www.dropbox.com/es

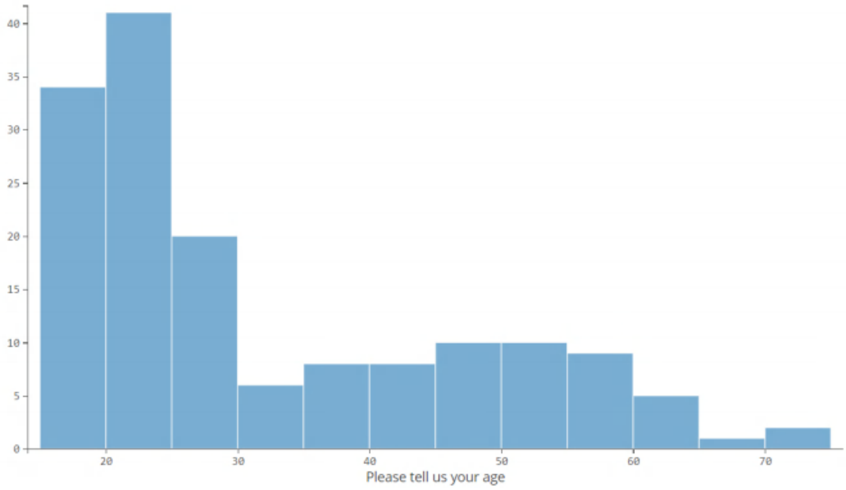


Figure 63 - Pilot 3, Age of participants (bus users)

How much confidence do you have in CAVs? (Q6): It is interesting to note how most than 90% of participants show a medium or high confidence in CAVs from the beginning (see Figure 64).

Q6: Ho...CAVs?		Count	Percent
No trust at all		1	0.6%
Barely trusting		14	9.1%
Medium trusting		94	61.0%
Very trusting		45	29.2%
Total	0.0% 20.0% 40.0% 60.0%	154	100.0%

Figure 64 - Pilot 3, Participants' confidence in CAVs (bus users)

How did you feel while traveling in a CAV? (Q13): participants reported a majority of positive feelings when travelling as a bus occupant, with very few answers for negative associations with the bus (such as "Critical, Unaffected, Nervous or Insecure", see Figure 65).

Q13: How did...ng in a CAV?	Checked Percent	Check...Count
Curious	61.5%	96
Trustful	43.6%	68
Careful	28.2%	44
Safe	28.2%	44
Critical	12.2%	19
Unaffected	5.8%	9
Nervous	4.5%	7
Insecure	1.3%	2

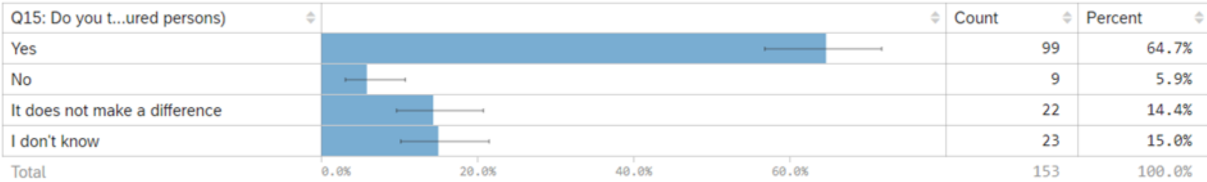
Figure 65 - Pilot 3, Participants' feeling about travelling in a CAV (bus users)

Was using a CAV the experience you had anticipated? (Q14): once travelling in the autonomous bus, participants reported positive or neutral feelings about this new mobility, see Figure 75. The general perception of AEC staff, as organizers of the waves, is that participants were happy to explore new forms of mobility and technologies, and they were quite impressed about the fact that this innovation was available for them at the UAM campus.

Q14: Was...cipated?	Count	Percent
Positively surprised	82	53.6%
It was as I expected	62	40.5%
Negatively surprised	5	3.3%
I don't know	4	2.6%
Total	153	100.0%

Figure 66 - Pilot 3, Participants' feeling after using the bus (bus users)

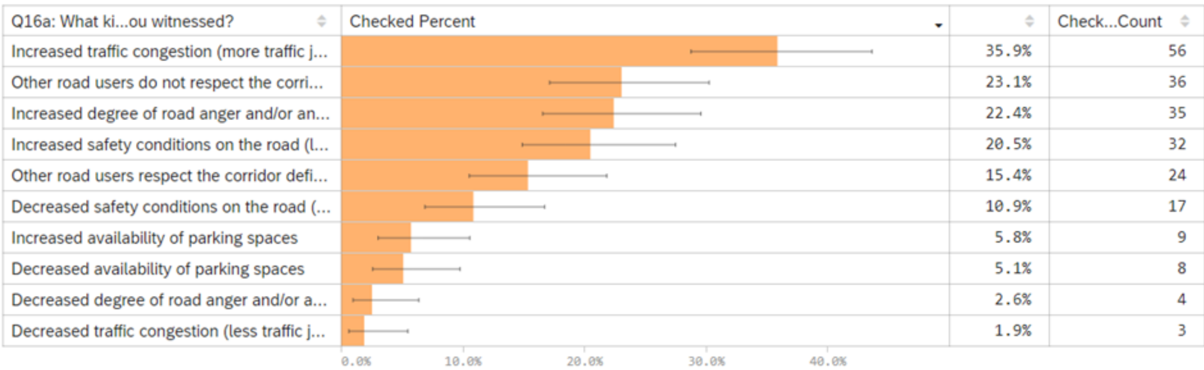
Do you think this kind of vehicle is safe to use for vulnerable users? (Wheelchair users, visually impaired persons, the elderly, injured persons) (Q15): AEC staff mentioned during each briefing that there was a platform for the access of vulnerable road users; however, the platform is not the only factor affecting willingness to use for vulnerable users, as it also involves confidence on technology and other elements. However, most of participants think it will be safe for vulnerable users, see Figure 67.



Q15: Do you t...ured persons)		Count	Percent
Yes		99	64.7%
No		9	5.9%
It does not make a difference		22	14.4%
I don't know		23	15.0%
Total	0.0% 20.0% 40.0% 60.0%	153	100.0%

Figure 67 - Pilot 3, Participants' perception on safety for vulnerable users (bus users)

Have you witnessed that the autonomous bus shuttle you have just tried influences the traffic conditions of the surrounding road users? What kind of influence have you witnessed? (Q16a): Regarding the influence of the autonomous bus in traffic conditions, it is interesting to note a high impact, from participants' perspective, in the increase of traffic congestion and anger of other road users, as well as lack of respect of the bus corridor from other users, see Figure 68. Thus, most of the negative concerns come from the fact that the space needs to be shared with a different stakeholder.



Q16a: What ki...ou witnessed?	Checked Percent		Check...Count
Increased traffic congestion (more traffic j...		35.9%	56
Other road users do not respect the corri...		23.1%	36
Increased degree of road anger and/or an...		22.4%	35
Increased safety conditions on the road (l...		20.5%	32
Other road users respect the corridor defi...		15.4%	24
Decreased safety conditions on the road (...		10.9%	17
Increased availability of parking spaces		5.8%	9
Decreased availability of parking spaces		5.1%	8
Decreased degree of road anger and/or a...		2.6%	4
Decreased traffic congestion (less traffic j...		1.9%	3
	0.0% 10.0% 20.0% 30.0% 40.0%		

Figure 68 - Pilot 3, Influence of autonomous bus on traffic conditions (bus users)

Would you let other members of your family or close circle use an autonomous shuttle service? (Q17): although there is a majority of positive answers (66%), it is surprising that 25% of participants do not show a clear confidence on the autonomous bus for their closest relatives or friends, see Figure 69.

Q17: Would yo...ttle service?	Count	Percent
Certainly	101	66.0%
Probably	37	24.2%
Depends on how technology evolves	15	9.8%
Total	153	100.0%

Figure 69 - Pilot 3, Participants' view on the acceptance of autonomous mobility (bus users)

Do you believe that CAVs can lower emissions and contribute to making transport networks more sustainable? (Q20): regarding the environmental concerns, the fact that the bus is electric means a reduction of emissions if compared con combustion engines, as shown in participants' perception to this question, see Figure 70.

Q20: Do you b...sustainable?	Count	Percent
Yes	136	90.7%
No	1	0.7%
It does not make a difference	6	4.0%
I don't know	7	4.7%
Total	150	100.0%

Figure 70 - Pilot 3, Participants' view on how CAVs can lower emissions (bus users)

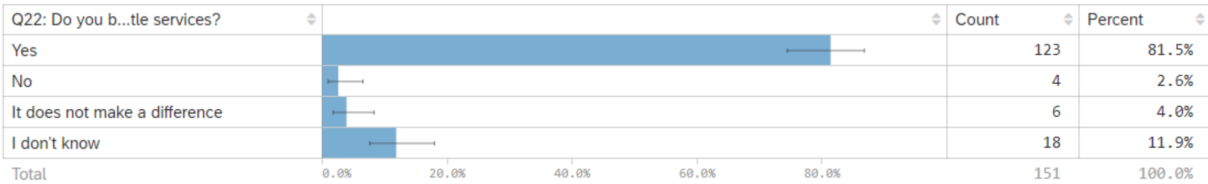
Would you pay for using an autonomous shuttle service? (Q21): it is remarkable that only 13% of participants would pay a separate fare for the autonomous bus, and 16% would not pay for it. It is likely that the existence of a unique bus line, working in a hourly-bases schedule, may affect this vision, see Figure 71.

Q21: Would yo...ttle service?	Count	Percent
I would not pay for this kind of service	25	16.6%
Yes, I would be willing to pay a seperate f...	20	13.2%
Yes, if the fee was included in my monthl...	106	70.2%
Total	151	100.0%

Figure 71 - Pilot 3, Participants' willingness to pay (bus users)

Do you believe that the transport system as a whole can be improved by the integration of such kind of autonomous shuttle services?

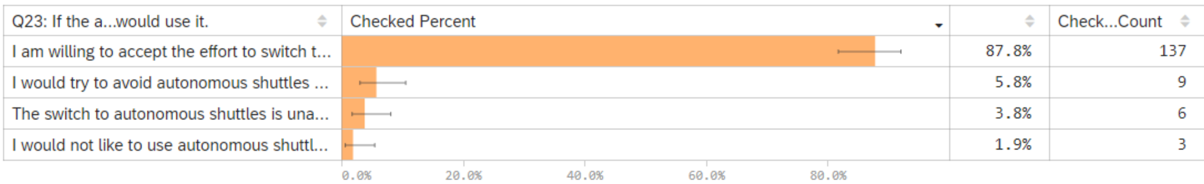
(Q22): in general, there is a positive perception about how the autonomous bus impact the performance of the transport system, see Figure 72.



Q22: Do you b...tle services?		Count	Percent
Yes		123	81.5%
No		4	2.6%
It does not make a difference		6	4.0%
I don't know		18	11.9%
Total	0.0% 20.0% 40.0% 60.0% 80.0%	151	100.0%

Figure 72 - Pilot 3, Participants' vision on potential improvement of transport system (bus users)

If the autonomous shuttle were available to me, I would use it. (Q23): again, participants show a positive attitude towards autonomous mobility, expressing their intention to switch to this new mode, see Figure 73.



Q23: If the a...would use it.	Checked Percent		Check...Count
I am willing to accept the effort to switch t...		87.8%	137
I would try to avoid autonomous shuttles ...		5.8%	9
The switch to autonomous shuttles is una...		3.8%	6
I would not like to use autonomous shuttl...		1.9%	3
	0.0% 20.0% 40.0% 60.0% 80.0%		

Figure 73 - Pilot 3, Participants' willingness to use the autonomous bus (bus users)

5.4.2 Road co-users

Age distribution for co-road users: most of the participants recruited were students of the university campus, so the age range between 18- and 23-years old participants is overrepresented, see Figure 74.

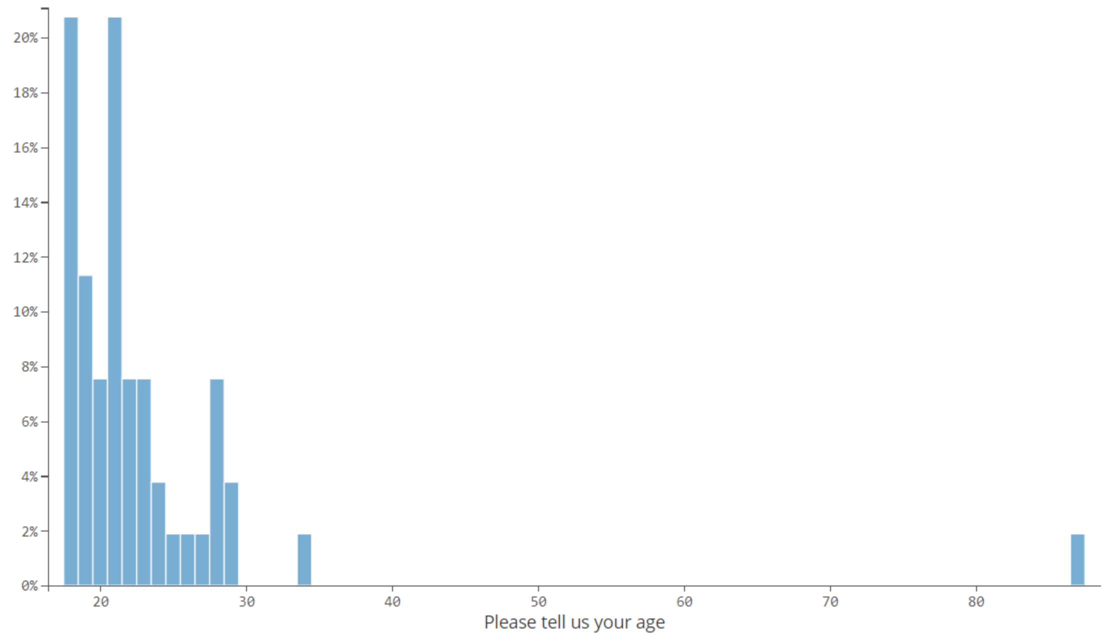


Figure 74 - Pilot 3, Age of participants (co-road users)

How much confidence do you have in CAVs? (Q6): the result of this question is similar to the one for bus users, showing a high confidence in CAVs, see Figure 75.

Q6: Ho...CAVs?	Count	Percent
Barely trusting	6	11.5%
Medium trusting	30	57.7%
Very trusting	16	30.8%
Total	52	100.0%

Figure 75 - Pilot 3, Participants' confidence in CAVs (co-road users)

Have you noticed a different behaviour in traffic flows around the Universidad Autónoma area in the last few months? (Q15): when asked about change in traffic flows, co-users do not perceive a significant impact in traffic due to the presence of the autonomous bus, see Figure 76.

Q14: Have y...few months?		Count	Percent
Yes, there is less traffic		3	5.9%
Yes, there is more traffic		9	17.6%
No		25	49.0%
I don't know		14	27.5%
Total	0.0% 20.0% 40.0% 60.0%	51	100.0%

Figure 76 - Pilot 3, Participants' vision on impact on traffic flows (co-users)

Have you witnessed that the autonomous bus shuttle influences the traffic conditions of the surrounding road users? (Q15a): in accordance to the previous question, it can be noted that the number of answers showing a significant impact on the traffic or other users is not so relevant, see Figure 77.

Q15a: What ki...ou witnessed?	Checked Percent		Check...Count
Increased traffic congestion (more traffic j...		18.9%	10
Increased safety conditions on the road (l...		15.1%	8
Increased degree of road anger and/or an...		13.2%	7
Other road users respect the corridor defi...		13.2%	7
Decreased traffic congestion (less traffic j...		9.4%	5
Decreased degree of road anger and/or a...		5.7%	3
Other road users do not respect the corri...		5.7%	3
Increased availability of parking spaces		5.7%	3
Decreased availability of parking spaces		5.7%	3
Decreased safety conditions on the road (...		1.9%	1
	0.0% 10.0% 20.0% 30.0%		

Figure 77 - Pilot 3, Influence of autonomous bus on traffic conditions (co-users)

Would you feel comfortable sharing the road with an autonomous shuttle service? (Q16): the majority of participants reported a positive answer, although the presence of other users is a significant factor to point out, see Figure 78.

Q16: Would yo...ttle service?		Count	Percent
Yes, in all traffic conditions		13	25.5%
Yes, in low traffic areas		18	35.3%
Yes, if the CAV has a dedicated lane		10	19.6%
Yes, if the CAV drives slowly (<20 km/h)		5	9.8%
No		2	3.9%
I don't know		3	5.9%
Total	0.0% 10.0% 20.0% 30.0% 40.0% 50.0%	51	100.0%

Figure 78 - Pilot 3, Participants' perception on sharing the road (co-users)

Do you believe that the transport system as a whole can be improved by the integration of autonomous shuttle services? (Q17): co-users show a similar perception than passengers of the autonomous bus, reporting a positive perception on the improvement of the transport system due to the introduction of autonomous services, see Figure 79.

Q17: Do you b...tle services?		Count	Percent
Yes		39	76.5%
No		1	2.0%
It does not make a difference		6	11.8%
I don't know		5	9.8%
Total	0.0% 20.0% 40.0% 60.0% 80.0%	51	100.0%

Figure 79 - Pilot 3, Participants' vision on potential improvement of transport system (co- users)

If the autonomous shuttle service were available to me, I would use it (Q18): the vision of co-users on this is, again, similar to the opinion of passengers of the autonomous bus; they show a positive attitude towards autonomous mobility, and are open to switch to it, see Figure 80.

Q18: If the a...would use it.		Count	Percent
I am willing to accept the effort to switch t...		43	84.3%
The switch to autonomous shuttles is una...		4	7.8%
I would not like to use autonomous shuttl...		4	7.8%
Total	0.0% 20.0% 40.0% 60.0% 80.0%	51	100.0%

Figure 80 - Pilot 3, Participants' willingness to use the autonomous bus (co-users)

5.5 Cross-fertilisation Activities Across WPs

In order to secure high effectiveness of the pilots and relevance of the research questions asked, cross-fertilisation and liaison between PAsCAL WPs have been sought and encouraged.

5.5.1 WP4

Following some communications with WP4, a custom HMI has been designed in collaboration with and developed by WP4 project partner Inetum (Realdomen). The HMI consists of a mobile application, which was installed on a tablet and then mounted on-board the bus. This device informed passengers of their next connections and underlined the multimodality of the vehicle to the participants. The application switched between the train station connections and the interurban long-haul bus station connections, depending on where the bus was located along its' itinerary to mirror real-time information on both complimentary modes of transport. Finally, the HMI also served in recording and monitoring the GPS location of the bus at all times, permitting to check the speed of the vehicle, identify critical black spots, near-collision incidents or emergency breaking. This information can help to differentiate the responses of participants who might have experienced an incident during their trip.

Figure 81 - Pilot 3, WP4 HMI

Also, WP4 hosted a joint workshop to explore a possible liaison with single pilots on 10th January 2022, in which some recommendations of WP4 for WP6 were discussed and considered. During the workshop, it became clear, that some of the recommendations are already implemented in the pilot setup, namely:

- UC 1.1 – *Presence of an emergency stop button within fully autonomous vehicles*;
- UC 1.4 – *Autonomous driving dealing with unusual/tricky situations (traffic jams, roadworks, vehicle parked on road)*;
- UC 2.3 – *Experimenting a CAV as a segment of a multimodal trip*;
- UC 4.2 – *The CAV respects the traffic rules and does not let pedestrians pass outside the crossings*;
- TV 1.3 – *Participants with different levels of knowledge and experience regarding CAVs*;
- TV 2.1 – *Impaired participants as part of the study population*;
- TV 2.2 – *Low number of passengers on board*;
- TV 2.5 – *Attitudes to be measured*;

Further, some WP4 recommendations were considered and finally implemented in the third and final pilot wave, namely:

- UC 1.3 – *Additional tasks (reading, mailing…) for participants* were monitored more closely and the shadowing staff paid special attention to the time passengers needed until they checked their phones or else became distracted of the bus;
- UC 4.1 – *The CAV stops or does not stop* was monitored and checked thanks to the HMI on-board the shuttle bus to record any accidental emergency stops.

5.5.2 WP7

Also, WP7 has had some impact on the data collected within this pilot and all datasets have been transferred to this WP after the completion of the pilot in an agreed-upon format and in time to allow for a detailed data analysis. The cleared and final version of the dataset was sent to WP7 on 04 February 2022.

5.5.3 WP8

For the Guide2Autonomy (G2A) in WP8, 3 distinct recommendations were drafted and submitted to the guide inventory on 04 February 2022.

5.6 Dissemination activities

Dissemination activities were carried out using different means, as explained below.

Before each pilot wave, AEC and Etelätär Innovation conducted intensive dissemination campaigns based in social media. Twitter, LinkedIn and Instagram were used. Whenever possible, official profiles from CRTM, ALSA and UAM were tagged, in order to enhance the dissemination of the posts across different stakeholders. ACE also identified the social media profiles of different faculties of UAM, to tag them individually.

Figure 82 - Pilot 3, Social media campaigns

In addition, AEC and Etelätär developed an intensive e-mail campaign to collect participants. It could be finally noted that most of participants arrived by this mean (there was a dedicated e-mail contact address for this activity, different from the one published in social media posts). The following groups of interest were considered for the identification of participants, having into account the necessity to include a wide range age:

- **Group of interest 1: UAM students and staff.** In order to reach as much students as possible, AEC sent the information on the pilot to the different schools of UAM in the campus, students association, coordinators of different degrees, libraries, cultural activities, sport centres, students' residences, international services, etc. In addition, students from other universities were also contacted, such as Universidad Alfonso X El Sabio by Etelätär and Universidad Carlos III de Madrid by AEC. Finally, participants in wave 1 were contacted for wave 2, in order to ask them to disseminate the recruiting e-mail to their contacts (it was specifically mentioned that it was not possible to participate twice); same procedure was used for participants in wave 2, when organizing wave 3;

- **Group of interest 2: research centres and companies in the UAM campus**. There are several research centres and companies in the campus and all of them were informed of the different waves. Their staff' response was particularly positive, as many researchers from Centro de Biología Molecular and Centro Nacional de Biotecnología, among others, participated;
- **Group of interest 3: Key stakeholders for autonomous mobility.** Regarding this group of interest, it is important to highlight the participation of one person from DGT, 4 from CRTM and 2 from ALSA. In addition, staff from UAM and members of the PAsCAL consortium could also participate, taking advantage of the consortium meeting held in Madrid at the end of November and beginning of December;
- **Group of interest 4: AEC staff**. AEC staff not involved in the preparation and conduction of the pilot participated as bus users (8 employees), also involving their friends and relatives. It was particularly interesting that one colleague could include her father and her father's friend (in their seventies), thus introducing the point of view of elderly people;
- **Group of interest 5: AEC members**. AEC members based in Madrid (around 80 companies and organizations) were contacted, and some participants could be recruited from this side. Specifically, for wave 3, some AEC members also developed their own dissemination campaign about the pilot, supporting AEC in the collection of participants.

Finally, a final event was held on March 25th 2022 online. It gave both Etelätär Innovation and AEC as pilot managers a platform to share information on the PAsCAL project, as well as the organisation and results of the pilot. Further speakers of CRTM, ALSA and UAM respectively shared their perspectives on CAV technologies and their potential for multimodal public transport systems, bus operations and on-campus deployments respectively.

5.7 Conclusions & Learnings

Although the transport service in the autonomous bus was fully operating in the campus of the UAM from October 2020 (after being inaugurated in February 2020, it suffered a compulsory stop of the service during the lockdown due to the COVID-19 pandemic), the planning and execution of the pilot was delayed several times for technical incidents on the vehicle.

The vehicle is quite sensible to weather conditions: wind and rain can affect the performance and the sensors. In addition, there were some problems with a specific sensor, which required specific maintenance operations from the vehicle manufacturer, and some others communication problems affecting not only the transport service, but also the internet service in the campus. These circumstances affected not only the calendar of the pilot, but also the confidence of potential users, which suffered a cancelation of the pilot in several occasions.

It was unlucky that the very first time the bus started to operate, in February 2020, there was an incident in the campus, involving the autonomous bus. Although it was not a problem related to autonomous mobility (it was a rear-end crash generated by another conventional vehicle), the incident appeared in several media, and this was in the mind of most of UAM students and staff.

It was also noted that there is only a few information about the bus service, not only in the campus, but also in the internet. Most of the participants in the surveys shown a poor concern about the bus and service provided, which suggest that more information about it is required and a higher level of integration into the wider transport system of Madrid is recommended.

Taking into account the comments and suggestions received from participants in the pilot, it could be noted that most of them found it was interesting, and even attractive, to have an autonomous bus in the campus; however, the majority of them have not tried it before because they do not really need it, as walking distances in the campus are quite reasonable for young and healthy people. In addition, the fact that the transport service is only available once in an hour and its low speed also introduces some difficulties to promote the general use of the bus.

The bus supervisor mentioned that the bus has had a very low occupation since it was launched, 7-8 passengers daily are the maximum number of passengers. Only the isolated case of a handicapped woman with a problem in her leg, using it every morning, could be considered as a regular bus user. For vulnerable users, it could be a very useful solution, as it is quite easy to access with wheelchair and it provides a comfortable trip; this could be checked directly by a wheelchair user participating in the pilot.

Regarding intramodality, it would be desirable to count with information about services and timetables of other public transport services in the campus, such as buses or trains. This information is not provided inside the bus and there is not a specific bus stop with such detail. Thus, it would be desirable to consider:

- Enhance the HMIs onboard by adding information on the next connections by train or autobus from the stops and their time of departure for better integration into the transport network;
- Enhancing the visibility of the bus line, for example by adding a timetable to the stops, information about the vehicle and/or integrating it into the public transport app (and suggesting users to use the shuttle instead of walking by default).

Considering the results of the pilot, it could be reasonable to suggest a major dissemination activity before the implementation of an autonomous mobility solution, and to continue it during the on-going of the service. It is important to warn users about the fact that it is a pilot solution or a research project, so that they are more open to admit technological problems causing malfunctions of the service. Today, autonomous mobility solutions are still under testing, so the level of quality performance and comfort requirements cannot be the same as those required for conventional bus lines or trains.

It was very good to have a real and positive involvement of CRTM, DGT, ALSA and UAM in the pilot, as they were also interested in improving their awareness on users' perception about autonomous mobility. This could be key for the massive deployment, step by step, of these technological solutions for sustainable transport.

There is currently not a clear roadmap for the implementation of autonomous mobility in Spain, being the UAM campus bus a first pilot solution which is currently under analysis. The conclusions of these first years of service will allow CRTM, DGT, ALSA and UAM to continue with the deployment of the service and, if decided, include new lines, inside or outside the campus. There are also other pilot projects involving autonomous vehicles across Spain, which will also be the base for the development of the future autonomous mobility model.

DGT has recently developed, and is about to formally approve, the new instruction for the certification of autonomous vehicles under tests, which will also promote the development of new research activities in this field, supporting the development of this mobility solution.

However, the UAM campus is a perfect environment to test and validate the performance of autonomous mobility solutions, as it is open to traffic (motorized and non-motorized) but it is not crowded of vehicles; it is an area where the priority of roundabouts could be easily changed to ensure the priority of the autonomous bus, which could create many problems in an open street area; at the same time, it is a testing area perfect to evaluate the coexistence of this type of vehicles with pedestrians, cyclists and other non-motorized vehicles.

Finally, it is important to mention that once the pandemic of Covid-19 is completely finished, it is likely that citizens are more open to travel in public transport, including autonomous bus, more regular. Although the level of use of public transport is quite high now, it has not reached the levels previous to March 2020.

6 Pilot 4: Shared connected transport

6.1 Introduction

The Shared Connected transport pilot study focusses on assessing attitudes and perceptions of "drivers" and passengers toward different types of shared connected vehicles, which include an autonomous shuttle and a shared car fleet including an electric vehicle with autonomous features, such as autopilot, automatic or guided parking and other autonomous features that would become available and allowed for operation on public roads at the time of this subtask.

The goal of this pilot is to better understand attitudes and public acceptance to different kinds of shared vehicles (by size, by type combustion or electric, by availability of autonomous features) and to various associated incentives. This pilot study will allow operators of shared fleets to:

1. optimally design and operate fleets of shared vehicles;
2. design well-suited incentive mechanisms to increase public acceptance and improve attitudes towards different kinds of shared vehicles.

The pilot is divided into two sub-pilots, which are presented in the following sub-chapters.

6.1.1 Shared car fleet pilot

During the shared car fleet sub-pilot, the employees of the University of Luxembourg, which already have a fleet of shared vehicles available, were asked to drive a shared vehicle with autonomous features (level 2 automation) and to provide relevant information in form of a survey on their driving experience. The vehicles of this shared fleet were provided by Moovee[16], a car shared fleet operator based in Luxembourg. The first and main objective of this pilot is collecting both qualitative and quantitative information on the acceptance of CAVs in the current daily life of professionals. A second objective of this sub-pilot is to assess the commercial potential of integrating CAVs into shared fleets of mobility service providers. The experiment took place during two weeks in November on an open road in the Belval area, which is located in the

[16] https://moovee.lu/en/

South of Luxembourg, close to the French border. An additional wave was organised during two weeks in March in Contern (Luxembourg), within a business campus close to Luxembourg city. The sample size consisted of 102 participants.

6.1.2 Autonomous shuttle pilot

For the autonomous shuttle bus sub-pilot, an autonomous electric shuttle is used which is operated by Sales-Lentz[17] in Contern, within a business campus. The shuttle is a *Autonom Shuttle Evo* model provided by the manufacturer of the vehicle, Navya[18]. The experience and knowledge of Sales-Lentz with both public and private clients is a strong added value and permits to understand how passenger and public administrations consider CAV as a potential solution to their mobility challenges. Participants will be asked to ride an autonomous shuttle in Contern on a pre-defined roundtrip on an open road. The sample size of the autonomous bus shuttle, which was initially planned to consist of 50 participants, will not be reached until the end of WP6 and will continue to be achieved in WP7.

6.2 Pilot execution, Observations & Deviations

6.2.1 Preparation shared car fleet sub-pilot

The main scope of this sub-pilot is to test and understand the benefits and interest of an integrated implementation of a fleet, of shared cars with autonomous features in Belval, Luxembourg, where also the University of Luxembourg is located. A service of shared cars is already implemented at the university by Moovee. Employees of the University of Luxembourg are using this service to reach another campus or professional meetings in Luxembourg or beyond. This experiment is aiming at testing the acceptance of users when integrating also cars with autonomous features as opposed to the classical cars, currently in the fleet of the University of Luxembourg.

As described in D6.2, it is assumed that the participants are driving the car with autonomous features exactly in the way they would drive a regular car of the shared fleet. From the end user perspective, the assumption is

[17] https://www.sales-lentz.lu/en/
[18] https://navya.tech/en/

that using a shared car with advanced autonomous features does not change drastically the user experience or behaviour. Indeed, most of the autonomous features are related to safety features rather than comfort features and accordingly, the autonomous features are activated only in the rare case of a road issue or imminent potential accident. These specific and occasional events happen, but were not expected to take place during the pilot.

Figure 83 - Pilot 4, Shared car without autonomous features of the fleet on-site (shared car fleet)

The sub-pilot was conducted during two weeks mid-November 2021 (November 8th until November 19th) in iterative waves. An additional wave was organised for two weeks mid-March 2022 (14th March until 25th March). The material needed to be organized included:

- **Electric vehicle with autonomous features (**see Figure 84**)**: The vehicle used was a Mercedes EQC[19] with level 2 autonomous features. These features include the latest driver assistance systems, which allow to automatically maintain a fixed distance from the car in front of the vehicle, remain in lane or stick to a speed limit, which can be automatically identified by the vehicle. Level 2 automation also allows to take the hand off the steering wheel,

[19] https://www.mercedes-benz.es/passengercars/mercedes-benz-cars/models/eqc/explore.html

however, the driver must be able to intervene if any part of the system fails and must stay alert to road conditions;

- **Booking platform and access cards/badges**: Moovee developed and provided a booking platform, where the users of their service can book a timeslot of half an hour to drive the vehicle with autonomous features. In addition, access cards/badges were organised to be able to unlock the vehicle and to exit the parking, where the vehicle was parked during the pilot;
- **Information sheets**: A small description of the PAsCAL project and the pilot, including the QR-Code to fill out the questionnaire with the participants' private smartphones;
- **Incentives**: Every participant received a small incentive after filling out the questionnaire. It included a voucher, which can be used by the Moovee users for their next ride with a vehicle of the shared car fleet.

Figure 84 - Pilot 4, Mercedes EQC exterior (shared car fleet)

The automated vehicle to be integrated into the shared car fleet is equipped with several sensors. The front part of the car is equipped with distance and speed limit assist sensors, allowing to regulate the speed and distance to the vehicle in front of it (see Figure 84).

The scenario route which was defined in deliverable D6.2 (see Figure 85), and which is the same for every participant, is combining parts of highways, countryside roads and urban environment (traffic lights) around Belval. This 11 km trip on the open road is considered similar to trips that the employees of the University of Luxembourg are doing when booking a car from the shared fleet.

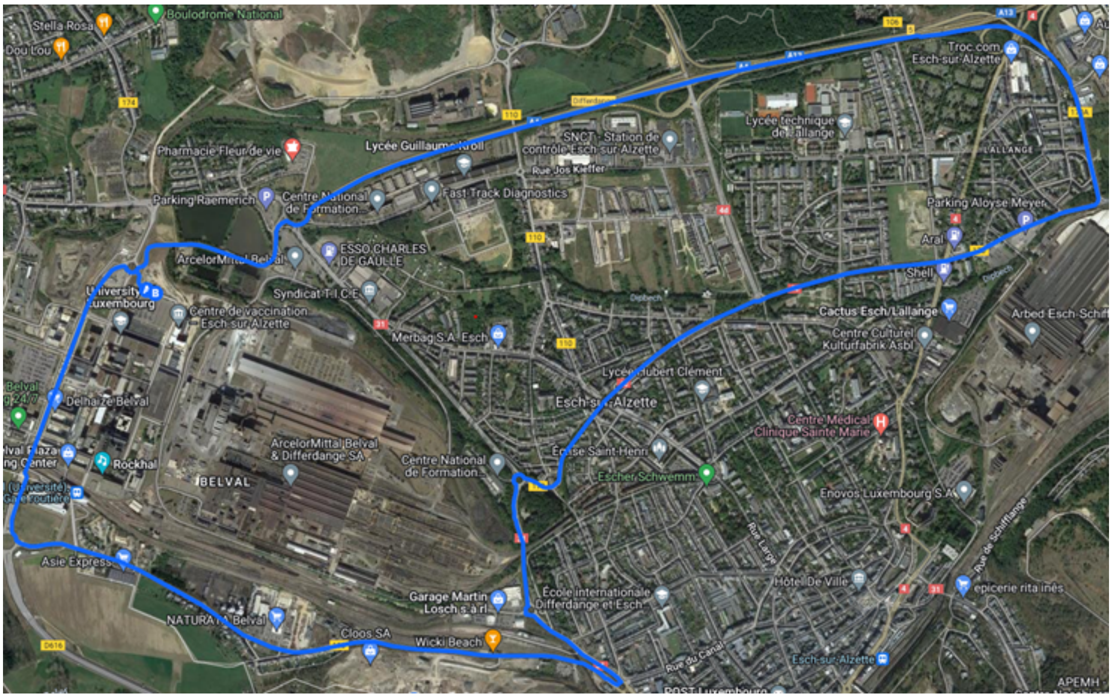


Figure 85 - Pilot 4, Planned route (shared car fleet)

During the test drive before the first wave, it became clear that the route trip, which has been foreseen originally, is not feasible in the time period of 15 minutes, due to too much traffic in the city. In addition to this, the usage of the autonomous features couldn't be tested while driving in the city setting. Therefore, it was decided to drive only on a highway to be able to test the autonomous features more efficiently. The new route is a trip from the university to the village Pontpierre and back, going via the highway. This route is 15 km long (instead of 11 km) and takes approximately 10 to 15 minutes (see Figure 86).

It has been decided to reduce the time of each time slot from 45 minutes to 30 minutes, to attract more participants. The time needed for one participant (briefing, car trip and survey time) is close to 30 minutes. Each day of the working week had 12 timeslots, which started at 10:00 and ended at 16:00, which means that maximum 12 individual participants could take part in the experiment each day.

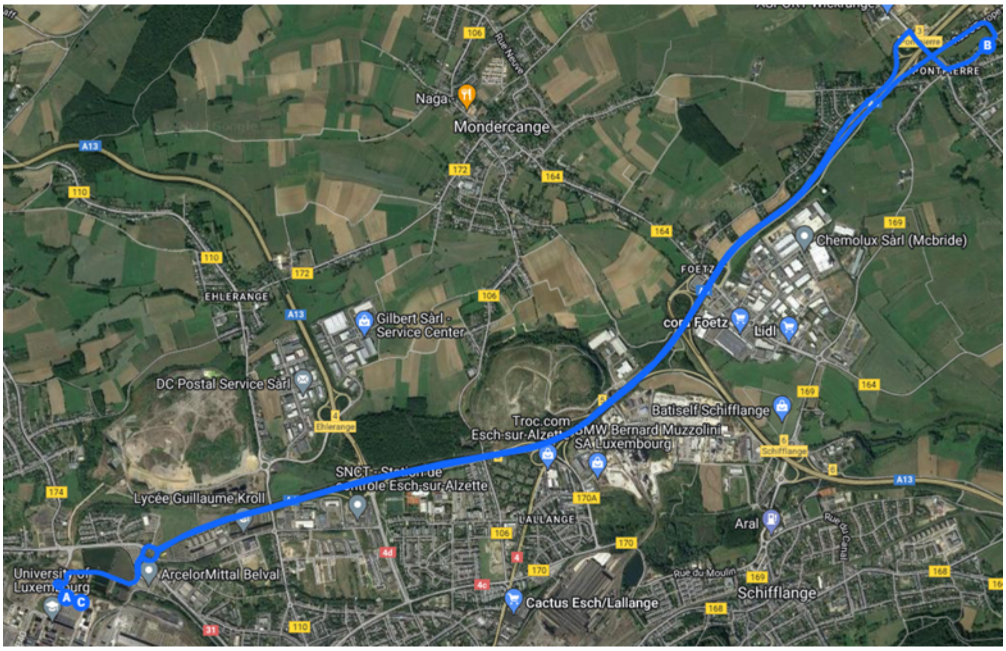
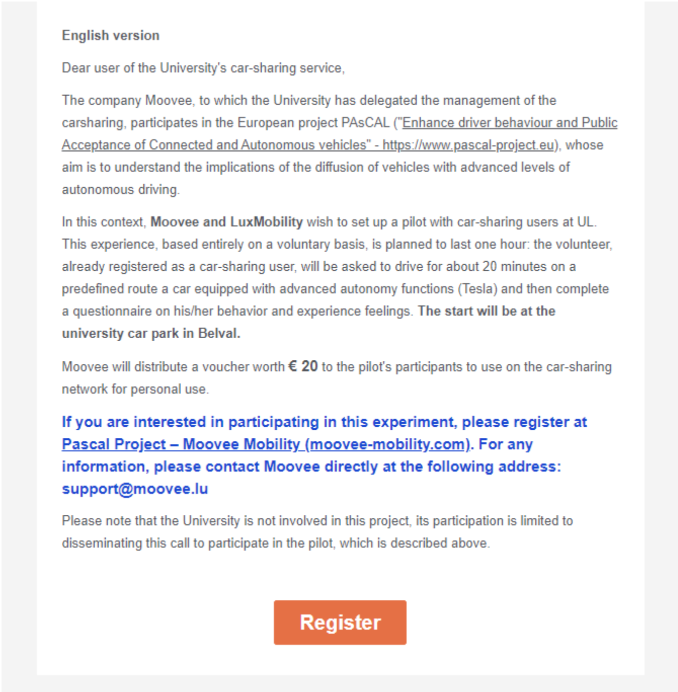


Figure 86 - Pilot 4, Actual route (shared car fleet)

Frequent users of the car fleet service were contacted by e-mail and asked to participate in the controlled experiment. As they are already familiar with the service and understand intuitively how it works, the experiment consists in driving a car with autonomous features in particular. All participants are employees (or Master and PhD students) of the University of Luxembourg, they all have a valid driving license, have used the University car sharing system multiple times and are aged between 18 and 65. It was planned to invite interested participants in taking part in a (digital) briefing session where details about the PAsCAL project and the practical information of the experiment are presented before driving the vehicle. It proved that the briefing could be shortened and organised during a 30 minutes time slot. The participants booked a time slot of half an hour that fits their personal schedule to run the experiment. The booking was done through the same booking platform than the normal booking of the regular cars. The figures below show the email text, which was sent to all the car sharing users and also a wider network of consortium partners within the University of Luxembourg. To register the users had to indicate their email address, mobile phone number and the date and time during which they are interested in taking part in the experiment.



English version

Dear user of the University's car-sharing service,

The company Moovee, to which the University has delegated the management of the carsharing, participates in the European project PAsCAL ("Enhance driver behaviour and Public Acceptance of Connected and Autonomous vehicles" - https://www.pascal-project.eu), whose aim is to understand the implications of the diffusion of vehicles with advanced levels of autonomous driving.

In this context, **Moovee and LuxMobility** wish to set up a pilot with car-sharing users at UL. This experience, based entirely on a voluntary basis, is planned to last one hour: the volunteer, already registered as a car-sharing user, will be asked to drive for about 20 minutes on a predefined route a car equipped with advanced autonomy functions (Tesla) and then complete a questionnaire on his/her behavior and experience feelings. **The start will be at the university car park in Belval.**

Moovee will distribute a voucher worth **€ 20** to the pilot's participants to use on the car-sharing network for personal use.

If you are interested in participating in this experiment, please register at Pascal Project – Moovee Mobility (moovee-mobility.com). For any information, please contact Moovee directly at the following address: support@moovee.lu

Please note that the University is not involved in this project, its participation is limited to disseminating this call to participate in the pilot, which is described above.

Register

Figure 87 - Pilot 4, Invitation e-mail sent to the participants

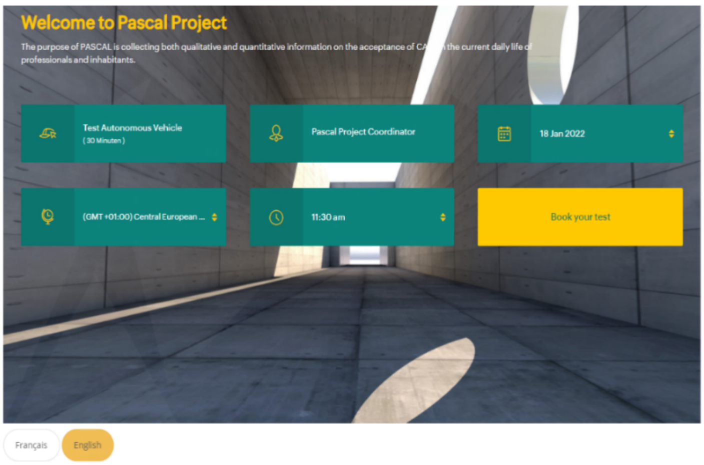


Figure 88 - Pilot 4, Booking platform to register for the experiment (shared car fleet)

In order to keep a setting and an experience which is as close as possible to a normal usage, the car with autonomous features was parked in the same place than the other University shared cars and can be accessed with the staff' badges, just like regular cars of the fleet. On the day of the pilot execution, each participant was welcomed with an incentive and a summary of the pilot. During the experiment, two members of the coordinating team (one employee of Moovee and one employee of LuxMobility) were in the car with the driver to make sure that the protocol (defined path, speed limit) is respected and to intervene in critical situations.

The participants accessed the vehicle and received technical instructions of all the autonomous features. After driving for approximately 15 minutes, participants responded on-site to the survey, which is available in 3 languages on their personal smartphone. Having the pilots' coordinator at the disposal of the participants is helpful to solve minor technical issues (survey access, question understanding, etc.).

6.2.2 Waves report shared car fleet sub-pilot

During two weeks in November 2021, the experiment was organised in two waves. Before each wave, the number of registered timeslots has been controlled. At least two staff members are present at the pilot site on any given day. The week before the two waves, a check has been conducted to make sure everything is ready, which includes that the car is on-site and charged, that the QR-codes for the questionnaires are working and that participants receive a voucher as an incentive. An additional wave was organised to reach the target number of participants.

6.2.2.1 Pilot 4, Wave 1 report

During the first wave, a total of 29 persons participated in the pilot. Unfortunately, 14 participants who registered didn´t show up. The detailed number of participants for each day is shown in Table 13.

Table 13 – Pilot 4, Wave 1 number of batches and participants (shared car fleet)

Date	Time	Batch Number	No. of participants
November 8th, 2021	10:00-14:00	1	6

November 9th, 2021	10:30-14:30	2	5
November 10th, 2021	10:00-15:30	3	5
November 11th, 2021	10:00-15:30	4	7
November 12th, 2021	10:00-14:00	5	6

For the shared car fleet pilot, only one scenario was conducted. This scenario was as close to a typical commuting as possible, which means that the experiment is as realistic as possible to the normal usage of the shared car fleet. As the service of the shared fleet of cars is already implemented at the University of Luxembourg, this experiment should allow employees to drive a vehicle with autonomous features instead of being distracted with the functionalities of the shared car fleet or the rental process. They are already familiar with the service and understand intuitively how it works.

Figure 89 - Pilot 4, Participant driving the vehicle on the highway using the hands off the wheel autonomous feature (shared car fleet)

The main qualitative observations of this first wave were:

- After the participants had been instructed to switch on the autonomous driving feature and to take the hands off the steering wheel, some participants still grabbed the steering wheel out of caution while driving autonomously;
- Some participants hovered their foot over the brake pedal out of caution, even if the car was adapting its speed to the car in front of it;
- Three participants had already participated in the Pilot 1: *High-capacity autonomous bus operations* of the same PAsCAL project;
- Many participants were afraid or uncomfortable driving an automatic gear, as they are used to only use a manual gearshift;
- Some participants throughout the wave worked professionally in the field of developing autonomous features and felt comfortable using a car with autonomous features.

Some incidences occurred during this first pilot wave, namely:

- The vehicle sometimes had issues in correctly reading the speed limits, most likely when another vehicle obscured the car's sensors. This required the driver to take control over the vehicle and reduce or increase the speed manually at times;
- 14 registered participants cancelled or didn't show up. For those who cancelled, reasons included not being aware of the testing being on the Belval campus, or not interested or having no time anymore;
- One participant was very nervous and almost crashed into the highway divider on the return trip (the staff member of Moovee sitting next to the driver had everything under control);
- The route of the test drive changed. Instead of driving through Esch-Sur-Alzette and around Belval, the route almost only included the highway from the Belval University parking lot to Steinbrücken/Pontpierre and back. This was done to test the autonomous features more than the original route planned;
- A different return route had to be taken for two participants due to traffic jams.

6.2.2.2 Pilot 4 Wave 2 report

During the first wave, a total of 19 persons participated in the pilot. 6 participants who registered didn´t show up. Unfortunately, for the second week, less people registered. The detailed number of participants for each day is shown in Table 14.

Table 14 - Pilot 4, Wave 2 number of batches and participants (shared car fleet)

Date	Time	Batch Number	No. of participants
November 15th, 2021	10:00-13:30	1	6
November 16th, 2021	10:30-14:30	2	5
November 17th, 2021	11:00-12:00	3	2
November 18th, 2021		4	0
November 19th, 2021	10:00-15:30	5	6

The main qualitative observations of the second wave were:

- One participant works in law and asked questions about the liability in case of an accident while driving a vehicle with autonomous features;
- One participant was very unsure and almost collided four times with other vehicles while driving (the staff member of Moovee sitting next to the driver had everything under control);
- One participant privately owns a level 2 autonomous vehicle and was very comfortable using the vehicle;

6.2.2.3 Pilot 4 Wave 3 report

Another wave was organised for two weeks (14th March to 25th March 2022), to get more participants in order to reach the target number of 100 participants for this sub-pilot. This pilot wave was not organised in Belval with the University of Luxembourg staff. Instead, due to the high number of employees of the University of Luxembourg teleworking, it was decided to run an additional wave at Campus Contern, where the autonomous shuttle sub-pilot will be running. Therefore, another route needed to be defined (see Figure 90). Participants were asked to drive a 26 km long route, which includes parts of regional roads and most of the time highways. The time of one batch took 45 minutes, including the short briefing (5 minutes), the drive (30 minutes) and answering the questionnaire (10 minutes). The participants were recruited by Campus Contern, by sending out e-mails to the tenants of Campus Contern, the business Club Contern[20], and the commune of Contern. The tenants are also visited personally to explain the purpose of the pilot. In addition, the information and registering QR code for the experiment have been displayed in the business buildings.

Figure 90 – Pilot 4, New route for wave 3 (shared car fleet)

For this wave, a Tesla model S was used, which has the same autonomous features than the vehicle used in Belval in previous pilot waves. The additional feature is that the Tesla model has is that it can perform lane changes on the highway autonomously. During this wave, a total of 54 persons participated in the pilot. Some passengers were added to the pilot setup in the last week of piloting to further raise the number of participants.

Table 15 - Pilot 4, Wave 3 number of batches and participants (shared car fleet)

Date	Time	Batch Number	No. of drivers	No. of passengers

[20] https://www.businesscontern.lu/

March 14th, 2022	10:00-13:00	1	3	-
March 15th, 2022	10:00-13:00	2	4	-
March 16th, 2022	10:00-13:00	3	5	-
March 17th, 2022	10:00-13:00	4	2	-
March 18th, 2022	10:00-13:00	5	3	-
March 21st, 2022	10:00-13:00	6	2	1
March 22nd, 2022	10:00-13:00	7	3	4
March 23rd, 2022	10:00-13:00	8	5	3
March 24th, 2022	10:00-13:00	9	5	4
March 25th, 2022	10:00-13:00	10	6	4

The main qualitative observations of the second wave were:

- A clear difference could be observed again between participants who already used autonomous features before and those who didn't. The participants who had already used autonomous features before felt more comfortable and less nervous than the participants who had never used autonomous features. In addition, some of the participants work or worked in the automotive sector and have had already an interest for autonomous features and CAVs in general before the pilot;
- Most of the participants never used an electric vehicle before, and neither a vehicle with autonomous features. 9 out of 54 participants had already driven a vehicle with autonomous features;
- Most of the participants were excited and eager to test all of the features the vehicle had to offer. On the other side, some participants were less impressed and expected a higher level of automation of the vehicle;
- Event with a short briefing, most of the participants had no issues to use the autonomous features of the vehicle. It could be observed that some participants learned how to use them faster than others;
- To reach the target number of participants (100) for this sub-pilot, people were asked if they would like to be a passenger in the vehicle

and to join their colleagues driving the vehicle passively. Even if they did not drive the vehicle themselves, they showed similar reactions to those who steered the vehicle themselves. They had to trust the vehicle and the driver at the same time. Most of the time, they felt even more nervous than the drivers as they didn't have the option to take back control over the vehicle;

- Most of the people hit the brakes manually and didn't let the vehicle break itself when they approached another vehicle. Even if the Tesla braked more smoothly than the Mercedes EQC used in previous pilot waves. Out of habit, the participants also kept their hands on the steering wheel. However, when they intervened and manually braked or steered the vehicle, it switched off its' autonomous features automatically. When the vehicle deactivated the features, the participants had to react quickly to take back the control of the vehicle.

Figure 91 - Pilot 4, Participants entering (left) and driving the vehicle (middle) and filling out the questionnaire after the pilot (right) (shared car fleet)

Some incidences occurred during this pilot wave, namely:

- An alarm of the car went off a few times, as the vehicle wanted to turn off of the autonomous autopilot mode. One participant in particular was very slow in reacting to the alarm due to a language barrier. The vehicle shut off the autonomous mode because the driver didn't react to the vehicle alarm and after receiving the instructions to touch the steering wheel. The vehicle decelerated very quickly and has to be stopped to reactivated the autopilot mode;

- As mentioned previously, some questions of the questionnaire were not clear and some participants misunderstood the questions at times and subsequently required help from the pilot staff;
- Only a few participants are not working at Campus Contern or within the wider industrial areas of Contern municipality;
- 5 persons cancelled their bookings and there were overall less no-shows than in the previous pilot waves in Belval;
- The autonomous features of the changing the lanes did not always work well due to increased traffic volumes or insufficiently clear horizontal marking on the road. On one particularly rainy day, the street lines were not visible enough and the car switched off the autonomous mode altogether. Once in autopilot mode, the vehicle did not recognise the horizontal markings and performed abrupt movements twice.

6.2.2.4 Pilot 4 General observations

During the three pilot waves, some general observations could be made, noticeably:

- Quite a few participants had difficulties to understand some of the survey questions. Especially, questions Q5, Q5a and Q5b asking if they already have had some experiences with CAVs. Some of the participants asked questions while filling out the survey, however, after checking and analysing the questionnaire results, it can be observed that some participants didn´t understand the question correctly and gave an incorrect answer;
- During the first two pilot waves in Belval, each batch should have lasted 45 minutes, however, to reach a higher number of participants for the two first waves, it was decided to reduce the duration of each batch to 30 minutes. The vehicle trip was planned to be 15 minutes long, however the duration of the briefing was reduced to 5 minutes and the filling out the questionnaire was reduced to 10 minutes. It has been observed for some participants, that the briefing was probably not long enough and they couldn't get to know and get used to the vehicle in that short time. The planned timing also didn't take too much time in consideration for traffic issues. This resulted in delays of some of the batches. Based on these learnings, the test

drives in Concern were adapted and each batch took 45 minutes per participants. This was also needed as the trips of the last pilot wave on the highway where participants piloted the autonomous features took longer than in Belval. No delays happened during the last pilot wave in Contern;

- Another issue in Belval was that participants from the University of Luxembourg who registered did not show up, which resulted in not having enough participants for the pilot. The number of participants of this pilot was set to be 100 participants. The best case would have been that each wave had 50 participants. However, realistically speaking, it would have not been possible to have 10 participants each day during one working week. In addition, many employees were still working from home and did not travel to their working place). This resulted in having an additional wave for the sub-pilot at Campus Contern. As the sub-pilot was organised as close to the real-life settings as possible, it is normal that changes can happen;
- The main observation for the three waves was that some participants who already had experiences with autonomous vehicles, had no issues to navigate the car and were even expecting to use higher levels of automation during these tests. They felt safer than participants who didn´t have experience with vehicles with autonomous features. Most participants were more nervous when they had to overtake other vehicles. There was a small difference between the test drives with the University of Luxembourg staff and the employees at Campus Contern. The participants at the later location were more experienced drivers and overall, less incidences happened;
- During the two waves at Belval, there was no rain during the two weeks, it was only a bit foggy, which had no impact on the pilot execution. During the wave at Campus Contern, only during one day it rained a lot, which caused low visibility and led to the malfunctioning of the autonomous features.

6.2.3 Preparation autonomous shuttle sub-pilot

The objective of this sub-pilot is to measure the perception of the participants related to the implementation of a shuttle connection running with autonomous vehicles.

This sub-pilot includes employees of a business campus, called Campus Contern, to share their opinion on the integration of autonomous vehicles in their daily commuting trips. The commuting trip with the shuttle is connecting the train station of Sandweiler/Contern with the Campus Contern site. The shuttle is operating only during peak hours, when employees are travelling to work and back home on their working day. This means that the shuttle is running between 7:00h and 9:00h and between 16:00h and 18:30h. The trip takes about 20 minutes (given there are no incidences or delays).

The sub-pilot had foreseen two scenarios, one where the shuttle is only stopping in front of the train station, where the shuttle is running smoothly with none of the perturbances implemented on purpose for this sub-pilot (except regular traffic conditions). The employees can use the shuttle from the train station to their working place and/or vice-versa. The second scenario intended that the autonomous shuttle is not running smoothly, and an irregular behaviour of the shuttle is created on purpose. It was not possible to create the irregular behaviour of the shuttle on purpose. When there is an irregular behaviour of the shuttle, an incidence report is filled out.

Due to the size of the autonomous shuttle, only 5 participants can be on-board at the same time. After the ride, participants are asked to respond to the dedicated questionnaire. Participants of the pilot provide their response using their smartphone (QR code). During a regular day of pilot executions, it is expected to have 2 batches of 5 participants during each weekday. During the pilot execution, which takes place on open roads and in an urban environment, no human driver aboard the bus need to use a steering wheel or perform manual operations to manoeuvre the vehicle. However, a trained driver from Sales-Lentz is present in the shuttle in case of incidences.

Figure 92 – Pilot 4, Shuttle at Campus Contern (autonomous shuttle)

For preparing this sub-pilot, Navya, the shuttle provider, had to do some additional tests due to a construction on the initial route. A remapping was considered; however, it was finally not needed. A driving permission was asked to the commune of Contern and to the Ministry of Transport, as one part of the route includes a state road.

Figure 93 – Pilot 4, Route and schedule of vehicle in the industrial area of Contern (autonomous shuttle)

It was assumed that from the users' perspective that a good performance of the vehicle associated with the novelty and innovation aspect of an autonomous shuttle leads to a positive perception on the short term. On the other hand, when incidences are occurring, it is assumed that the experience is perceived negatively and that the confidence in this type of technology is negatively affected.

Initially, it was planned to explore a new autonomous shuttle line in the city of Differdange or Belval (Luxembourg), however due to administrative reasons, Sales-Lentz decided that it was not possible to install a new line. Therefore, it was decided to relaunch the shuttle line in the industrial zone of Contern. Sales-Lentz has been responsible for implementing the autonomous shuttle. Due to technical issues of the shuttle (communication issues and a possible remapping due to a small change of the route), which occurred during the tests, and the late arrival of permissions from the commune of Contern and the Ministry of Transport, huge delays occurred, of which LuxMobility had not a lot of control over it.

In addition, due to the fact that many employees did teleworking from their homes because of the ongoing COVID-19 pandemic, not enough potential participants could be reached. Also, Sales-Lentz and their client Campus Contern expected employees not to come back to work before February 2022.

Sales-Lentz already set up an autonomous shuttle line between Campus Contern and Sandweiler/Contern train station from late 2018 to late 2020 (with a break between March and September 2020).

Campus Contern, LuxMobility and Sales-Lentz organised a schedule to restart the autonomous shuttle project in Contern, which faced several unexpected complications:

1. Navya (the manufacturer of the shuttle) was firmly convinced that a remapping of the whole route and additional budget would be needed. As this additional budget was not covered by any project funding, the negociations between Navya and Sales-Lentz about these additional costs lasted for weeks and cause a large delay;
2. Two additional tests with the shuttle have been conducted – the first test was unsuccessful because the shuttle could not connect to the (needed) GNSS-antenna, while the second test was successful and proved that no remapping was needed;
3. The Ministry of Mobility and Public Works (MMTP) was asked again for permission to restart the shuttle line, which took longer than expected. In addition, the municipality of Contern had to give their approval. However, the College of Aldermen of the municipality raised safety concerns about the deployment, even though the first deployment of the shuttle between 2018 and 2020 had been accident-free. This caused an additional delay;
4. Before the shuttle can kick off, the shuttle stewards had to undergo a specific training by Sales-Lentz with the help of Navya to be able to operate the vehicle in emergency situations. This training should have taken place in February and was postponed to the end of March 2022.

Due to these delays, LuxMobility wasn’t able to deliver the results of this sub-pilot. It was therefore decided together with the WP6 coordinator Etelätär Innovation and the coordinator of the project LIST to deliver the results from the data collection in WP7, in which the passengers’ level of acceptance of CAVs based on their responses to attitudinal questions and also based on the observed behaviours in the pilots of WP6 will be analysed and concluded. A clear timing is needed to achieve the data collection for this sub-pilot. A work plan has been set up, see Table 16.

Table 16 - Pilot 4, Work plan for april 2022 (autonomous shuttle)

Leader	**Task**	**Deadline**
Sales-Lentz	Training of drivers and operational planning of drives	28th-31st March 2022
LuxMobility	Preparation of material (questionnaires, information sheets for briefings, etc.)	28th-31st March 2022
Sales-Lentz	Kick off of the shuttle line	1st April 2022
LuxMobility & Campus Contern	Communicaiton and recruitment of participants	Mid-April 2022
LuxMobility	Data collection and evaluation in WP7	Before 30th April 2022

6.3 Data collection

The data for the shared connected transport pilot includes two types of data:

1. **Quantitative data in form of questionnaire results**: Each participant had to fill out the questionnaire after the trip with the vehicle with autonomous features. These results allow to make first conclusions on the attitudes and perceptions of “drivers” toward shared connected vehicles.
2. **Qualitative data in form of Incidence Report Forms for each batch**: During each batch, two staff members were present to observe the reactions of the participants and to respond to questions/comments if needed. The notes taken during each batch allowed to fill out the incidence reports after each wave. In addition, pictures and video material were collected for communication purposes, however, participants don´t appear on the pictures or in the video.

The documentation of the pilot is done thanks to the survey responses and information on the services' usage (shared car fleet and autonomous shuttle). In order to be consistent, similar data and information is collected for the two different sub-pilots, see Table 17.

Table 17 - Pilot 4, Data collected for both sub-pilots

Data	**Type & Format**
Shared Connected Transport Sub-pilot	
ToolID	Questionnaire and Incidence report
VehicleID including vehicle size; fuel type; autonomous features	 Medium-size passenger cars (2); Electric (2); Highway platooning (1)
Autonomous shuttle sub-pilot	
ToolID	Questionnaire and Incidence report
VehicleID including Vehicle size; fuel type; autonomous features	 Mini-bus Electric (2) Urban driving (3)

The questionnaire data includes: DavID, StartTime, StopTime, UserID, QuestionnaireID.

In order to capture information regarding the context and setting of the pilot, but also the remarks or feeling of the participants, a specific Incidence Reporting Form is used. This small digital survey helps to quickly and simply link contextual or external information with the participants surveys. The incidence reports collect the following information: Pilot name; wave number; incidents related to the pilot (if any); incidents unrelated to the pilot (if any); weather conditions; size of batches; additional comments & feedback.

All the participants have read and agreed to sign a GDPR compliant form at the end of the questionnaire. All data collected is being anonymised, so that none of the persons who have filled out the survey are identifiable through the dataset. Only the distribution of the voucher, participants receive after the completion of the batch, is personally attributed to each participant. The data collected is shared with LuxMobility and the involved PAsCAL partners, which includes the Work package 6 leader ETELÄTÄR and WP7 leader UNIVLEEDS, who will be responsible for the detailed data analysis. The data will be kept for 12 months. Participants were informed that they can access the data, rectify it, request its deletion or exercise their rights to limit the processing of their data if needed

6.4 Data evaluation

6.4.1 Car fleet sub-pilot

The three waves of the car fleet sub-pilot, which were organised during two weeks in November 2021 and two additional weeks in March 2022 counted 102 answers in total. Out of these, 66 participants were male and 34 were female, while 2 participants identified as another gender or preferred not to answer the question, see Figure 94.

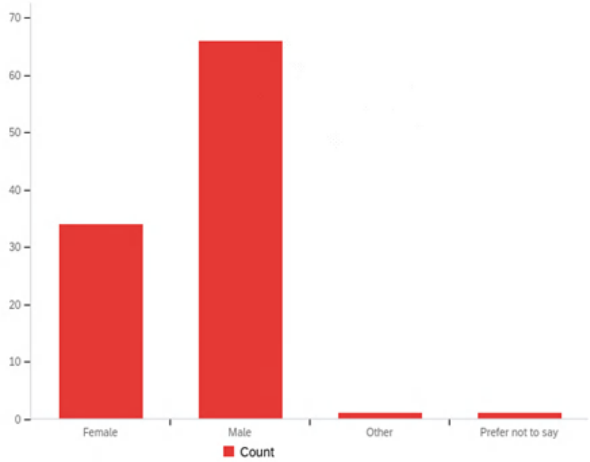


Figure 94 – Pilot 4, Gender of the participants (shared car fleet)

Participants were asked what kind of CAV they have tried so far. Navigation and routing services have been used the most (75.5%), followed by driver assistance (59.8%) and adaptive cruise control (54.9%). 50% of the participants already used ride-sharing services. 9 persons indicated that they had never tried a CAV before. Only 1 participant even indicated that they don't know which kind of CAV they already used. This also underlines the fact that this question was misinterpreted several times, by the participants and it was not intuitively clear to them what a CAV is.

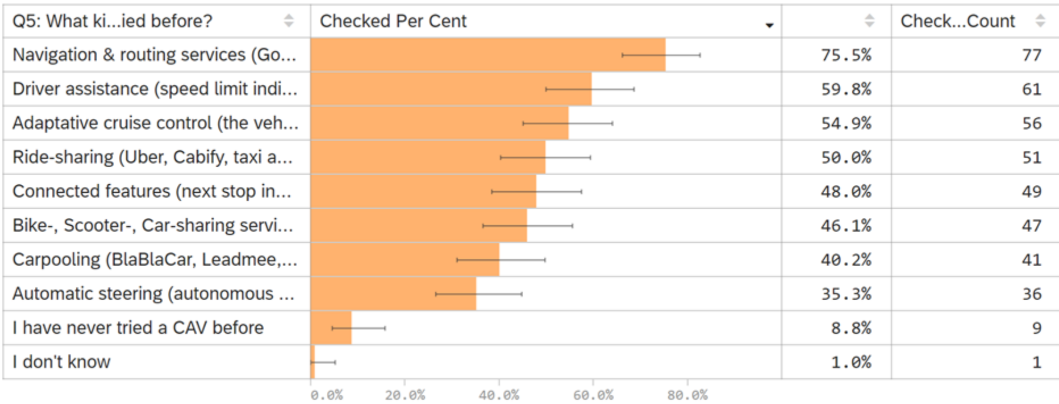


Figure 95 - Pilot 4, Kinds of CAV already tried by the participants (shared car fleet)

When asked about how often they have used CAVs in the past, 31 out of 93 participants answered that they only once used a CAV. Followed by 24 participants using CAVs only rarely. 9 participants answered that they use CAVs systematically and 15 participants only occasionally.

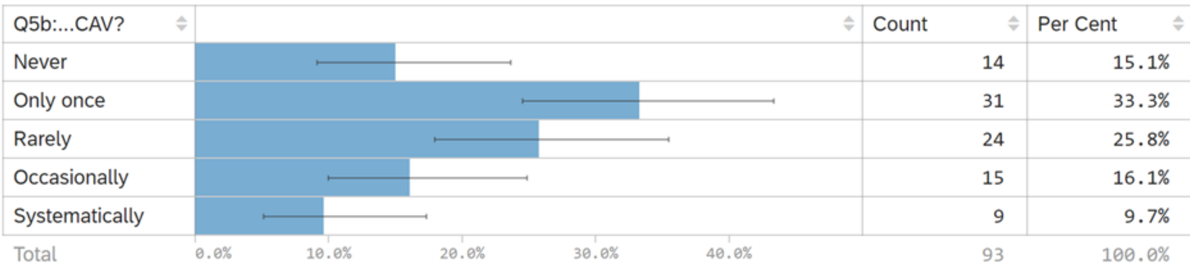


Figure 96 – Pilot 4, Usage of CAVs (shared car fleet)

Out of 101 answers, it could be retrieved that 88 participants are full-time employed, 9 are students, 2 are retired and 2 didn't indicate their occupation, see Figure 97.

Q11: Which...ccupation?		Count
Full-time work (over 30 h a week)		88
Student		9
Retired		2
Other		2
Total	0.0% 20.0% 40.0% 60.0% 80.0%	101

Figure 97 - Pilot 4, Current occupation of the participants (shared car fleet)

Participants were also asked about their commutes to work and back home. This includes the average one-way distance of their daily commuting trip and how often they travel to work or place of education prior to the COVID-19 pandemic. Figure 98 below shows that most of the participants (50 out of 99) travel to their place of work or education every day. Out of these 50, 29 travel over 16 km to their place of work or education and back home. 3 participants travel less than once a week to their place of work or education and live closer to the place where they are working or studying.

	Q11a: How of...19 pandemic?					
	Total	Less than...nce a week	Once a week	2-6 times per week	Everyday	More often...once a day
Total Count	99	3	2	42	50	2
Up to 5 km	18	1	0	9	8	0
5-15 km	25	2	1	9	13	0
16-25 km	29	0	0	15	14	0
26+ km	27	0	1	9	15	2

Figure 98 – Pilot 4, Commuting trips and average distance (shared car fleet)

When asking the participants whether their experiences using the shared car fleet CAV were as anticipated, 58 persons answered that they were positively surprised with their experiences. 33 participants mentioned that their experience was as expected and 5 participants were negatively surprised, see Figure 99.

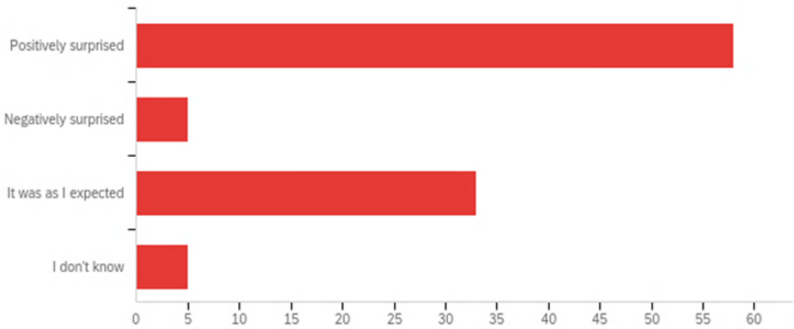


Figure 99 – Pilot 4, Subjective experience vs. expectation (shared car fleet)

Participants were also asked how they felt while travelling in a CAV. To check, whether there is a relationship between the level of driving experience in general and the feeling people have when trying something innovative, they were also asked the number of years they own a driving license. 64 out of the 102 participants already own a driving license for over 10 years. Out of these participants, most of them felt curious however also careful. Out of all the participants, most of them felt curious and careful. Only 49 felt critical, see Figure 100.

	Q8: How long...ing license?					
	Total	I don't have one	1-5 years	5-10 years	10-15 years	15+ years
Total Count	102	0	15	23	27	37
Trustful	39	0	2	8	12	17
Careful	61	0	9	13	17	22
Insecure	11	0	1	4	3	3
Safe	30	0	4	5	11	10
Nervous	19	0	4	5	4	6
Curious	56	0	6	13	15	22
Critical	9	0	1	3	3	2
Unaffected	1	0	0	0	1	0

Figure 100 – Pilot 4, Subjective feeling of CAV experience vs. number of years of driving experience (shared car fleet)

Participants were asked if after this experience, they would use a shared connected vehicle for their daily. 50 participants said yes, 34 participants would only use this type of service depending on how the technology evolves. 9 participants responded that they would not use it at all, see Figure 101.

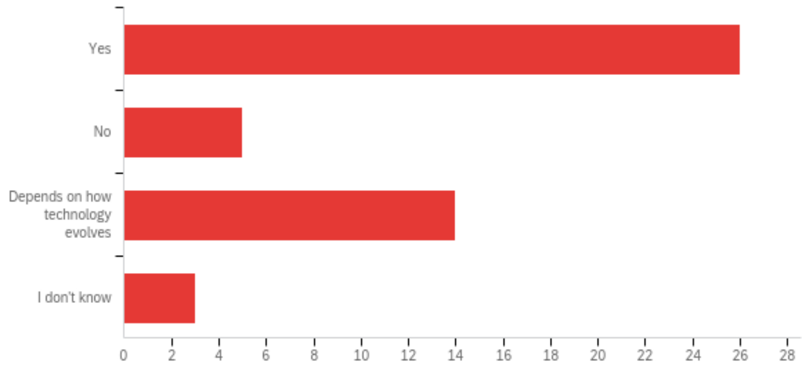


Figure 101 – Pilot 4, Usage of shared connected vehicle in the future (shared car fleet)

When asked which potential benefits the participants see in using a shared fleet composed of CAVs, 60% answered that they perceived an increase in safety, 49% indicated that they see a potential for lower levels of pollution (most of vehicles with autonomous features are also powered by electricity), followed by 41% indicating time savings as potential benefit. Participants see the least potential in a better service quality and none fo the benefits mentioned above, see Figure 102.

27: Which...ted Choice	Checked Per Cent		Check...Count
Increased safety		60.8%	62
Lower pollution		49.0%	50
Time savings		41.2%	42
Increased punctuality		39.2%	40
Lower price		33.3%	34
Less congestion		26.5%	27
Better service		25.5%	26
None of the above		10.8%	11
Other (please specify):		8.8%	9

0.0% 20.0% 40.0% 60.0%

Figure 102 – Pilot 4, Potential benefits in using a shared fleet composed of CAVs (shared car fleet)

When asked which potential shortcomings the participants see in using a shared fleet composed of CAVs, 63.7% answered that there is a potential for higher prices. 20.6% of the answers indicate that people see a potential in decreased safety and less security, followed by 15.7% indicating loss of jobs as a potential shortcoming. Participants see the least shortcomings in a worse service and less information on-board, see Figure 103.

28: Which...ted Choice	Checked Per Cent		Check...Count
Higher price		63.7%	65
Decrased safety		20.6%	21
Less security		20.6%	21
Loss of jobs		15.7%	16
None of the above		13.7%	14
Other (please specify):		5.9%	6
Worse service		3.9%	4
Less information onboard		3.9%	4
	0.0% 20.0% 40.0% 60.0%		

Figure 103 – Pilot 4, Potential shortcomings in using a shared fleet composed of CAVs (shared car fleet)

When asked whether they would pay a higher price for a shared vehicle with autonomous features, the answers were very diverse – 24 participants answered that they wouldn't pay more, 33 replied that they would not pay more, another 33 answered that the acceptable price depends on how the technology evolves and 11 participants answered that they don't know yet, see Figure 104.

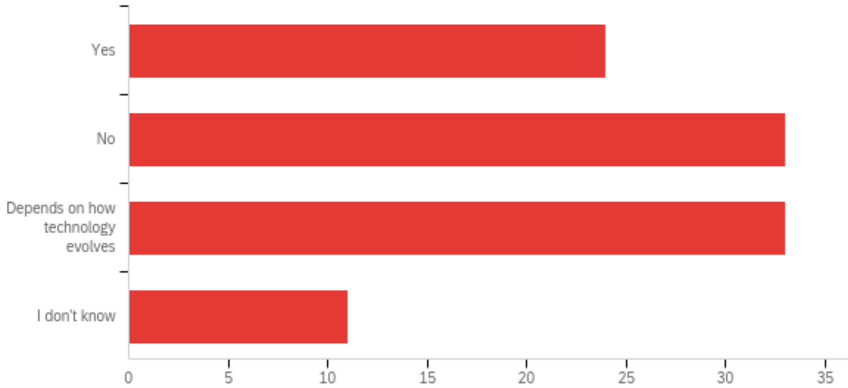


Figure 104 – Pilot 4, Acceptance of pricing for shared fleets (shared car fleet)

Participants were also asked, whether they would use a shared fleet composed of CAVs if it was available to them. Out of 102 participants, 86 would be willing to accept the effort to switch to a shared fleet composed of CAVs. 11 participants answered that they would not like to use this kind of shared fleet. 4 participants even answered that they would try to avoid to use a shared fleet composed of CAVs, see Figure 105.

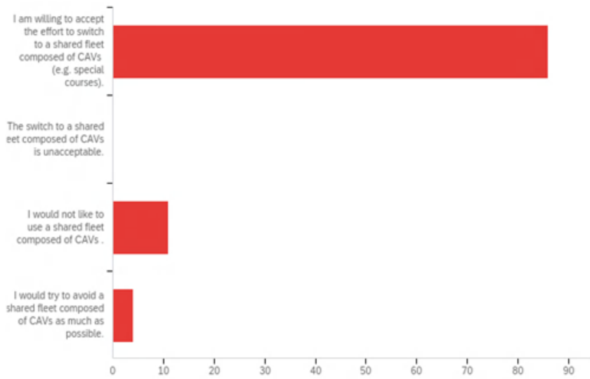


Figure 105 – Pilot 4, Willingness to adopt CAV fleets (shared car fleet)

6.5 **Cross-fertilisation Activities Across WPs**

The data collected during this pilot will be sent to WP7 leader UNIVLEEDS, who is responsible for the integrated data analysis, after the completion of the pilot. UNIVLEEDS will analyse and conclude on the drivers'/passengers' level of acceptance of CAVs based on their questionnaire responses and observations being made during the pilot.

The same HMI, which has been developed for Pilot 3: *Autonomous bus line* is also installed on-board of the autonomous shuttle line to collect data on the location, speed and potential incidences of the vehicle. A mobile application is installed on a tablet, which is placed on-board the CAV and displays the next connections for passengers. The HMI also serves in recording and monitoring the GPS location of the bus at all times, permitting to check the speed of the vehicle, identify critical black spots, near-collision incidents or emergency breaking. This information can help to differentiate the responses of participants who might have experienced an incident during their trip. It was planned to use the same HMI for the autonomous shuttle. However, due to the deviations it was not possible to test it during the WP6 pilot.

6.6 Dissemination activities

For recruiting participants for the shared connected transport pilot, Moovee clients within the University of Luxembourg were contacted by e-mail to ask if they are interested in participating in the experiment. The e-mail included a short description of the PAsCAL project and the pilot, including the link for registration. Before the start of the pilot, the e-mail was only disseminated to clients working for the University of Luxembourg. However, as many people registered and didn't show up, it has been decided to disseminate the e-mail also with the University staff not using the car sharing service already. The same has been done at Campus Contern. In addition, the information of the test drives at Campus Contern together with the QR code to book a time slot had been displayed on the information screens at the entrance of the business buildings, see Figure 106.

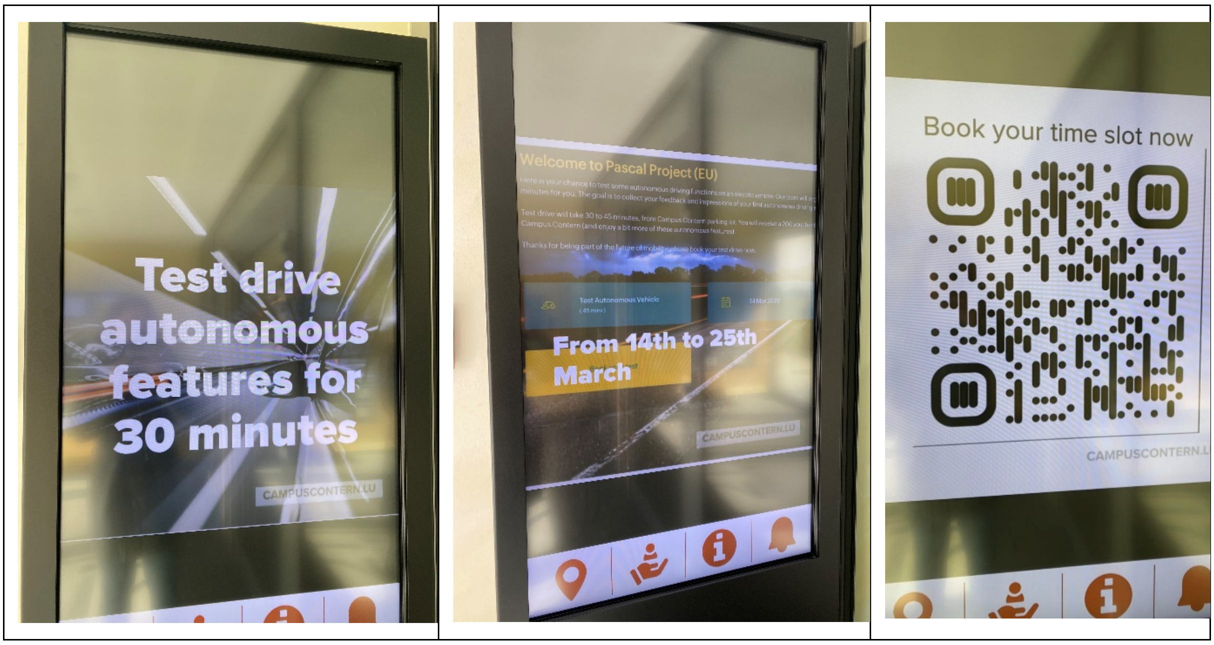


Figure 106 – Pilot 4, Communication about the test drives at Campus Contern (autonomous shuttle)

Pictures and videos have been taken to disseminate them on LuxMobility's LinkedIn page and to disseminate them on PAsCAL's communication channels. A professional videographer has been hired to make a small video of the pilot. The objective is to have materials showing participants driving the shared cars, using the booking app and travelling with the autonomous shuttle.

A press release about the results of the pilot is being prepared and sent to ACI as communication & dissemination leader of the project.

A launch event was planned to take place before the official launch of the autonomous shuttle. However, due to the delays explained previously, the official launch event needs to be organised after the end of the pilot. For this event, companies and public authorities will be invited. It will allow Luxmobility will be able to present the results of the pilot and to show the video.

6.7 Conclusions & Learnings

Following the execution of 3 pilot waves (a fourth one is planned to take place in April with the autonomous shuttle) to assess the perception of CAV technologies in a shared and connected context, some conclusions both general and specifically can be drawn.

Employees of the University of Luxembourg and Campus Contern were asked to drive a shared vehicle with autonomous features on the open road in a real test environment. This allows them to drive as close to the reality as most of the participants take the same route every day to travel to their work/education place, including traffic. Both private organisations, the University of Luxembourg and Campus Contern, are clients of Moovee – the shared fleet operator – and offer their employees the opportunity to use a shared vehicle for their trips during their working days. This allows especially the employees who don´t own a vehicle to be more flexible and to use a vehicle only occasionally. In addition, the companies do not need to offer company cars to their employees.

Even if not all the participants of the pilot were users of the Moovee services, several participants mentioned that they already used shared services before. When asked what kind of Connected and/or Automated Vehicle (CAV) they have tried before, 47 out of 102 participants answered that they used bike- and/or car-sharing services. 51 participants already used ride-sharing services followed by 41 participants using car-pooling services. When asked about which mobile applications they are using, 44 participants answered that they are using shared mobility applications. This shows that people are aware of shared services and would be potential users for new shared connected CAV services.

From a user’s perspective, it was assumed that the participants drive the vehicle with autonomous features in the way they would drive a regular vehicle of the shared fleet. For most of the participants it was the first experience using a vehicle with autonomous features. For them it was an unusual experience, and it took a bit more time to get used to use the autonomous features and to trust the vehicle. With a bit more practice and time, participants would trust the vehicle even more and they would quickly get used to use autonomous feature during their commuting trips. Most of the participants see as a benefit of using autonomous features an increased safety, however, they also see as a shortcoming the higher price to include and use autonomous features in a vehicle and in shared services. As seen in the results of the questionnaires, 66 out of 102 participants would not pay more or would wait for the technology to evolve to use a vehicle with autonomous features. Besides the participants who already used autonomous features before the test drives, people are open to use them in the future and would make the effort to adapt to new technologies and new mobility services.

New mobility services like shared connected fleet services are using technologies that provide different mobility services to users, which replace the users' privately owned or leased vehicles. The services offered depend on several features, which includes:

- Length and duration of the trip;
- Payment methods;
- Booking process and vehicle access method;
- Interconnection between different mobility services;
- Availability of help and customer support;
- Data privacy and security considerations.

CAVs can have an influence on any of these features. In case of the integration of CAVs in a shared fleet, the length of trip can be more comfortable than in a usual car, by using the autopilot for longer trips. After the usage of shared connected car, the payment will directly be booked from the account created by the user. To book a shared vehicle, a booking platform can be made available, in which the users can reserve a vehicle for a specific time. The car can be easily accessible via the use of company badges or via a mobile application, so no need to exchange keys. Different transport modes can be connected, like for example the users can use an autonomous shuttle which connects the train station with their working place and if needed they can use the shared car in their company fleet to do short or long business trips during their working day. Help and support can be easily offered remotely by offering a helpdesk/support service to clients. These features all combined can be integrated in a MaaS (Mobility as a Service). This allows users (in this case employees) to get a complete and turnkey mobility solution without any management constraints. By integrating CAVs into MaaS, the driver costs could be eliminated (for now not yet possible due the national legislations) and reducing other costs (like training costs for the drivers), making it competitive with public transport.

The results of the pilot study and the resulting recommendations in WP8 allow shared fleet operators to optimally design and operate fleets of shared vehicles and to design well-suited incentive mechanisms to increase public acceptance and improve attitudes towards different types of shared vehicles.

This main learning from the pilot allows shared fleet operators to adapt their offers and integrate new technologies and CAVs in their shared fleets. For car sharing operators, autonomous features can be associated with more safety or more comfort and thus represent an added value for their service offer. However, it needs to be considered, that users are not directly willing to pay more to use autonomous features. If the operator includes new technologies in his service offer, it also means that it must increase its budget for having a vehicle with autonomous features in the fleet of shared vehicles. These test drives allowed the shared fleet operator Moovee to see what their user´s needs or potential new user´s needs are. It allowed them to promote their services and improve their future services based on the opinions of the test drive users.

The organisation of this pilot had several deviations, however, all of them could be mitigated, except the autonomous sub-pilot could not been executed within WP6 due to administrative and technical issues. The data collection will be conducted in the following weeks and the results from the data collection will be analysed in WP7, in which the passenger’s level of acceptance of CAVs based on their responses to attitudinal questions will be concluded. The employees of Campus Contern and other companies in the industrial zone will be asked to use an autonomous shuttle on one part of their commuting trip, which is between their workplace and the next train station. They will be asked to share their experiences by answering a questionnaire. This will allow to understand how passengers consider CAVs as a potential solution to their daily mobility challenges. It will also allow the shuttle operator Sales-Lentz to promote a new shared connected transport to other private or public clients.

7 Pilot 5: Experience of vulnerable travellers with connected transport environment

7.1 Introduction

The last pilot, focusing specifically on the experience of different groups of vulnerable travellers, involved 236 participants in total. It consisted of several different tasks and took place over the course of 5 months:

- **Field testing of the *Apertum*[21] application**. This activity was divided in 3 pilot waves, which were further split in 24 user batches and involved a total of 165 individual testers with mobility constraints;
- **UI/UX testing of the *Apertum* application**. To ensure scientific significance of the testing, 20 participants were split into two groups of 10 each, consisting of digital nomads and digital migrants;
- An **in-depth interview was conducted with the main stakeholder** of the Madrid transport system, the Madrid Regional Transport Authority (*Consorcio Regional de Transportes de Madrid,* CRTM[22]), including 9 detailed debate topics about connected transport environments;
- **Four Focus Discussion Groups (FDGs)** were conducted by the Italian member of the *European Blind Union* (EBU[23]), *Unione Italiana dei Ciechi e degli Ipovedenti* (UICI[24]), including 51 blind or partially sighted participants.

All these different tasks took place in Madrid (Spain) and in Rome, Bologna, Milan and Naples (Italy) and over the course of 5 months from March 2021 to July 2021.

7.2 Pilot execution, Observations & Deviations

Each of the pilot tasks had a slightly different focus and goal and subsequently, the corresponding user groups, location, setting-up and briefings changed depending on the kind of activity or research question

[21] https://www.apertum.world/
[22] https://www.crtm.es/
[23] http://www.euroblind.org/
[24] https://www.uiciechi.it/homeInglese.asp

of the task. Therefore, it only makes sense to report on each task separately.

7.2.1 Apertum field testing

The pilot execution of this first task followed the FESTA methodology [3] of iterative waves, which allowed for enough time in-between waves to do a preliminary data analysis, identify potential issues or shortcomings and design and implement changes for the next pilot wave. This allows by design to resolve issues before the entire dataset is collected and ensure the highest quality data possible. All participants read and signed a GDPR form in order to inform them of the treatment and storage of their data. A copy of this document is included in Annex I.

The local associations *Nadiesolo*[25] ("No one alone") for elderly persons, Fundación *Lesionado Medular* (FLM[26]) for persons with spinal injuries and the *Universidad Alfonso X El Sabio* (UAX[27]), a private University in Madrid, assisted the pilot execution substantially by recruiting the participants for the pilot and promoting it among its' members and partners. A few days before each of the pilot waves, all participants attended an introduction briefing to CAV technology, which took place partly in person in Madrid and partly virtually using the video call platform GoToMeeting [28], depending on the level of tech-savviness of each group. During these meetings, participants were also informed where and when the group would meet and what they had to expect.

7.2.1.1 Pilot 5 Wave 1 report

The first pilot wave took place on the 15th and 16th of March 2021 in Madrid. This pilot batch followed scenarios 1 and 4 as per defined in Deliverable D6.2. [5] For participants following scenario 1, the meeting point was just outside of the *Principe Pío* station in Madrid. For scenario 4, the meeting point was at *Portazgo* Metro station in a suburb of Madrid. In both locations a large roll-up poster helped participants to find the meeting point.

[25] https://nadiesolo.org/
[26] https://www.medular.org/en/
[27] https://www.uax.com/
[28] https://www.gotomeeting.com/en-gb

Figure 107 - Pilot 5, Wave 1 meeting point (field testing)

Three different user groups were involved in this pilot wave, including 9 elderly persons (ELD) above 65 years old, 42 persons with Temporary Mobility Constraints (TMC) and 9 persons with Spinal Cord Injuries (SCI). The first wave consisted of 8 batches with the following distribution:

Table 18 - Pilot 5, wave 1 overview (field testing)

Batch Number	User Group	Number of Participants	Scenario Number	Date	Time
1	ELD	4	1	15/03/2021	11:00 – 12:00
2	ELD	5	1	15/03/2021	12:00 – 13:00
3	TMC	7	1	15/03/2021	17:00 – 18:00
4	TMC	6	1	15/03/2021	18:00 – 19:00
5	SCI	5	4	16/03/2021	11:00 – 12:00
6	SCI	4	4	16/03/2021	12:00 – 13:00
7	TMC	15	1	16/03/2021	17:00 – 18:00
8	TMC	14	1	16/03/2021	18:00 – 19:00

In total, 60 participants filled out the questionnaire in this pilot wave. Each batch was scheduled to last 1 hour, which consisted of the following timetable:

15	min	Briefing & FDG
20	min	Following scenario
20	min	Completion of questionnaire
5	min	Debriefing

On both days of the pilot execution, the weather was very sunny, which made it hard for participants to see their phone screens and they needed to seek a shadow. Furthermore, some road works close to the meeting point disturbed the briefing and discussions a few times.

Figure 108 - Pilot 5, Wave 1 elderly, disabled and student participants (field testing)

One key member of the staff fell ill the day before this pilot wave launched, but the team was able to distribute their task among each other. During the implementation of this first pilot wave, several issues arose, which were handled and documented by the staff, especially concerning the FDGs, the Qualtrics platform, the questionnaires, the installation process and the UI of the Apertum application:

- FDGs: An important insight from the briefings and discussions is that the general public and the participants of this pilot did not understand, what a CAV is or what kind of services this term encompasses. Therefore, the briefings and the questionnaires needed to be adapted. A lot of participants were questioning, why the information provided by the *Apertum* application is not widely available and also how the operator is involved in the Project or where the funding of accessible mobility solutions comes from;
- Qualtrics platform: Some phone models (specifically an iPhone XS Max with iOS 14.4 and a Samsung Galaxy J7) had compatibility problems with the Qualtrics website and were sometimes unable to open the questionnaire for participants. A spare smartphone should always be be kept on-site. Also, participants did not like that the survey auto-advanced in Qualtrics and did not like that it was not possible to go back one page in the questionnaire to edit responses. Some participants had trouble accessing the questionnaire using a QR code, as they did not seem familiar with this technology. One participant proposed to add an auto-correct function to the questionnaire;
- Questionnaires: In the questionnaire, one question was not translated properly and appeared in English language only, which needed to be corrected. The translation of one the questions led to confusion among participants, as they did not understand what was asked of them. For any question focusing on regular mobility patterns, a disclaimer should be added to remind participants to answer these questions for pre-pandemic mobility patterns;
- Installation process: Especially older participants found the installation process on-site tedious and difficult. Participants preferred to download and install the application prior to the pilot execution. Furthermore, the participants needed to be reminded to check some technical requirements, such as the activation of some permissions like the access of the application to the location of their phone. One participant pointed out that it would be a good idea to send a disclaimer upon downloading the

application that the installation of the application *Crosswalk*[29] will also be required to run the application successfully. Some participants proposed to implement a feature to display all accessible places (such as museums, restaurant, shops) around the stations. Some phone models (specifically a Huawei P20) had issues installing and operating the *Apertum* application;

- UI of the application: The participants were not certain about some functionalities of the application, such as the meaning of symbols and the user interface design. For elderly users, some of the texts were too small or arrows were not noticeable. The application does not emit any sounds and is not compatible with Apple's VoiceOver nor with Android's TalkBack. Participants who use wheelchairs highlighted the necessity to label elevators additionally to mark the direction the elevators open, since they are often too narrow to turn around within the elevator;
- Surrounding infrastructure: Within the station, it was necessary to ask a staff of Metro de Madrid to open an extra-wide gate for participants with pushchairs or crutches. Some participants were not able to bridge the gap between the platform and the train without help.

Following the pilot execution and the comments received, changes were implemented to prevent similar issues or delays in the following pilot waves:

- Adaptation of FDG: The briefings of upcoming waves focused more on practical applications of CAVs, such as next stop indicators onboard a modern public bus. This helped participants in quickly grasping the concept of CAVs by applying the concept to everyday examples;
- Adaptation of schedule: During the first wave, each batch of testers, regardless of its size or user group, was planned to take 1 hour in total. This timeframe should be extended to 1.5 hours for the batches involving participants who are older or have spinal cord injuries. Especially during the following of scenarios and the completion of the questionnaire more time was needed;
- Qualtrics: The auto-skipping option was switched off and the missing question was translated. Furthermore, a digital version of the GDPR

[29] https://github.com/crosswalk-project

form was attached to the survey to ensure that all testers have agreed to have their data processed anonymously;

- Adaptation of questionnaire: Two questions were modified to avoid using the abstract CAV terminology: Instead of asking the participants whether they had ever tried a CAV and giving them only yes and no options, they were now asked first, what kind of CAV they have tried. In the new version of this question, many different kinds of CAV were listed with concrete and well-known examples, which were familiar to the participants including navigation & routing services (GoogleMaps, Waze), vehicle-sharing services (ShareNow, Free2Move, Lime), ride-sharing services (Uber, Cabify, Taxi applications), carpooling (BlaBlaCar, Leadmee), connected features (Next stop indicator in PT), driver assistance (Speed limit indicator, Blind Spot Detection), adaptive cruise control (Vehicle controls the speed according to traffic conditions) and automatic steering (Autonomous parking or vehicle keeping itself in lane). Only if they had not tried any of these services, they could select the option “I have never tried a CAV before”;
- Organisation: During the first pilot wave, it has proven efficient to group persons with temporary mobility constraints into larger groups and conduct fewer iterations.

Finally, as the pilot implementation took place during the COVID-19 pandemic, the participants as well as the staff wore surgical or FFP-2 masks and disinfecting gel was offered to everyone on a regular basis. All of the vulnerable participants, including elderly persons and those with disabilities were fully vaccinated by the time the pilot took place. Furthermore, a strict social distancing protocol was introduced and kept throughout the pilot implementation, taking multiple trips with elevators if necessary. Finally, the batches of participants were kept as small as possible as to avoid crowding and facilitate contact tracing in case of an outbreak. Participants received drinks and were able to sit down during the entirety of the pilot if needed.

7.2.1.2 Pilot 5 Wave 2 report

The second pilot wave took place on the 22nd and 23rd of April 2021 in Madrid. This pilot batch followed scenarios 2 and 4 as per defined in Deliverable D6.2. For participants following scenario 2, the meeting point was just outside of the *Plaza de Castilla* station in Madrid. For scenario 4, the meeting point was at *Portazgo* Metro station in a suburb of Madrid. Three different user groups were involved in this pilot wave, including 10 elderly persons (ELD) above 65 years old, 40 persons with Temporary Mobility Constraints (TMC) and 10 persons with Spinal Cord Injuries (SCI). The second wave consisted of 7 batches with the following distribution:

Table 19 - Pilot 5, Wave 2 overview (field testing)

Batch Number	User Group	Number of Participants	Scenario Number	Date	Time
1	ELD	5	2	22/04/2021	10:00 – 11:30
2	ELD	5	2	22/04/2021	11:30 – 13:00
3	TMC	14	2	22/04/2021	16:00 – 17:00
4	TMC	17	2	22/04/2021	17:00 – 18:00
5	TMC	9	2	22/04/2021	18:00 – 19:00
6	SCI	5	4	23/04/2021	10:00 – 11:30
7	SCI	5	4	23/04/2021	11:30 – 13:00

In total, 60 participants filled out the questionnaire in this pilot wave. Each batch with TMC participants was scheduled to last 1 hour and followed the same timetable as in the first wave, while the timetable for ELD and SCI participants was slightly modified to 1.5 hours as follows:

25	min	Briefing & FDG
30	min	Following scenario
30	min	Completion of questionnaire
5	min	Debriefing

On both days of the pilot execution, the weather was cold and rainy, which required to hold FDGs and briefings inside the Metro stations or under a shelter. In general, this pilot location was least suitable to conduct a pilot, due to high traffic volumes surrounding the station and lack of space inside the entrance of the station to gather as a group.

Figure 109 - Pilot 5, Wave 2 elderly, disabled and student participants (field testing)

As during the first pilot wave, any incidences, which occurred during the pilot implementation and have been documented by the PAsCAL team:

- <u>Qualtrics platform</u>: Some phone models (specifically an iPhone 6, iOS 12.5.2, C38NKPCPG5MR) had compatibility problems with the Qualtrics website and were sometimes unable to open the questionnaire for participants;
- <u>Requested features</u>: The users requested the tutorial to be translated into Spanish language, they believed it would be useful to see real-time information of the transport system such as departure times. Someone pointed out that it would be convenient to save route itineraries for a later point. The possibility to use the application with voice command or audio commands to navigate would be helpful for blind or partially sighted users. An indoor navigation, including different levels of the station would be very helpful for easy navigation and orientation within larger stations;

- FDGs: A recurring question in the FDGs was whether the application had been created in collaboration with Metro de Madrid and a possible integration of the service into Google Maps. Furthermore, several participants inquired on the possibility of monetising the *Apertum* application and funding options for the project;
- Translations: Some participants pointed out irregular translations concerning two questions in the survey;
- Accessibility: Participants with reduced hand mobility found it difficult to navigate the application or answer the survey and required some help in doing so. Not every wagon of the train allows pushchairs and wheelchairs inside it. The signposting for elevators and accessible features of the station are not clear and hard to find. In a lot of buses, the ramps for wheelchair users do not work, these users requested that this information should be made public by the operator of the bus system to receive a warning before they start their trip. Participants reported on a very low availability of wheelchair-friendly spots onboard trains or buses;
- Security: The videographer, who accompanied the pilot implementation on this day was stopped inside the station and asked to leave, after some discussion they were allowed to continue filming within the metro system, due to a recent change in legislature. During another batch, two guards from a private security contractor interrupted a briefing and controlled that social distancing regulations were kept. Since they could not find any irregularities, the briefing continued normally;
- Surrounding infrastructure: The design and layout of the *Plaza de Castilla* station was non-intuitive for the participants, luggage and pushchairs got stuck in the blind tracks and the elevators faced the same direction for entrance and exit, but they are too small to turn around inside of them comfortably. Some of the doors of the trains needed to be pushed open manually and with force, which presented an issue for vulnerable travellers.

Following the pilot execution and the comments received, changes were implemented to prevent similar issues or delays in the following pilot wave:

- Adaptation of FDG: The briefings of upcoming waves also included information on the history behind this solution and the importance of collaboration with public and private stakeholders;

- Translations: The proposed changes to the translation of the questionnaire were implemented and updated;
- Accessibility: During the next pilot wave, more staff was present to aid persons with reduced hand mobility in filling out the survey.

As in the first pilot wave, the pilot took place during the COVID-19 pandemic, the participants as well as the staff wore surgical or FFP-2 masks, and disinfecting gel was offered to everyone on a regular basis. All the vulnerable participants, including elderly persons and those with disabilities were fully vaccinated by the time the pilot took place. Furthermore, a strict social distancing protocol was introduced and kept throughout the pilot implementation. Finally, the batches of participants were kept as small as possible as to avoid crowding and facilitate contact tracing in case of an outbreak. Participants received drinks and were able to sit down during the entirety of the pilot if needed.

7.2.1.3 Pilot 5 Wave 3 report

The third and final pilot wave took place on the 13th and 14th of May 2021 in Madrid. This pilot batch followed scenarios 3 and 4 as per defined in Deliverable D6.2. For participants following scenario 3, the meeting point was just outside of the Sainz de Baranda station in Madrid. For scenario 4, the meeting point was at Portazgo Metro station in a suburb of Madrid. Three different user groups were involved in this pilot wave, including 12 elderly persons (ELD) above 65 years old, 24 persons with Temporary Mobility Constraints (TMC) and 10 persons with Spinal Cord Injuries (SCI). The last wave consisted of 7 batches with the following distribution:

Table 20 - Pilot 5, Wave 3 overview (field testing)

Batch Number	User Group	Number of Participants	Scenario Number	Date	Time
1	ELD	6	3	13/05/2021	10:00 – 11:30
2	ELD	6	3	13/05/2021	11:30 – 13:00
3	TMC	11	3	13/05/2021	16:00 – 17:00
4	TMC	6	3	13/05/2021	17:00 – 18:00
5	TMC	7	3	13/05/2021	18:00 – 19:00
6	SCI	5	4	14/05/2021	10:00 – 11:30
7	SCI	5	4	14/05/2021	11:30 – 13:00

In total, 45 participants filled out the questionnaire in this pilot wave. Each batch with TMC participants was scheduled to last 1 hour and followed the same timetable as in the first wave, while the timetable for ELD and SCI participants continued to last 1.5 hours.

On the first day of this pilot wave, one of the members of staff had a small car accident on their way to the meeting point and was later. On both days of the pilot execution, the weather was very sunny, which made it hard for participants to see their phone screens and they needed to seek a shadow.

Figure 110 - Pilot 5, Wave 3 elderly, disabled and student participants (field testing)

Several incidences occurred during the pilot implementation and have been documented by the staff along with other remarks:

- <u>UI/UX</u>: When entering a start or ending point, the application proposed different locations depending on whether the entered term is capitalised. General city areas or quarters should be removed from the list of possible locations, as they often had the same name as a nearby public transport station;
- <u>Requested features</u>: Participants said that implementing a text-to-speech function would be useful for blind or partially sighted people as well as persons who cannot use their hands due to heavy luggage. Furthermore, users requested the option to use their current location as a start or destination point;
- <u>Surrounding infrastructure</u>: Some participants pointed out that it was hard to access and use buttons inside and around the elevators and that the direction elevators are facing within the stations are not always clear. Also, elevator doors in the Madrid Metro system close very fast, making it difficult for persons in wheelchairs to enter and leave the elevator. In some stations, markings for blind or partially sighted person were missing in part or completely.

As in the previous pilot waves, the pilot took place during the COVID-19 pandemic, the participants as well as the staff wore surgical or FFP-2 masks and disinfecting gel was offered to everyone on a regular basis. All of the vulnerable participants, including elderly persons and those with disabilities were fully vaccinated by the time the pilot took place. Furthermore, a strict social distancing protocol was introduced and kept throughout the pilot implementation. Finally, the batches of participants were kept as small as possible as to avoid crowding and facilitate contact tracing in case of an outbreak. Participants received drinks and were able to sit down during the entirety of the pilot if needed.

7.2.2UI/UX Testing

One of the activities to ensure that feedback from participants can be implemented and actively improve the *Apertum* application consisted of a user interface and user experience (UI/UX) testing. To ensure that all user groups are represented, the testing was split into two different peer-groups, consisting of digital natives and digital migrants respectively. To ensure the scientific relevance of the results, a minimum group size of 10 people per user group needed to be recruited, in collaboration with the *Nadiesolo* association and from the personal and professional network of *Etelätär Innovation* staff. According to literature, 10 participants are the minimum for a proper user experience [22], however, increasing this number to 20 is useful to find at least 95% 220 of the possible problems in an application.

The testing took place on 21rst June in the offices of the *Nadiesolo* association in Madrid, Spain. To structure the UI/UX testing and to ensure that participants delivered relevant insights, the following agenda was followed:

For digital natives – 1.5 hours:

20	min	Introduction & Briefing
20	min	Free usage of the application
3	min	Task 1: Finding and opening the tutorial
5	min	Task 2: Finding all accessible station in the area
7	min	Task 3: Calculate 2 different scenarios
5	min	Task 4: Report a broken elevator in Sol station
20	min	Filling of UI/UX survey
10	min	Debriefing

Figure 111 - Pilot 5, Digital natives (UI/UX testing)

For digital migrants – 2 hours:

15	min	Introduction & Briefing
20	min	Free usage of the application
10	min	Task 1: Finding the tutorial
5	min	Task 2: Finding all accessible station in the area
15	min	Task 3: Calculate 2 different scenarios
10	min	Task 4: Report a broken elevator in Sol station
35	min	Filling of UI/UX survey
10	min	Debriefing

Figure 112 - Pilot 5, Digital migrants (UI/UX testing)

The participants ended up not needing as much time as originally planned on the 4 separate tasks and almost all of them finished the tasks before the time limit had been reached.

Some Bugs and comments were extracted that are useful in order to improve the app in the future. Some Bugs involved the application redirecting to an old version of wheelmap[30] that is no longer in use, or some problems with the algorithm where selecting a combination of both metro and bus would result in a route slower than if only metro is selected and sometimes the walking distance is longer in the metro and bus combined.

Other comments and suggestions were noted from the pilot are that the app could prompt the tutorial the first time the user downloads the app or that looking stations around the user takes some time to load. Also, some non-intuitive behaviour was observed in the app, for example, you cannot search for a station if you are not calculating a route or that you have to click on the magnifying glass icon to close the search options.

Lastly there were some feature requests like having the real time information of the buses and trains embedded in the app and adding the current location as the route starting point.

An exhaustive explanation of the tasks performed can be found in Annex IV.

7.2.3 Stakeholder Interview

The key stakeholder of the public transport system in Madrid, the Regional Transport Authority, CRTM, agreed to conduct an interview consisting of 9 questions on connected transport environments. During the interview, two representatives of the association connected with PAsCAL staff using the *Zoom*[31] video call platform.

[30] https://wheelmap.org/search
[31] https://zoom.us/

Figure 113 - Pilot 5, Stakeholder interview

The operators were under the impression, that a connected transport environment does not directly increase the number of users, but instead provides them with a better user experience, which might increase the number of users and the loyalty of existing users on the long term. There is a clear trend towards offering the customer more information than before and if operators fail to supply this; users switch to other means of transport. Younger persons seem to have a better degree of understanding of the network and the itineraries due to using connected applications. Connected transport environments are not expected to increase the number of interchanges, but they might reduce anxiety concerning the information given about the exchange (for example the types of vehicles, their exact location within the station, etc.). A major issue that delays the implementation of a totally connected transport environment are data ownership and financing of infrastructural investments to modernise parts of the public transport system. Persons with disabilities or impairments could greatly profit from more connected transport environments, especially concerning incidences or obstacles. Budgets to realise SUMPs should be increased to reduce emissions by encouraging users to switch to public transport and travel more sustainable.

CRTM also revealed interesting insight into the way the Regional Transport Authority of Madrid uses data and information in the Madrid Transport System, by tracking mobility patterns via the customer's card, which acts as a ticket. The interviewee admitted that this data collection is becoming obsolete and is being complemented more and more by other information such as automatic passenger recognition. Although the public transport system in Madrid today is not fully accessible and funding for accessibility measures is sparse, CRTM has invested in some projects such as applications specifically for visually impaired persons or to free more safe space for wheelchair users on buses and trains. The interviewee said that they follow Madrid's regional government accessibility policy but do not identify European efforts directly. Currently, smart infrastructures such as intelligent occupancy measurements, real time management, separated bus lanes, autonomous buses and deterrent parking lots represent efforts of the operator to switch to a CAV-adapted environment.

The representatives highlighted that without a working infrastructure at the foundation of connectivity, connected features add little to no value, stressing the importance of a generally intact and working transport infrastructure first.

7.2.4 Visually Impaired Focus Discussion Group

In collaboration with the Italian member of the *European Blind Union* (EBU), *Unione Italiana dei Ciechi e degli Ipovedenti* (UICI), four Focus Discussion Groups were scheduled, including over 50 blind or partially sighted participants across Italy. To ensure that the pool of participants is as diverse as possible, the FDGs took place in different regions and cities of the country. Due to the COVID-19 pandemic, the PAsCAL staff was only able to join the discussions in form of a video call via *Zoom*. Both the PAsCAL staff and UICI together planned and executed the FDGs successfully. The programme, which was sent out to all participants before the day of the FDG was as follows and lasted 2.5 hours:

20	min	Briefing & Introduction
40	min	Filling of questionnaires
20	min	Coffee break
60	min	Discussion
10	min	Debriefing

During the coffee break, the PAsCAL staff conducted a preliminary data analysis in real-time to contribute to the discussion with some questions based on the participants' answers. To ensure easy communication, a UICI staff member translated throughout the entire FDG to PAsCAL staff and vice versa in real-time.

7.2.4.1 FDG 1 in Rome

The first FDG took place on 24th June and involved a total of 11 participants, which were all older than 50 years. Furthermore, 4 sighted volunteers were present during the entire FDG meeting to aid the participants in filling in the questionnaires.

Figure 114 - Pilot 5, FDG Rome

At the beginning of the FDG meeting, the UICI staff experienced a few technical issues, partly due to internet connection problems and issues with the video call programme in arranging an audio channel for translation to English language only. Due to this, the FDG meeting was delayed by 40 minutes, but the staff was able to find an adequate solution for these issues.

During the briefing, a UICI representative introduced the concept of CAV technology and their potential for persons with reduced mobility. The PAsCAL staff welcomed the participants and introduced the PAsCAL Project, its objectives and activities and gave participants some examples of CAV technologies they might already be familiar with.

Following their self-introduction, participants filled out the questionnaire, for which all of them required help by a volunteer and took a short coffee break. During this time, the PAsCAL staff monitored the responses received and analysed the dataset for irregularities, conflicts or unexpected results, resulting in three questions:

- Participants seem to be very divided on whether current transport systems offer enough information on accessibility. What kind of information would be helpful in a connected and/or automated environment?
- 20% of the participants use a dog as aid, do they believe this is convenient for public transport? Is there something that would make travel for them easier?
- Women feel on average less safe to travel long distances or without assistance by another person. What would help them increase their autonomy of mobility?

Once the coffee break was over, all participants were asked to join a discussion round and talk about the technologies, tools and ideas they had been introduced to in the briefing and they were also asked the questions developed from the data analysis. The participants had the following concerns, points and questions:

- Safety is the keyword, CAV technology can only be trusted if it is 100% safe, CAV safety features depend on electronical components, what if those components broke?
- Connected and automated mobility will still need human interaction until the entire transport system switches to CAVs, that should be connected also among individual CAVs and poses a big threat to vulnerable road users;
- CAVs must be able to communicate and interact with the requests of blind or partially sighted users, who could need to know that the CAV is approaching, where it stopped, to tell it where to go and so on. It was said that it could be very useful if CAVs could remind the owner when the vehicle needs some maintenance, also by routine;
- CAV technology has been developed for many years, but the issue that remains is that such vehicles, for the time being, can safely move only in special, dedicated lanes and not many cities have a suitable street arrangement;
- Apart from public transport, what visually impaired people would particularly welcome are privately owned CAVs, that could make a

huge difference for a larger number of them to travel more independently;

- The female participants reported not feeling safe in public transport by themselves, due to accidents or threatening situations they had experienced previously. These experiences were mostly linked to unexpected obstacles or harassment.

Following the discussions, participants were thanked for their participation and given all information they need to find the results of their contribution and of the Project as a whole afterwards.

7.2.4.2 FDG 2 in Bologna

Following the first FDG meeting, some more preparations were made to ensure that there would be no technical issues for the later FDGs and a separate translation channel was set up in the Zoom video call platform. This made the translation process much more pleasant and smooth. Furthermore, the technical arrangement at the Francesco Cavazza Institute of the Blind in Bologna was more performant. This FDG meeting took place on 1st July 2021.

To accommodate in case of further issues and to render the experience more pleasant for participants, the following FDG meetings were scheduled to start 30 minutes earlier and finish 30 minutes later than originally planned, extending the schedule to 3.5 hours in total. In total, 13 persons participated in the FDG, and 3 volunteers as well as an employee of the *National Institute for the Evaluation of Assistive Technology Aids*, INVAT[32] were present to aid the participants in filling out the questionnaire if needed.

[32] https://www.invat.info/

Figure 115 - Pilot 5, FDG Bologna participants

As in the first FDG meeting, the UICI held a briefing and introduced the concept of CAV technology and its potential for persons with reduced mobility. The PAsCAL staff welcomed participants and introduced the PAsCAL Project, its objectives and activities and gave participants some examples of CAV technologies they might already be familiar with. Furthermore, an internal automation expert of UICI was present, who gave some insights on the latest automated technologies and their risks.

Comparing this group with the participants in the first FDG in Rome, the presence of young people in Bologna should be noted. In addition, participants' familiarity with IT technologies was higher in Bologna and this was confirmed by the number of people who succeeded in filling in the online questionnaire independently (only 2 out of 13 participants asked for support to fill it in, whereas all of the participants in the first FDG required aid of some sort). Most of them used their own mobile phone. Two reasons for this are that the average age of participants was lower in Bologna and that the institute where the meeting was held carries out IT training activities for visually impaired persons specifically. The participants for this FDG were pooled from those who attended such courses and had a higher affinity for IT devices and tools. All participants lived in the intense urban setting of the city of Bologna, and nobody came from rural areas; this was indicated by a participant as a missing element, as traffic conditions, the availability of a well organised, ordinary public transport and issues of rural transport, are all strong elements that come into play when discussing about new connected and automated transport.

Following the introductions, the participants filled out the questionnaire and took a short coffee break. During this time, the PAsCAL staff monitored the responses received and analysed the dataset for irregularities, conflicts or unexpected results, resulting in five questions:

- Given that almost all the participants reported that the current information about the transport environment around them is not sufficient, they also answered that they would pay for a better-connected transport environment. What features or services would they like to have implemented for such a price?
- Do participants believe that almost all of them being very used and familiar to using smartphones does have an impact on how they perceive CAV technology?
- Have participants heard a lot about CAVs before today? What was they perception before the FDG? What is their perception afterwards?
- Most of the participants are quite brave and are used to travelling alone or with minimal help. What kind of minimum information or technology would help them to travel even further distances (for e.g. between cities or countries, in an unknown urban environment)?
- Do participants regularly use the bus and how has their smartphone helped them to increase their confidence to use public transport?

Once the coffee break was over, all participants were asked to join a discussion round and talk about the technologies, tools and ideas they had been introduced to in the briefing and they were also asked the questions developed from the data analysis. The participants had the following concerns, points and questions:

- The group showed more cautious views about CAVs because the efficiency of the traditional transport network in Bologna, that is a city of 388,000 inhabitants compared with the size of Rome (2,800,000 inhabitants), was perceived as good enough for the needs of blind and partially sighted citizens;
- The idea of private owned CAVs was welcomed, although participants perceived that the safety of this technology can only be guaranteed with the implementation of a whole connected and

automated system. The coexistence of CAVs and ordinary transport was perceived as impossible to be safe enough;

- Regarding car-sharing modality in form of “robo-taxis” or on-demand automated buses, the participants found it interesting, and recognized the increased sustainability from the ecological and urban point of view. However, in order to successfully implement CAV technology in car-sharing services and offer them to blind and partially sighted users, interaction with the vehicle is required as the car must communicate to the user that it is approaching, where it stops, get the indications on where to take the user and provide environmental information both during the journey and at its end to help the user to find their way to the final destination. The issue of navigation outside the CAV and locating the vehicle in the first place was perceived as a high priority for visually impaired passengers. Automated driving should be combined with environmental information and indoor navigation in one integrated system;
- One participant specifically expressed their security concern about the issue of the dependence from electronic systems that could be hacked, as this makes even totally CAV-implemented transport systems vulnerable to attacks;
- For visually impaired persons, urban navigation is very challenging and CAV technologies today do not offer a solution for all issues. An external priority should lie on re-arranging the urban spaces by enlarging pedestrian areas in the city centres;
- CAVs’ internal “code of conduct” is also an issue that was highlighted: how would CAV react if a blind person would cross the street in a point where, according to traffic laws, it is not allowed to do it? Would the vehicle be able to recognise a visually impaired person’s white cane warning the cars in a busy and complex traffic scenario? Would automated alerts and braking be sufficient just as the person was on a pedestrian crossing?
- The ethical aspects of CAV software programming were also discussed: what could a CAV be instructed to do in dangerous situations and how would it decide ethically? Who should be able to ethically decide upon damage priorities in CAV software programming?
- One comment replying to many of the perplexities highlighted above was that in any case visually impaired persons are subject to external decisions when travelling, either when they are accompanied by a human assistant and when they are driven by a CAV, with no substantial differences.

Following the discussions, participants were thanked for their participation and given all information they need to find the results of their contribution and of the Project as a whole afterwards.

7.2.4.3 FDG 3 in Milan

The meeting in Milan was held on 7 July 2021 in the prestigious Sala Barozzi of the *Institute of the Blind in Milan Foundation*. In total, 16 participants took part in the discussion, 2 of which attended online via *Zoom* and they were supported by 3 sighted volunteers when they filled out the questionnaire. The participants consisted of 7 women and 9 men.

Figure 116 - Pilot 5, FDG in Milan

Although most of the participants were over the age of 50, they required very little assistance, which points at a high level of tech-savviness in the group. Only 4 of them asked for support at all and most were able to complete the survey in little time. This is probably also because several participants were technology experts and work with UICI as well as the Institute of the Blind in Milan.

The subject was introduced by Franco Lisi, Director of the Institute of the Blind of Milan and Director General of the National Institute for the Evaluation of Aids and Technologies for the Independent Living of Blind and Partially Sighted People (INVAT), founded by the Italian Union of the Blind and Partially Sighted. Also, Alberto Piovani, President of the local office in Milan of the Italian Union of the Blind and Partially Sighted greeted the audience. The introduction to the CAV concept also included the element of connected mobility technologies as a fundamental part of CAVs that are already largely used by the general public.

This time, the FDG meeting took place before the participants filled out the questionnaires to examine what effect a discussion prior to filling out the survey may have. Participants explored different aspects of CAVs and their potential, as well as the possible obstacles they might have to face in a connected transport environment:

- Currently, connected technologies seem to partly compensate for the lack of accessibility of information in transport systems. A person from a neighbouring small city said that apps for connected transport, such as Google Maps, are very useful to fill the current gap in the accessibility of websites of local and regional transport providers. Also, car navigation services are not accessible and there too Google Maps is used to fill the gap;
- The precision of geo-localisation was also raised as an issue. How could CAVS be fully implemented if technology does not allow blind and partially sighted persons to reach the exact point where they want to go (25-30 metres average precision error)? Also, geo-mapping has uneven levels, which are very good in urban settings, sometimes very bad in rural environments. The participants also thought it is important that CAVs should provide environmental information in order to help passengers to orientate themselves when they get off the vehicle. Investment in improving this technology is essential, such as 5G technology. It seems that Turin is the most advanced Italian city from this point of view. Franco Lisi declared that the technology to solve these issues already exists and we must strongly call for its implementation;
- Different from privately owned cars, CAVs are seen as more likely to be implemented as a car-sharing or ride-sharing service. In this modality, in fact, the issue of finding a parking space close to the destination is not applicable as such cars would just take people to their destination and leave. A future concrete CAV development could lie in so-called “robo-taxis” which find the person that called them, pick the passenger up and take him/her to the desired destination;

- As in the FDG in Bologna, the issue of ethical programming has been raised and questions were asked on who would decide upon the reaction of a CAV in front of unexpected, potentially dangerous, happenings, such as a (blind or partially sighted) pedestrian crossing a street in a point where pedestrian crossing is not allowed. The perception of the participants was that implementing CAVs will in the long term limit the number of vehicles in the streets, with a reduction of accidents due to the lower number of vehicles;
- The issue of the existence of insurance schemes for passengers of totally automated CAV, and in particular for visually impaired passengers was raised with PAsCAL staff. Currently, there are no such schemes widely and commercially available, mainly for liability issues (insurances and operators could not agree on who is liable in case of an accident). For this reason, the private ownership of such vehicles remains impossible, at least in Europe currently. However, cars with some CAV features, say, the automated parking feature, are available across the continent already. In case of a crash during an operation using autonomous features, legislation states that drivers are liable, because they could choose whether to use the automated feature or not. For higher levels of automation there are no legislative norms as there are no fully automated vehicles except prototypes operating today. A big European operator has launched an automated bus in regular traffic, and this operator is liable for accidents. They got an insurance, but this is an exception that was possible due to very large financial and political means of the operator;
- One particularly important feature that any CAV who interacts with blind or partially sighted passengers should have is an audio alert before the CAV brakes, communicating information on the cause of braking, in order to reduce the confusion and scare in the visually impaired traveller. This echoes with EU Regulation 540/2014 which mandates all manufacturers to equip their electric and hybrid vehicles with an Acoustic Vehicle Alert System (AVAS) [33].Participants then spoke about the “Lilac” metro line in Milan, a driverless line that has features very much appreciated by visually impaired people: barriers on the platform, with sliding doors that perfectly align with the train doors, so that there is no risk of slipping

[33]https://www.plm.automation.siemens.com/global/en/resource/avas-for-electric-vehicles/76717

in the gap between the train and the platform. In metro stations the issue lies in getting to the train, as there is no assisted route from the entrance to the platforms, nor the possibility to identify where emergency buttons are, for instance. In Milan only some stations have a common layout, and most of them have a rather complex structure, so an accessible transport system must integrate various navigation systems to be fully inclusive. For instance, the Italian Union of the Blind and Partially Sighted is promoting radio beacons, a cheap technology that allows blind persons to find their own way in metro stations by means of a special white cane activating the audio beacons that guide visually impaired persons to the desired destination;

- Participants expressed their off-topic concern about e-scooters, that are both obstacles when they are parked and because they cannot be heard from a distance. They wanted to hear about the situation in other countries. A UICI representative explained the work of the European Blind Union about AVAS on silent electric vehicles and the research carried out on e-scooters recently. The PAsCAL staff reported about the fact that in Madrid the problems created by e-scooters were solved with a mixed strategy by the local government of fines for inappropriate use and agreements with e-scooters providers aimed at making them responsible for inappropriate parking and identifying designated places where e-scooters could be parked regularly.

Figure 117 - Pilot 5, FGD Milan board and participants

Summing up the results of the discussions, equal opportunities in CAV technologies mean that visually impaired people should not be only passive passengers but travellers able to interact with this mobility technology, just like anybody else and, to this aim, this technology should be made accessible in all its parts, possibly from the design phase. Secondly, CAV technology cannot solve all the issues concerning independent mobility in a city, as it should be part of a general framework that promotes independent mobility, also including Orientation and Mobility and/or guide dog training, accessible online services (such as car-sharing platforms and car navigation), adequate orientation tools and infrastructure in the city planning. All this would involve a big investment and it can be done only with the cooperation of Public Authorities. The participants recognised that CAV technology is already part of their everyday life and were generally confident that the development of CAV technology will boost their independent mobility, but only as part of an accessible transport and urban infrastructure where hardware and software technology consider the needs of persons with disabilities and more traditional adaptive navigation means, such as the white cane, are also involved. In this respect, visually impaired persons have an important role to play in raising the awareness of decision-makers, technicians, manufacturers and service providers on the accessibility features that need to be implemented in the existing CAVs to develop true inclusive mobility.

7.2.4.4 FDG 4 in Naples

The FDG was held at the local office in Naples of the Italian Union of the Blind and Partially Sighted on 8 July 2021. In total, 13 participants took part in the discussion. 3 sighted volunteers were present to aid 5 persons in completing the survey later.

Naples is a large city, with the highest population density in Italy, and it integrates different urban transport modalities, not only buses and metro, but also funiculars (cable railways laid on the city’s steep slopes) and a network of regional train lines. Despite such an articulated transport system, the city is characterized by very high-density traffic that often makes moving on public transport, except metro, not convenient in terms of journey duration. Moreover, traffic jams often cause irregular driving behaviour.

Figure 118 - Pilot 5, FDG Naples

During an initial self-presentation round, some participants expressed their doubtful feelings about the CAV concept, as they thought their city has already many structural accessibility and mobility issues that should be solved before installing such technologies. One participant shared his view that such technologies are mainly pushed forward for commercial reasons and that they should not be a priority, as he felt that they do not put human interaction at the centre of their development. Participants with a technical background and younger participants expressed instead more positive views about CAVs, thinking that they can contribute to reducing the number of vehicles circulating, with the result of improved traffic conditions and a much lower number of accidents.

Going off-topic from CAVs, all participants shared the view that many simple, low technology solutions are already available that could improve the mobility of visually impaired people in the city, but the implementation of such technology is unfortunately far from being completed. The local office of the Italian Union of the Blind and Partially Sighted is engaged in providing solutions to improve the mobility of persons with visual disabilities in the city, and most participants declare that, despite numerous mobility issues and countless obstacles they have to face, they move mostly independently in the city, although they understand that the standard of safety and accessibility is not the same as in other cities.

During the introduction, the CAV concept was introduced by Giuseppe Fornaro, a digital accessibility expert active in the UICI local office in Naples. He introduced some examples of useful CAV features that allow for assisted rides in metro trains, which ensure that the trains always stop in the same position, allowing visually impaired people to know the right place where to wait for the train doors to open. In the long run, CAVs will have a role in reducing the number of vehicles in the streets, improving transport quality. Mr Fornaro further mentioned the importance of implementing CAV technology starting from the analysis of the specific needs and level of accessibility of each city, in order to better adapt such technology to the individual urban conditions. He also mentioned the need to verify the legal framework that would apply to CAVs as it may be necessary to develop new regulations in parallel with their introduction. A UICI representative then introduced the different levels of automation and the aims of the PASCAL project and asked to know the views of the audience on future, concrete applications of this technology, thinking about the advantages that it could bring to visually impaired persons and stressing the importance of making their requirements known since this development phase, in order to enhance the accessibility of this technology.

The discussion can be summarised in the following points:

- Touch screens are more and more used in transport, navigation and also in household goods and professional products. This technology is not accessible to a number of participants. However, this issue could be easily solved if such screens were designed from the beginning with the idea of making them accessible through, for example, audio menus and controls. This echoes with the 7 principles of Universal Design[34]. Universal Design is the design and composition of an environment so that it can be accessed, understood and used to the greatest extent possible by all people regardless of their age, size, ability or disability;
- In Italy there are excellent laws on accessibility and non-discrimination, but the lack of conformity to such laws is very common;
- Also in Naples, e-scooters were mentioned as a critical issue for the independent mobility of visually impaired people;
- One participant pointed out that, at least in Naples, CAV need to be forcefully accompanied by a cultural shift toward a higher respect of rules and improved behaviour in the urban environment to be

[34] http://universaldesign.ie/what-is-universal-design/the-7-principles/the-7-principles.html.

successfully implemented. A general recognition of everybody's right to safe and independent mobility needs to be recognised. They also said that, like in Milan, independent mobility starts with personal mobility skills, such as white canes and guide dog training, so a fully inclusive and accessible transport system should include not only CAVs but also guidance tools and accessible information;

- Another participant raised the issue of emergency situations in driverless automated means of transport and asked how visually impaired people could correctly follow, for instance, evacuation procedures if they are not assisted by another person. Participants mainly said that if CAVs implemented efficient safety measures they could be reasonably confident on driverless means of transport;
- The awareness raising and training of staff is also very important, because sometimes public transport staff do not use the existing technology that could help persons with disabilities (e.g., they regularly switch off the audio announcements in trains) or create mobility obstacles (e.g., putting obstacles on tactile guiding paving) because they are careless of the needs of persons with a visual impairment, or they are simply not aware of them;
- Some mobile applications, in particular *Moovit*[35] and *WeTaxi*[36], are reported to be fully accessible and very reliable on GPS equipped means of transport.

When the participants were asked which kind of features they would deem essential onboard a CAV, they gave the following answers:

- Description of the environment outside the vehicle;
- Information about the duration of the journey, the distance to destination, announcement of next stops, the number of the coming bus, possible connection with other means of transport;
- Audio signals to identify doors or buttons;
- Trains and buses to reach target positions at stops and stations;
- Accessible applications and design.

[35] https://moovitapp.com/
[36] https://wetaxi.it/en/

7.3 Data collection

All the data collected has been received from natural persons who have read and agreed to sign a GDPR compliant form. The form has been collected with the rest of the questionnaire, but has later been anonymised, which ensures an anonymous data analysis. None of the persons who have filled out a survey within this pilot or have agreed to conduct an interview or participate in a FDG are identifiable through the dataset analysed. Furthermore, all participants who appear in photo- or videography footage have given their explicit consent to be recorded and for this footage to be used for analysis and communication purposes.

The data collected can be divided into multiple categories:

3. **Quantitative data**, which comes from the questionnaires, which have been prepared for three of the 4 activities as well as data collected from the *Apertum* administrator panel containing data regarding the routes searched and the incidences reported during the days the tests were performed;
4. **Qualitative data**, which are gathered through additional comments of the participants, photo- and video footage and finally observations and minutes prepared by the staff.

All data has been saved in a dedicated and secured *Dropbox*[37] folder, which only the PAsCAL staff has access to. All data has been checked to conform to GDPR standards and be as homogenous as possible for a successful and smooth data analysis process.

7.4 Data evaluation

Although the full data analysis of all the datapoints collected within WP6 will be performed in the subsequent WP7, a preliminary data analysis serves in providing a brief overview and interpretation of the data collected.

In total, pilot 5 used three different questionnaires, one geared towards participants of the *Apertum* piloting, one for participants of the UI/UX testing and including a *Wammi*[38] questionnaire and a final questionnaire for the Focus Discussion Groups in Italy. Additional information and graphics can be found in Annex III. For the interview with CRTM, no

[37] https://www.dropbox.com/es
[38] http://www.wammi.com/questionnaire.html

automated questionnaire was necessary, as the two high-level employees of the organisation that participated in the interview did not represent enough demographic data to be of relevance.

7.4.1 Apertum field testing

The first questionnaire for pilot 5, focusing on the piloting of the *Apertum* application, was performed over a sample of 165 testers that used the app and tested it in real conditions in the public transport. The participants followed 1 of 4 predefined scenarios as per Deliverable D6.2 and were split up in 3 separate pilot waves.

A preliminary data analysis shows that the difference of gender among the participants is almost equal, with some more female users responding to the questionnaire than males.

More than half of the participants were under the age of 24, with an average age of 35. Although a considerable effort has been made to include as many elderly participants as possible, one of the sources for Testers for this pilot were universities, with students acting as users with temporary mobility restrictions (heavy luggage, crutches, baby stroller…). This also shows in the occupation graph, where 51% of the testers declared to be students.

Q9: Which is your cur...		Count	Percent
Student		86	52.1%
Full-time work (over 30 ...		8	4.8%
Part-time work (30 h pe...		17	10.3%
Currently not employed		3	1.8%
Retired		42	25.5%
Other		9	5.5%
Total	0.0% 20.0% 40.0% 60.0%	165	100.0%

Figure 119 - Pilot 5, Field testing, Participants' occupation (field testing)

As mentioned previously, the effort to include more elderly people shows: a high percentage of participants claimed that they were retired people. Despite this, 97% of the interviewees regularly make use of a smartphone or a computer. Most of them have been using the devices for more than five years and are used to it.

A high percentage of users in the first wave (45%) claimed they had never used a CAV, and after checking this results in the first wave, the survey was changed. Instead of asking testers directly if they had used a CAV before, and then which kind of CAVs had they tested, the question was changed to “What kind of Connected and/or Automated Vehicle (CAV) have you tried before?” Giving users options for the different types of CAVs with concrete examples as well as an option at the end stating “I have never tried a CAV before”. This was a success as in Waves 2 and 3 only a 4% of the participants said they had never tried a CAV.

The most common CAV examples people use are i) Navigation and routing services and ii) Ridesharing.

Q5: What kind of Connected a...	Checked Percent		Checked Co...
Navigation & routing services (Goo...		52.7%	87
Ridesharing (Uber, Cabify, Taxi-ap...		40.6%	67
Connected features (Next stop indi...		32.7%	54
Vehicle sharing services (ShareNo...		17.6%	29
Driver assistance (Speed limit indi...		14.5%	24
Carpooling (BlaBlaCar, Leadmee,...)		12.7%	21
Adaptative cruise control (the vehi...		8.5%	14
Automatic steering (autonomous p...		6.1%	10
I have never tried a CAV before.		4.2%	7
I don't know		0.0%	0
	0.0% 20.0% 40.0% 60.0%		

Figure 120 - Pilot 5, Field testing, Connected and automated services used (field testing)

Since the majority of participants regularly use these services, it comes as no surprise that they mostly have medium or high trust in CAV technologies.

The testers mostly move in public transport, specifically with buses or subways, but private cars have also high usage rates.

Q11: Which mode of trans...		Count	Percent
Private car		49	29.7%
Public transport - Bus		63	38.2%
Public transport - Subway		39	23.6%
Walking		12	7.3%
None of the above		2	1.2%
Total	0.0% 10.0% 20.0% 30.0% 40.0% 50.0%	165	100.0%

Figure 121 - Pilot 5, Field testing, Preferred mode of transport (field testing)

These surveys were conducted in the months of March, April and June 2021 and due to the COVID-19 pandemic, people used public transport less to go to work or university during the months prior and during the pilot was conducted. Still, the survey found that around 60% of the users use public transport to commute at least once a week.

Half of the participants reported that they rarely or never encounter obstacles in the public transport system, while the other half reported encountering them sometimes to very often.

Q14: When ...		Count	Percent
Very often		35	21.2%
Sometimes		49	29.7%
Rarely		64	38.8%
Never		17	10.3%
Total	0.0% 10.0% 20.0% 30.0% 40.0% 50.0%	165	100.0%

Figure 122 - Pilot 5, Field testing, Frequency of obstacles in public transport system (field testing)

When we explore this same question separated by age groups, we can see young participants (25 and under) rarely or sometimes finding obstacles, and something similar happens with older participants (over 65) where the most common option was rarely. However, from ages 26 to 64 participants most common option was that they found obstacles very often. This is caused because most of the participants in that age range have spinal cord injuries that require them to use either a wheelchair or crutches. Younger participants were mostly students with a temporary mobility constrain such as heavy luggage, a stroller or crutches and the older participants sometimes used a crane, but in most cases had no problem going through a single or couple of steps, but not an entire floor.

Q2: Please tell us your age	Q14: When using public transport for your urban trips, ...			
	Very often	Sometimes	Rarely	Never
≤ 25	8.6%	36.6%	46.2%	8.6%
26 - 64	50.0%	22.5%	25.0%	2.5%
≥ 65	21.9%	18.8%	34.4%	25.0%

Figure 123 - Pilot 5, Field testing, Obstacles encountered according to age (field testing)

Strikingly, 40% of the participants reported that they don't find the current information offered by the transport network insufficient and less than 4% deemed the information to be totally sufficient for their purposes.

Most of the participants (84% in total) think that a connected transport environment will help them use public transport independently, and 90% said that it is important for them to have a high autonomy in their daily mobility.

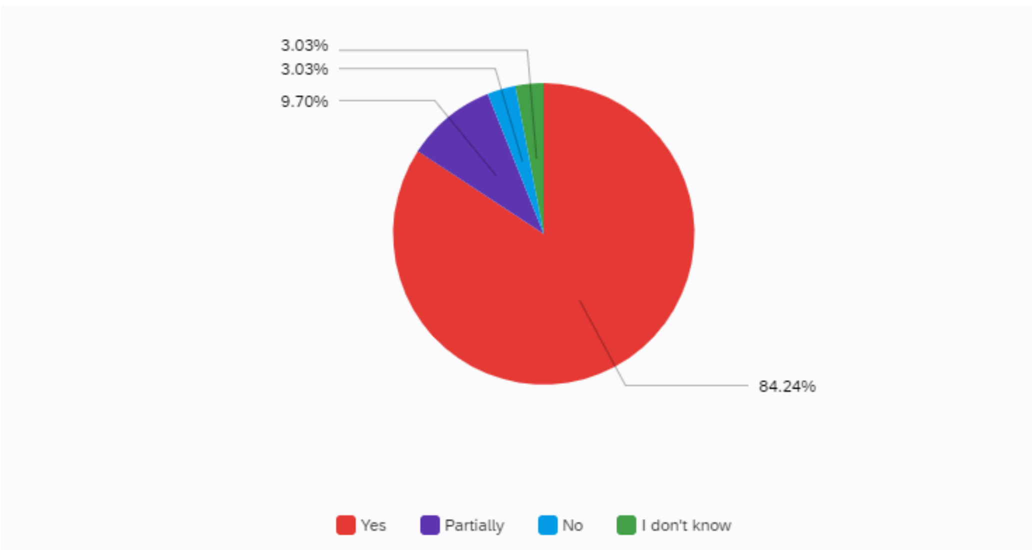


Figure 124 - Pilot 5, Field testing, Perception of the usefulness of additional information in public transport system (field testing)

The Accessibility information about the Stop/Station is what most users consider important in a connected trip, followed by real time information about arrivals, accessible routes inside the stations, learning whether a station/stop is accessible in advance and lastly specific routes for non-conventional users.

Q18: Which information do you co...	Checked Percent
Station/stop information (accessibility ...	75.8%
Real-time information about arrivals	68.5%
Accessible routes inside stations	61.2%
Learn in advance if the station/stop is ...	60.0%
Routing adapted to the type of non-co...	47.9%

Figure 125 - Pilot 5, Field testing, Usefulness of additional information in public transport system (field testing)

Most users (87%) are willing to make use of connected transport Applications. And share accessibility related information such as broken elevators or construction works.

Although most of the users think connected transport environments will save them time (62%) or can possibly save them time (28%), less than half of the users (47%) are willing to pay for this type of service. Figure 126 shows the users willingness to pay in price ranges, and a 31%

Q22: Would you pay for ...	Count	Percent
I would not pay for this kin...	88	53.3%
<5 Euros per month	51	30.9%
5 to 10 Euros per month	22	13.3%
>10 Euros per month	4	2.4%
Total	165	100.0%

Figure 126 - Pilot 5, Field testing, Willingness to pay for connected transport environment (field testing)

7.4.2 UI/UX Testing

This test intended to collect information on how users feel when using the app and detect possible flaws in the design in order to improve it. There were two groups one involving tech savvy participants belonging to the younger age groups where they are considered digital natives and an older group, over 65 years old considered as digital migrants as they learnt how to use technology later in their lives.

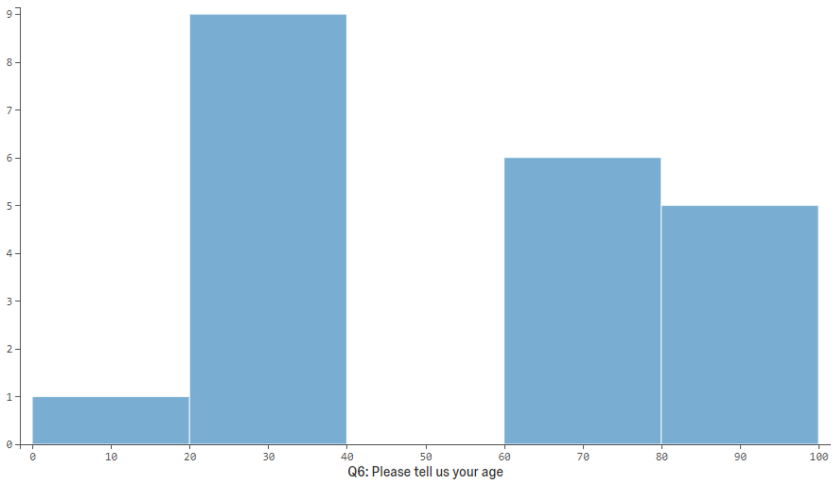


Figure 127 - Pilot 5, Participants' age (UI/UX testing)

Therefore, even the average age is 50 years old, half of the participants are under 40 and the other half is over 60.

Most of the users 95% already had experience managing maps applicationms such as Google Maps or Waze or public transport application such as Moovit or the Madrid Transport App.

Q9: Do you use one or seve...	Checked Percent	
Routing and guidance application		66.7%
Public transport application		66.7%
Shared mobility application		23.8%
No, I don't		4.8%

Figure 128 - Pilot 5, Applications used (UI/UX testing)

The users were asked to perform 4 tasks within the app, and the completion rate of the tasks was a 94% and users who were not able to complete them explained the reasons mostly due to the app not being intuitive when performing some of the operations.

Also, in all the tasks performed a 27% stated that even though they could complete the task, they needed some help because it was not as intuitive as it should be, or the text was small, or they had to click somewhere, and the button was not big enough.

However, when performing the *Wammi* Questionnaire most of the users stated that the functions in the app are useful and they mostly get what they are expecting when they click on the app.

However, not everyone thinks Using the app for the first time is easy, with a 24% of the participants disagreeing.

	Using this applicati...
Strongly agree	33.3%
Somewhat agree	33.3%
Neither agree nor disagree	9.5%
Somewhat disagree	4.8%
Strongly disagree	19.0%

Figure 129 - Pilot 5, Ease of first-time application usage (UI/UX testing)

A complete overview of the *Wammi* analysis can be checked in Annex III.

7.4.3 Visually impaired Focus Discussion Groups

Regarding the focus discussion groups performed by the European Blind Union (EBU) with their member organisation in Italy (UICI), in the cities of Roma, Bologna, Milan and Naples, the average participant age was 54, and only 28% of them were under 50.

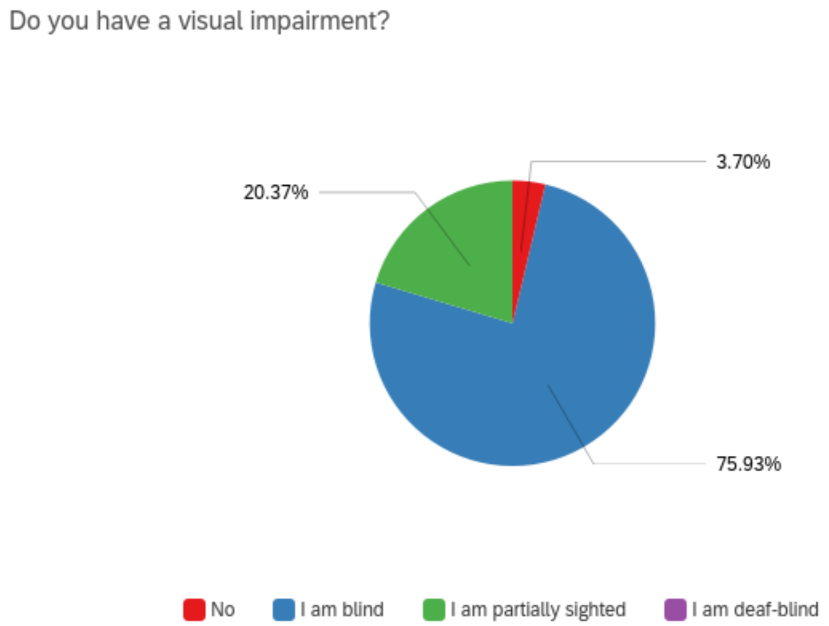


Figure 130 - Pilot5, Participants' degree of visual impairment (FDGs)

From the 54 total participants, 76% were blind, 20% partially sighted and the remaining 4% were sighted people accompanying a blind participant.

Domanda 13 di 27: Backgrou...		Count	Percent
No		2	3.7%
Only known routes, for short dis...		12	22.2%
Known routes any distance		28	51.9%
Yes, even unknown routes		12	22.2%
Total	0.0% 20.0% 40.0% 60.0%	54	100.0%

Figure 131 - Pilot 5, Perception of safety on own travel (FDGs)

90% of the participants stated that being able to travel alone was very important to them, however, as shown in Figure 131, only 22% of them are comfortable doing it in routes the do not know.

Domanda 1 di 27: Backgr...	Domanda 7 di 27: Background		
	I can travel alone	I can travel alone, but I have diffi...	I can only travel with someone else
Female	47.6%	33.3%	19.0%
Male	56.3%	37.5%	6.3%

Figure 132 - Pilot 5, Feelings about travelling alone according to gender (FDGs)

And this seems to be a gender issue because while only 6% of men need someone else to travel, 19% of women require assistance and a higher percent of men can travel alone both with and without difficulties while doing it.

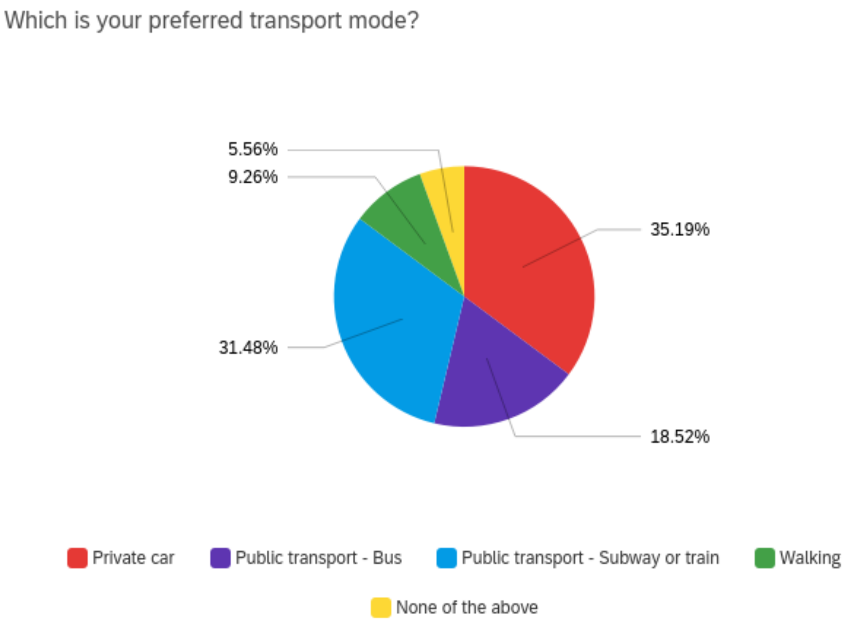


Figure 133 - Pilot 5, Preferred transport mode (FDGs)

Compared to the participants in the main pilot, blind participants are more likely to travel in a private vehicle than in public transport, but the latter is still the most common with the subway and train being used more than the Bus as can be seen in Figure 133.

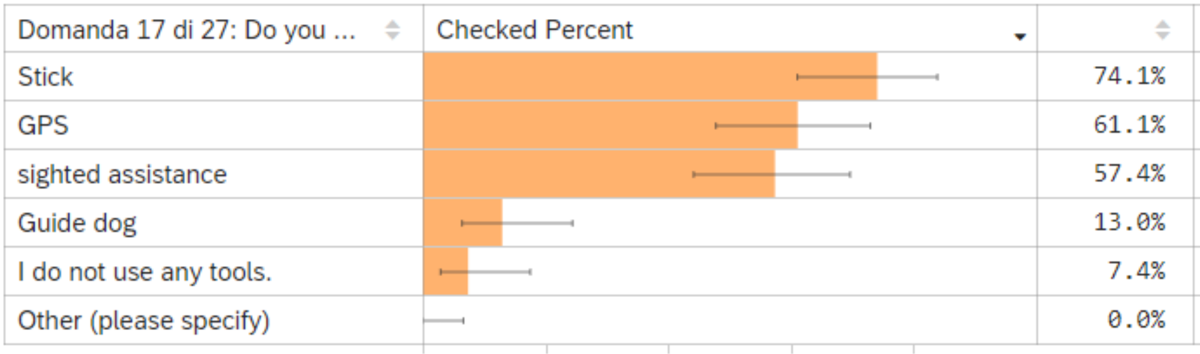


Figure 134 - Pilot 5, Tools used (FDGs)

The most common tools are the stick, GPS and sighted assistance. However, around 76% of the participants think that connected transport environments will help them travel through public transport more independently.

Regarding the user's willingness to adopt CAVs, 55% of the users would certainly use driverless vehicles and 36% would use them depending on how the technology evolves.

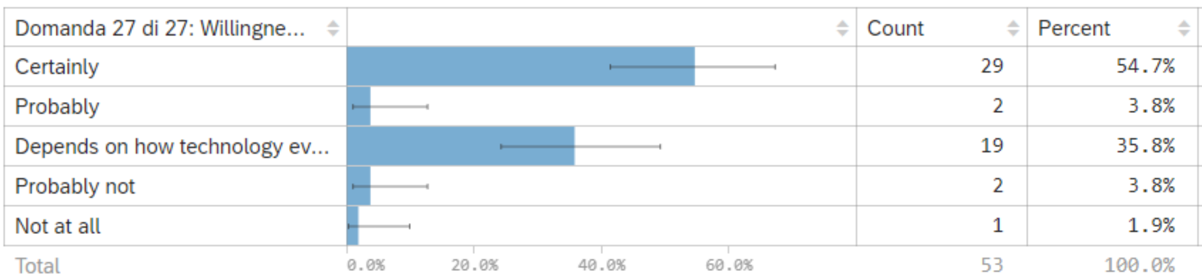


Figure 135 - Pilot 5, Willingness to use driverless vehicles (FDGs)

And comparing to the previous analysis with Apertum users, a 90% of Blind participants are willing to pay more in order to use connected and automated transport, and in 30% of the cases more than 10€ a month. This matches with the 90% of participants that are willing to use connected transport environments in the future

Overall, the data collected from all three questionnaires holds value for the project due to the high number of datapoints from different type of users and can be used to check the public acceptance of connected transport based on KPIs defined in WP7.

7.5 Cross-fertilisation Activities Across WPs

7.5.1 WP4

Following some communications with WP4 and a joint workshop to explore a possible liaison with single pilots on 10th January 2022, in which some recommendations of WP4 for WP6 were discussed and considered, it became clear that one of the recommendations are already implemented in the pilot setup, namely:

- TV 1.6 – *Attitudes to be measured*.

7.5.2 WP7

Also, WP7 has had some impact on the data collected within this pilot and all datasets have been transferred to this WP after the completion of the pilot in an agreed-upon format and in time to allow for a detailed data analysis. The cleared and final version of the dataset was sent to WP7 on 26 July 2022.

7.5.3 WP8

In total, 4 recommendations were drafted to the Guide2Autonomy (G2A), the final and most important deliverable of the project. The recommendations will be part of the database, which will be available for policy makers, stakeholders, researchers, the general public and many other groups of society. Through this, the findings of the pilot can have a direct impact on the future of CAV design, development, requirements and legislation and impact directly the acceptance of connected transport environments.

7.6 Dissemination activities

One of the most effective communication actions of this pilot proved to be the actual pilot implementation. Before, during and after the pilot execution, participants received PAsCAL brochures and Apertum stickers. Furthermore, they were presented with a PAsCAL presentation some days before the in-person meetings took place. The participants had many questions about the project and used the opportunity to exchange on it.

Figure 136 - Pilot 5, Communication material

Throughout the entire planning and execution process, the PAsCAL pilot manager continuously communicated about the pilot activities on its *Twitter* account[39] and *LinkedIn* page[40]. In total, 9 tweets and 7 retweets as well as numerous likes and comments have been published from the Etelätär and *Apertum Twitter* accounts. 6 entries have been published on its' *LinkedIn* page and 2 content from the PAsCAL *LinkedIn* page has been shared.

Apart from the active social media presence, 8 separate news articles (written by both the WP leader and UICI) of at least one page have been transferred to WP9 partners to be published in blogs or news outlets.

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[39] https://twitter.com/etelatar_world
[40] https://www.linkedin.com/company/etelatar/mycompany/?viewAsMember=true

As agreed on by WP6 partners, a video[41] was filmed and edited by a professional videographer, which was transferred to WP9 as well and published on all online platform the company has at their disposal.

During each of the pilot waves, the participants received incentives in from of a voucher and additionally, a raffle was organised for each of the pilot waves. The three winners were from a different participant group every time and they received a free tablet.

Figure 137 - Pilot 5, Raffle winners

The interview in collaboration with CRTM also served as a good dissemination activity, enhancing the operator’s awareness of on-going research projects and possibilities of European funding opportunities for the modernisation and enhanced connectivity of transport environments.

Finally, a closing event took place on 28 October 2021 online. In total, 29 persons attended which were of mixed backgrounds (representatives of disability associations, consultants, researchers, general public and vulnerable travellers directly affected by the topic). The event was held in such a way that it was accessible and understandable to the general public. Both Etelätär Innovation and UICI gave short presentations

[41] https://youtu.be/af1PWPstAi0

respectively and the entire event including questions lasted 1 hour and 15 minutes. The recordings and presentations were sent out to all participants after the event took place and everyone had the chance to ask questions or contact the presenters directly via email in case they have any doubts. The presentations[42] and recordings[43] are also available to the consortium and wider public.

7.7 Conclusions & Learnings

Following the execution of several pilot waves and other activities to map and assess vulnerable travellers' perception of CAV technologies, some conclusions both general and specific can be drawn.

The focus of this pilot were the vulnerable travellers and how connected environments can help them. Although multiple activities were performed within the pilot, the main activity was the field testing where participants with mobility constrains, that could be permanent such as spinal cord injuries, or temporary, such as a passenger carrying heavy luggage, would test the Apertum app as a connected transport environment in a metro station. Participants would test the accessibility according to the information given by the app. The other activities performed included an interview with the regional transport consortium in Madrid (CRTM), Focus discussion groups on Italy and user experience testing for the Apertum app.

As demonstrated in the preliminary data analysis, the participants were confused by the CAV terminology and did not seem to know that traditional means of transport such as a bus with a next stop indicator inside are also part of a connected transport environment and therefore a CAV. Despite some efforts to highlight this in briefings, participants remained puzzled by the term and it was clear that more concrete examples and use-cases needed to be introduced. It is therefore questionable whether the CAV term should be used when communicating with the general public.

The most common connected and automated environments users have tried are Navigation systems, ridesharing apps (uber, taxi apps…) and

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42 https://luxmobility.sharepoint.com/:b:/r/sites/Projects/Shared%20Documents/PAsCAL%20Project/WP%206%20Pilot%20Implementation/Presentations/Pilot%205%20Final%20Event/PAsCAL_WP9_Pilot5%20Event_Presentation.pdf?csf=1&web=1&e=gDwD19

43 https://youtu.be/af1PWPstAi0

Connected features such as the next stop indicator in buses. Autonomous features such as adaptative cruise control and automatic steering are the least tried features. This leads to the recommendation to enable more people to try and experience these features both as passengers and as drivers to familiarise them with features of higher levels of automation. This can be achieved by integrating more higher levelled CAVs into public transport or urban mobility systems and to encourage their use through communication strategies, subsidies and governmental recommendations.

It is not rare that users find obstacles while traveling by means of public transport and most users (87%) are willing to make use of connected transport applications in order to navigate and share accessibility related information such as broken elevators or construction works. To ensure the maximum convenience in accessing this information, it should be made obligatory for PT operators of medium to large cities to publish this information transparently, but also to integrate it into their local navigation platforms or commonly used navigation services.

Discussing with Madrid's Regional Transport Authority (CRTM) also revealed some insights relevant for the pilot on both accessibility and connected transport. A connected transport environment is important to avoid losing passengers to other means of transport like private vehicles, and passengers with reduced mobility can benefit from it by finding accessible routes and being informed in real time about the status of accessibility elements such as the elevators. However, improving the infrastructures to make stations accessible is what helps limited mobility users the most, but sourcing funding is not always easy.

Regarding the user experience testing, elder citizens seem to be increasingly more tech-savvy and are more familiar with the usage of smartphones and computers than anticipated previously, most of them have been using them for over 5 years. This leads to the assumption, that it is not enough to recruit retired or old people when a technology is to be checked for usability taking into account people who are not very used to technology.

Taking into account the inclusion of blind and visually impaired persons, it is vital that HIMs which are already onboard of CAVs today are equipped with more options to access or command the HMI using audio and voice activation. Furthermore, the vehicle needs to communicate with its' environment using audio cues like signal sounds to ensure the safety of visually impaired persons in the CAV surroundings. During the FDGs, participants seemed quite optimistic on the increased autonomy of mobility

CAVs could offer them in their daily lives. However, many of them were concerned about the dangerous integration of CAVs into regular traffic as well as ethical concerns when it comes to the decision making of a fully autonomous vehicle.

8 Conclusions

While conducting the surveys and analysing the first responses from pilot 5 in March, it became clear that the terminology of a "CAV" is not easily understood or simple to grasp by the general public. Even after several attempts to explain the different characteristics of a connected or and automated vehicle, participants did not relate the concept to real-life services, tools or experiences they have had before the pilot execution. It became therefore necessary to replace the general concept of a CAV with simple and relatable everyday examples to receive exploitable answers, for example by concretely naming services like *Google Maps* [44]or *Waze*[45].

Secondly, when conducting pilots of this kind, it is of great importance to apply dynamic planning, which adapts to different user types and seasons. Especially the involvement of vulnerable travellers in two pilots profited from this approach, but also the rest of the pilots due to unexpected delays because of the COVID-19 pandemic during the execution of these pilots.

The FESTA methodology has proven to be very effective in planning pilots involving novel technologies and different user groups – the iterative waves allowed for modifications in between each wave and across the entire Work Package.

Apart from the topic-related conclusions of each pilot within its' own sub-chapter, it can be said that the piloting of all 5 solutions brought to light either statistically significant quantitative results and/or qualitative insights of great importance. The validation of all different kinds of advanced CAV technologies under real-world conditions is much needed.

From 319 persons across all pilots, 178 (56%) reported being positively surprised by the technologies and 112 (35%) said it was the experience they had anticipated prior to the pilot. Only 28 participants of the entire WP6 said they were either unsure or negatively surprised by the technologies they had tested (9%), see Figure 138. This feedback proves to our consortium, that the wider uptake of CAV technologies is welcomed by the vast majority of the population across different countries, age groups, gender, occupation and mobility habits. The piloting itself served as a great dissemination platform by allowing participants to experience higher levels of automation and connectivity in a safe and assisted manner.

[44] https://www.google.com/maps
[45] https://www.waze.com/es

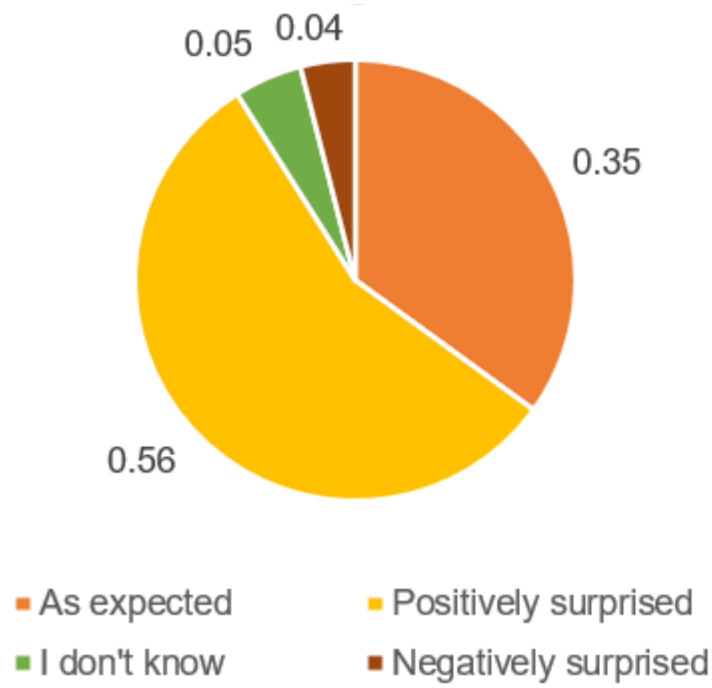

Figure 138 - Expectations vs. real experience (all pilots)

Future avenues for additional research include the following:

- Acceptance of CAVs under specific conditions (at night, in the presence of especially vulnerable passengers such as children with parents, during snow storm, alone vs. in a group);
- Training methodology with a group of driving learners and implementation with a larger real-world sample over a longer period of time (e.g., in several driving schools over the period of 2 years);
- Acceptance of autonomous vehicles by vulnerable and disabled user groups and the additional autonomy of mobility achievable;
- Wider integration of CAV level 2-3 into public car sharing fleets & need for training;
- Potential of connected transport for additional vulnerable user groups (e.g., persons affected by hearing loss, children, persons with intellectual disabilities).

9 References

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Annex I: GDPR form

This annex contains the form shown to the users before they completed the survey to inform the how their data is being processed according to the GDPR regulation.

PAsCAL

Enhance driver behaviour and Public Acceptance of Connected and Autonomous vehicLes

PAsCAL Pilot 5
(EU's H2020 Research & Innovation Programme – Grant Agreement nº 815098)
Agreement for Research Participants - Individuals

Pilot place: Italy

Pilot period: June and July 2021

Responsibilities of Research Participant:

- Assisting the FOT team in collecting user data;
- Attending and following an introduction meeting on CAVs, the PAsCAL project and the Apertum application;
- Actively participating in the Focus Discussion Group discussions;
- Giving feedback regarding user needs;
- Appearing in photo and video footage for pilot dissemination;

I accept to cooperate with PAsCAL project under the above-mentioned conditions.

I understand that signed consent forms, questionnaire responses and video recordings are securely stored in the PAsCAL database until the completion of the research project, after which this data shall be deleted. I am in the understanding that the PAsCAL Consortium is not transferring these data to any third party without my formal authorisation.

Participant name: Date & Place:

Signature:

Signature FOT Team
(on behalf of the PAsCAL Consortium):

etelätär

1

Also, in the Figures below the digital version can be found. This was shown to the participants before they started filling the survey. It includes also space to be completed with their information and signature.

GDPR.

PAsCAL Pilot 5

(EU's H2020 Research & Innovation Programme – Grant Agreement nº 815098)

Agreement for Research Participants - Individuals

Responsibilities of Research Participant:

- Assisting the FOT team in collecting user experience data;
- Attending and following an introduction meeting on CAVs, the PAsCAL project and the Apertum application;
- Actively participating in the usage of the Apertum platform;
- Giving feedback regarding user needs and product features;
- Appearing in photo and video footage for pilot dissemination;
- Becoming an active user during the pilot.

Reward structure:

- Amazon gift card for the user's participation;
- Refreshments in form of drinks and snacks on-site;
- Participation certificate.

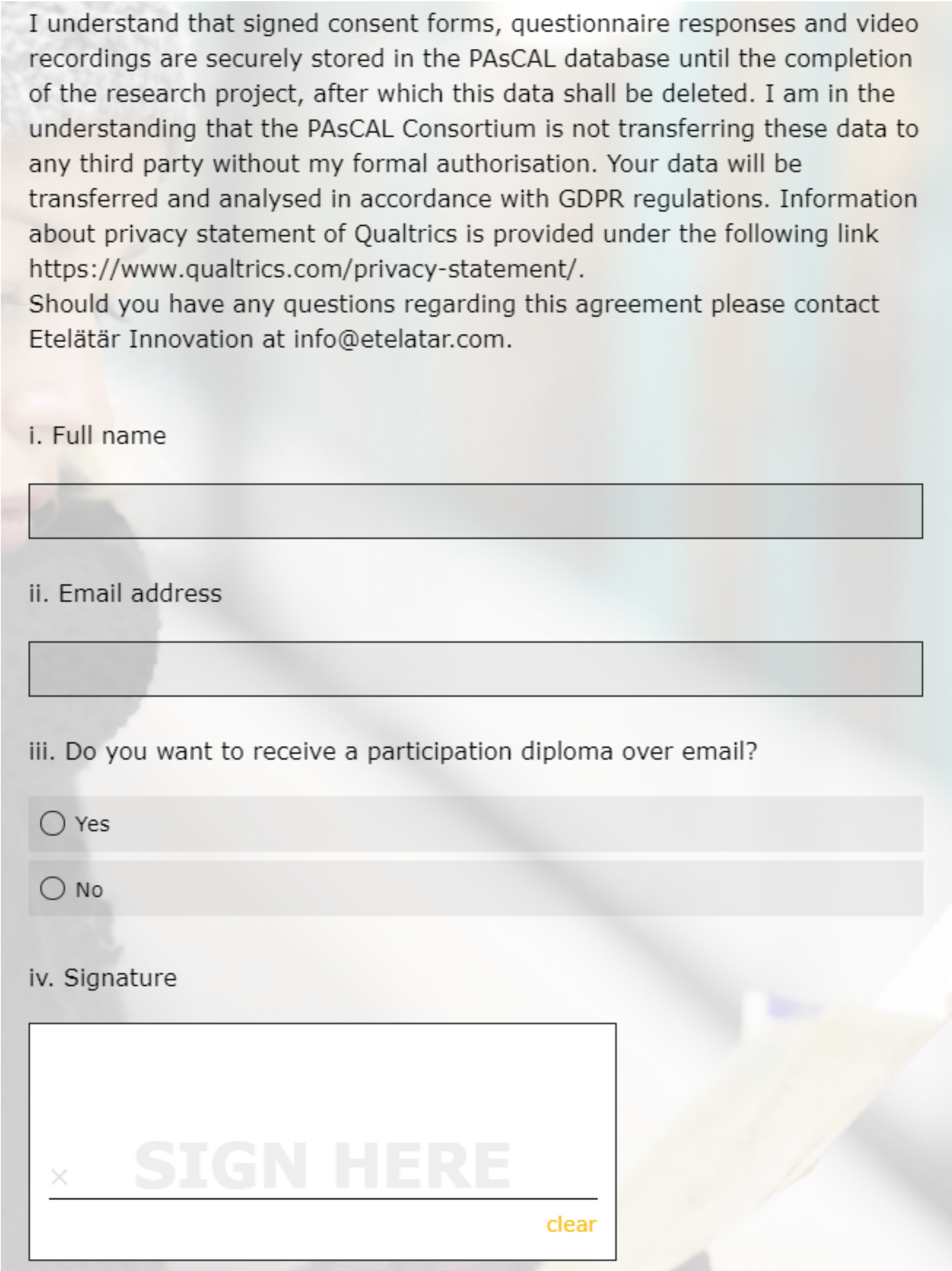
Term definitions:

Active user:

- User has downloaded the Apertum app or is able to access the www.apertum.world web-application;
- User searched for at least 3 stations and routes during the pilot;
- User fits one or more target group criteria (reduced mobility).

I accept to cooperate with PAsCAL project under the above-mentioned conditions.

Figure 139 - Pilot 5, Field testing: Digital GDPR form part 1


I understand that signed consent forms, questionnaire responses and video recordings are securely stored in the PAsCAL database until the completion of the research project, after which this data shall be deleted. I am in the understanding that the PAsCAL Consortium is not transferring these data to any third party without my formal authorisation. Your data will be transferred and analysed in accordance with GDPR regulations. Information about privacy statement of Qualtrics is provided under the following link https://www.qualtrics.com/privacy-statement/.
Should you have any questions regarding this agreement please contact Etelätär Innovation at info@etelatar.com.

i. Full name

ii. Email address

iii. Do you want to receive a participation diploma over email?

Yes

No

iv. Signature

×

SIGN HERE

clear

Figure 140 - Pilot 5, Field testing: Digital GDPR form part 2

Annex II: Incidence Report Forms

During each batch in the pilot executions, a Pilot reporting form was filled by members of the staff containing the conditions and external factors in which the pilot was performed in order to use all this information in WP7 when performing the in-depth analysis.

This form includes information regarding:

- Pilot Wave and Batch numbers
- Incidents related to the pilot (e.g., the vehicle had issues ...)
- Incidents unrelated the pilot (e.g., police...)
- Weather conditions (if the pilot is performed outside)
- Number of tester users in the wave
- Additional comments
- Date and time of the beginning and end of the pilot

Timestamp	Pilot name	Batch number	Wave number	Incidents related to the pilot, (e.g. the vehicle had issues ...)	Incidents unrelated the pilot, (e.g. police, construction works...)	Weather conditions (if the pilot is performed outside)	Number of tester users	Additional comments	Time of the beginning of the pilot.	Start date	End time of the pilot	End Date
3/15/2021 13:52:23	Pilot5 Experience of vulnerable travellers with connected transport environment	1	1	Following the introduction, the participants still asked a considerable number of questions to the Etelätär staff, especially concerning the trajectory of the trip. One participant in particular pointed out that the application selected "Goya" district instead of "Goya" metro station by default, which he found confusing. The participants critisised the installation process, which was describes as tedious and complicated, as	The capacity of the station was at medium capacity.	Very sunny, participants had to seek shadow to fill out the questionnaire and use the application.	4		10:50:00 AM	15/03/2021	11:55:00 AM	15/03/2021

				the apertum app requires the crosswalk application to be installed as well. The participants did not like that the qualtrics interface auto-advanced the questions one they had been answered and did not understand clearly the different types of CAVs available. The dicussion group left in general some organisational questions open and did not focus enough of the concrete pilot execution.								
3/15/2021 14:05:59	Pilot5 Experience of vulnerable travellers with connecte	2	1	Following the introduction, the participants still asked a few questions to the Etelätär staff, especially concerning the	One participant	Very sunny, participants had to seek shadow to fill out the questionn	5	One participant suggested to add the bus and metro timetables inside the	12:05:00 PM	15/03/2021	12:50:00 PM	15/03/2021

	d transport environment			accessibility information displayed for each station. The participants did not like that the qualtrics interface auto-advanced the questions once they had been answered, the small size of the font and did not understand clearly the different types of CAVs available. Furthermore, they found the turtorial within the apertum application non-intuitive and had trouble navigating the app without help. Finally, they did not like that it is obligatory to select a proposed address when a user has		aire and use the application.		app for easy & quick access.				

				manually entered the full address before. The dicussion group left in general some organisational questions open and did not focus enough of the concrete pilot execution. One of the questions in the questionnaire had not been translated properly and did not follow the order of the questionnaire. Finally, the group found it very difficult to open the questionnaire using a QR code. One of the users could not install the application as he did not know the password to his apple id account, instead he used the									

				webapp using a browser.								
3/15/2021 17:39:23	Pilot5 Experience of vulnerable travellers with connected transport environment	3	1	There was an iPhone XS Max with iOS 14.4 that could download the app but not open it, searching for the app we. (www.apertum.world) didn't work. There was some doubts about the warning signal that appears in the app when you should walk more than your limit. Is not enough clear the information about the color ranking for the stations and the info of each station doesn't appear whan you click on it.	None	Sunny	7	None	5:05:00 PM	15/03/2021	5:35:00 PM	15/03/2021

				People don't know anything about the door for special passengers. The app is not intuitive for use it.								
3/15/2021 18:50:07	Pilot5 Experience of vulnerable travellers with connected transport environment	4	1	The app only has 1 star in App Store. They don't know if there is necessary select the exact location or if could be approximately. It's difficult to see the arrow to expand the travel agenda. The app doesn't have sound and doesn't work with the Apple reading system. How to close the searcher for the starter and final point.	None	Sunny	6	None	6:05:00 PM	15/03/2021	6:40:00 PM	15/03/2021

				The meaning of the RYG bottoms. People don't understand properly the meaning of a CAV. (Add a paragraph at the beginning of the survey about the meaning?) The question about your confidence in apertum is not enough clear. Go to your work in normal circumstances (out of Covid) Explain that BiciMAD is public transport. The info about Principe Pio station is located in the mall not in the station.								

3/16/2021 12:33:28	Pilot5 Experience of vulnerable travellers with connected transport environment	5	1	There were some questions about the contracts with public transport operators in Madrid. Questions about why is not possible to have the real time information about the elevators and accessibility of metro stations. One of the testers of the next batch arrive earlier and join the first batch and was necessary to explain again. He doesn't know what is a CAV Location in the app doesn't work properly because some of them doesn't have the permissions	Tha apertum roll-up makes easy to the testers to find us and distinguish between the two elevators. It was very sunny and make it difficult to see the screen. It was a lot of traffic during the explanation and was hard to hear properly the testers' There were works near to the used place and make the place noisy. Some of	Sunny	5	None	11:07:00 AM	16/03/2021	12:30:00 PM	16/03/2021

				allowed. A mobile phone have the location permissions allowed to the app but the location inside apertum doesn't work properly. The are some doubts about the color ranking. In one mobile phone doesn't work properly the app to search the beginning point. Finally app works properly. Samsung galaxy J7 with Android (version?) The server failed for one tester. Mismatch with architecture CPU, some	mobiles have bad internet connection.							

				mobile phones don't give the possibility to install crosswalk. They should search it by themself in play store There is an option to seach a POI, a station, etc. Not only stations. Is not clear if there is bus option or more than one option to do the route. Is not possible to select the origin by the map. Portazgo station doesn't show the accessibility characteristics if you click on it. A man leave the test earlier (before test the elevator and fill									

				the survey) and be away for a long time. There were some doubts about the most used mode of transport There are some suggestions to add the accessible places near to the area.								
3/16/2021 13:44:06	Pilot5 Experience of vulnerable travellers with connected transport environment	6	1	A Huawei P20 has some problems with app. The problem was that they had the internet data disconnected. Questions about what is a CAV. Questions about how to report incidences in the metro station. Questions about what kind of	There were some construction works near to the meeting point and was a noisy place due to high traffic & bypassing emergency vehicles. The elevator used was easy to find it by the testers	Sunny	4	None	12:17:00 PM	16/03/2021	1:15:00 PM	16/03/2021

				apps are the navigation, shares mobility etc. Issues related that is not posible to go back in the questionnaire. Doubts about the question if you would pay to use a connected mobility environment. In some situations elevators are very narrow and cause problems to turn around. The autocorrect tool should be add to the questionnaire because some people had problems to write their responses.	thanks to the roll-up. There is a step between the train and the station that make it difficult for some people to go inside the train. Main problem for the majority of the testers. They need help to go inside the train.							

3/16/2021 18:05:55	Pilot5 Experience of vulnerable travellers with connected transport environment	7	1	There are some doubts about what crosswalk is. Explain what is a CAV She fdid not know about the time of commute to go to the University Some doubts about if a university student is graduate or undergraduate Explain better abour shared mobility, navigation apps etc. Could be needed a longer explanation about that. Some people ask about how we plan to take money using this kind of app.	It was necessary to talk to the security guard to open the special door for the stroller and the crutches. In some cases it is necessary help to open the door. Probably if the suitcase is too big is also necessary to use the special door.	Sunny	14	None	5:00:00 PM	16/03/2021	5:40:00 PM	16/03/2021

				Why adds are not an option in this app. Why public organisms don't give money to this kind of apps								
3/16/2021 18:54:22	Pilot5 Experience of vulnerable travellers with connected transport environment	8	1	Questions about the crosswalk app which is necessary for Android OS Some people ask if there is anything more in the agenda of the test Questions about how is the way to take money with this app	It was necessary talk to security guards to get access to the special door.	Sunny	14	None	6:00:00 PM	16/03/2021	6:50:00 PM	16/03/2021
4/22/2021 11:33:01	Pilot5 Experience of vulnerable travellers with connected transport environment	1	2	Participant did not know that she has to tap on Origen, finds the interface non- intuitive, did not know how to enter location, change mode of transportation or mobility	heavy traffic -> noises & distraction so participants move inside the station for briefing (there noises from outside, escalator	heavy rain, wind, cold	5		10:10:00 AM	22/04/2021	11:15:00 AM	22/04/2021

				constraint. Hecho/finalisar instead of como llegar. Some of the stations which are marked as "partially or non accessible" are accessible, some data is outdated Tribunal & Ventura Rodriguez, Gregorio M. Questions concerning collaboration with metro de madrid. Tutorial in Spanish app needs to be translated. One participant refused to answer the survey at first, was frustrated.	noises). Some participants had to sit down after 20 minutes. Metro de Madrid stopped videographer from filming inside the station.							
4/22/2021 12:38:37	Pilot5 Experience of vulnerable travellers with	2	2	One participants found the navigation in web app easier, she struggeled to use the interface.	heavy traffic -> noises & distraction so participants move inside the station	heavy rain, wind, cold,	5		11:35:00 AM	22/04/2021	12:40:00 PM	22/04/2021

	connected transport environment			Pinned web app to	for briefing (there noises from outside, escalator noises). Some participants had to sit down and one person carried a cane.							
4/22/2021 17:02:28	Pilot5 Experience of vulnerable travellers with connected transport environment	3	2	live info about metro save routes touch on the maps metro bus is slower than only metro	heavy traffic -> noises & distraction so participants move inside the station for briefing (there noises from outside, escalator noises). Two pushchairs blocked the ekevator, elecator was stopped to clean it. Participants blocked the	cloudy	14		4:05:00 PM	22/04/2021	4:55:00 PM	22/04/2021

					entrance to the station and one elevator on the platform temporarily. Pass is too small for luggage & pushchairs. Design of station unintuitive. Pushchairs & luggage got stuck in the blind trsck. Elevator is "wrong way" when users come up they need to turn around. Elevators are not marked, hard to find orientation, elevators have low capacity and are slow. two							

					participants had issues because they added a spsce by accident at the end of their email address							
4/22/2021 18:08:53	Pilot5 Experience of vulnerable travellers with connected transport environment	4	2	app monetization issues with app overlay that disappeared after restarting issues with qualtrics	GSI Security interrupted the briefing and participants had to move some metres and xalled the police due to social distancing concerns . Elevators are slow, qieues form (covid). Not each metro wagon allows pushchairs inside. Changing platform takes very long time.	sunny	17		5:00:00 PM	22/04/2021	6:10:00 PM	22/04/2021

PAsCAL
Enhance driver behaviour & Public Acceptance of Connected & Autonomous vehicles

					Door for bigger luggage & pushchairs, need assistance of personal. Only one machine for people in wheelchair. Slalom to avoid crashing into other people. Noticed blind lines for the first time. One elevator is hidden. Sign posting is not correct & could be amiliorated. Travel time is much later.								
4/22/2021 19:03:15	Pilot5 Experience of vulnerable travellers	5	2	Elevators marked on Google Maps. Add lines on the map surface. Compass is out	One participant took the escalator by mistake. Only one	sunny	9		6:00:00 PM	22/04/2021	7:00:00 PM	22/04/2021	

	with connected transport environment			of control inside the station. arrow to check where you are heading marketing to create username stops remaining would be useful voice alerts integration with google survey "viajar de forma independiente"	large entrance gate, which is in a misguiding spot within the station. Elevator only on one side of the station. Which elevator goes where. Very disturbing if there is a lot of persons - capacity feature and recalculate accordingly. Locking pushchairs inside Metro. Hidden elevators. Time during which it is forbidden to tske bikes or pets - warning in application for							

					vulnerable passengers. Indoor navigation. Space between trains & station, ramp. Old doors need to be pushed open msnually in an emergency. Sometimes no personal present. Coverage inside Madrid metro system is bad. People use intuitively the largest gate (even without mobility constraints).								
4/23/2021 11:19:30	Pilot5 Experience of vulnerabl	6	2	We should include a siclaimer that it is necessary to	some metros don't have ramp or the	sunny / cloudy	5		10:05:00 AM	23/04/2021	11:15:00 AM	23/04/2021	

	e travellers with connected transport environment			install also the app crosswalk.	ramp is not working, that's why sometimes they decide to take a Cabify or a taxi. two participants do not use a wheelchair and had to sit on a bench, which is located next to a busy road (noise of traffic).								
4/23/2021 12:54:23	Pilot5 Experience of vulnerable travellers with connected transport environment	7	2	Participants with reduced hand mobility found it difficult to navigate both the app and web app. Also difficulty to complete the survey on Qualtrics. Prefer routes with modern trakns over those who might not be fully accessible	2 participants are not in a wheelchair but use crutches, therefore the group had to move to a bench next to the elevator, which was next to a busy & loud	cloudy	5		10:35:00 AM	23/04/2021	1:00:00 PM	23/04/2021	

					street. Police sirens interrupted the briefing. A person interrupted the briefing to inquire on the project. One participant prefers using the bus because there is human driver who can help and extent a ramp (even though sometimes the driver does not help them or even lies about the state of the ramp or that the bus is already occupied by a stroller or							

					similar) - while the elevators of metro station sometimes don't work. Limit of 1-2 wheelchairs or pushchairs per coach in metro, sometimes it's already occupied.							
5/13/2021 11:35:18	Pilot5 Experience of vulnerable travellers with connected transport environment	1	3	One participant's phone was not compatible with neither the Web App nor the application, model: iPhone 6, iOS 12.5.2, C38NKPCPG5MR.	One of the managers had accident on the way to the pilot. Briefing took place next to a busy road (some noise), everyone wore a mask. Several participants received phone calls during the	cloudy & windy, later sunny	6		10:10:00 AM	13/05/2021	11:25:00 AM	13/05/2021

					meeting. What is a Web App? Some participants were not familiar with downloading, installing and using application & smartphones in general.								
5/14/2021 9:59:48	Pilot5 Experience of vulnerable travellers with connected transport environment	2	3	Some participants prefer to use the Web App due to low space on their smartphones.	many participants receive assistance from their children or grandchildren to install apps and are not used to it. One person refused to install the app and/or use the web app. Some participants asked questions concerning smartphone	sunny	6		11:30:00 AM	14/05/2021	1:00:00 PM	14/05/2021	

					s unrelated to pilot.							
5/14/2021 10:01:24	Pilot5 Experience of vulnerable travellers with connected transport environment	3	3	One participant pointed out that text-to speech would also be of interest to those who need to use their hands (Luggage, Wheelchair, Crutches, etc).	One participant was late. Remarked, that there is no track for the blind, inaccessible ticket machines, no human assistance at entrance.	Sunny	11		4:05:00 PM	13/05/2021	5:00:00 PM	13/05/2021
5/14/2021 10:02:19	Pilot5 Experience of vulnerable travellers with connected transport environment	4	3	In search for metro station, when users type small or cspital first letter, a different result appears.	windy	5		5:05:00 PM	13/05/2021	5:55:00 PM	13/05/2021	
5/14/2021 10:03:09	Pilot5 Experience of vulnerable travellers with connected	5	3	Option to use current location as Start and no need to select the station from a list if user has already typed full name. Text to speech &	windy	7		6:00:00 PM	13/05/2021	7:05:00 PM	13/05/2021	

	transport environment			voice commands desired. Push tutorial the first time after installing the app to draw user's attention to it.									
5/14/2021 11:50:29	Pilot5 Experience of vulnerable travellers with connected transport environment	6	3	Remove from list of proposed locations general areas, city quarters etc. to avoid confusion.	Button on the elevator and the communicator is hard/impossible to press for persons wmith reduced hand mobility and is placed in an inconvenient spot, which is hard to access with a wheelchair, buttons on the wall would be necessary. Elevator closes very	sunny		5	Eva Muelas Clemente would like to received a physical printed copy of the participation certificate as well.	10:20:00 AM	14/05/2021	11:45:00 AM	14/05/2021

					fast. Users do not know how or where they can complain about an inaccessible station or feature at Metro de Madrid.							
5/14/2021 12:34:44	Pilot5 Experience of vulnerable travellers with connected transport environment	7	3	User points out that Tesla chargers are not marked and could be included.	sunny	4		11:45:00 AM	14/05/2021	12:30:00 PM	14/05/2021	
9/30/2021 9:32:26	Pilot 3 - Autonomous bus line	1.1	1	Problemas de cobertura que afectan al trayecto, ya que funcione mediante red móvil.	Ninguno.	Nublado	2	Los usuarios preguntan acerca de si se va a aumentar la capacidad del vehículo, así como si va a	9:17:00 AM	30/09/2021	9:32:00 AM	30/09/2021

								haber un mayor número de trayectos, al considerar los escasos. Además preguntan si hay que realizar algún pago para utilizar este servicio. En cuanto a mi percepción creo que es un gran acierto la movilidad de las ruedas delanteras y traseras en diferentes direcciones para lograr giros de mayor precisión,				

								y en cuanto a mejoras, creo que se debería añadir la opción de no detenerse en una parada en caso de que no haya gente esperando para lograr mayor rapidez, aunque el operario comenta que eso ya ha sido comentado.				
10/28/2021 16:43:28	Pilot 1 - High-capacity autonomous bus operations	1	1	Scenario without particular events	24 degrees, sunny, partially cloudy	13	E-Bus recruiting Many University students	2:00:00 PM	10/06/2021	4:00:00 PM	10/06/2021	
10/28/2021 16:46:55	Pilot 1 - High-capacity	1	2	Scenario without particular events	16 degrees, slight prior rain.	8	Luxmobility recruiting	2:00:00 PM	24/06/2021	4:00:00 PM	24/06/2021	

	autonomous bus operations				Partially cloudy.		. People were drawn in by TV screens, Igor drew attention to the tablet.				
10/28/2021 16:49:33	Pilot 1 - High-capacity autonomous bus operations	1	3	Scenario with events (unexpected stop + blocking vehicle + Doors malfunction: Igor could not enter) and no IT support	16 degrees, partially cloudy	14	LIST recruiting. Many female participants	2:00:00 PM	01/07/2021	4:00:00 PM	01/07/2021
10/28/2021 16:52:04	Pilot 1 - High-capacity autonomous bus operations	1	4	Scenario with events (unexpected stop + blocking vehicle + Doors malfunction) and IT support + video call to resolve the malfunctioning doors	16 degrees, prior rain, but dry and light cloud cover during test	11	Luxmobility recruiting	2:00:00 PM	08/07/2021	4:00:00 PM	08/07/2021
10/28/2021 16:54:05	Pilot 1 - High-capacity autonomous bus	1	5	Scenario with some events (unexpected stop) and IT support in the form of vocal	14 degrees, prior rain, but dry and light cloud cover during test	5	EBU recruiting seeing impaired people	9:00:00 AM	20/09/2021	1:00:00 PM	20/09/2021

	operations			announcements only							
11/24/2021 16:27:45	Pilot 4 - Shared connected transport	1	1	Route of the test drive changed. Instead of driving through Esch and around Belval, we instead drove on the highway from the Belval University parking lot to Steinbrücken and back. This was done to test the autonomous features more than the original route planned and because of time restrictions. Car didn't read the speed limit once or twice most likely when another vehicle obscured the cars sensors.	4	Four people tested, one was late, and the rest (7 people) cancelled. Reasons included not being aware of the testing being on Belval campus, not interested anymore, or having no time.	10:30:00 AM	08/11/2021	2:00:00 PM	08/11/2021	
11/24/2021 16:34:49	Pilot 4 - Shared connected transport	2	1		Heavy traffic around 1-2pm which	5	Out of 7 persons who registered, 4	10:30:00 AM	09/11/2021	2:00:00 PM	09/11/2021

					resulted in delays		persons particpated.					
11/24/2021 16:39:31	Pilot 4 - Shared connected transport	3	1		First participant was very nervous and almost crashed into the highway divider on the return trip. We had to take a different return route for two participants due to heavy traffic (maintenance works).	5	Three of the participants had participated in the autonomous bus pilot.	10:00:00 AM	10/11/2021	3:30:00 PM	10/11/2021	
11/24/2021 16:43:16	Pilot 4 - Shared connected transport	4	1				7	One person canceled. One particpant had issues with the automatic transmission of the car.	10:30:00 AM	11/11/2021	2:00:00 PM	11/11/2021

11/24/2021 16:53:44	Pilot 4 - Shared connected transport	5	1				5	One person made a double appointment. One person forgot about the reservation.	10:30:00 AM	12/11/2021	2:30:00 PM	12/11/2021
11/24/2021 16:56:09	Pilot 4 - Shared connected transport	6	1				6	Out of 12 persons, 6 showed up.	10:00:00 AM	15/11/2021	1:00:00 PM	15/11/2021
11/24/2021 16:59:26	Pilot 4 - Shared connected transport	7	1				4		10:00:00 AM	16/11/2021	12:00:00 PM	16/11/2021
11/24/2021 17:02:02	Pilot 4 - Shared connected transport	8	1		One particpant almost collided four times with other vehicles while driving.	2	Only two reservations that day.	11:00:00 AM	17/11/2021	12:00:00 PM	17/11/2021	
11/24/2021 17:03:48	Pilot 4 - Shared connected transport	9	1				0	Unfortunately, no particpants that day.	10:00:00 AM	18/11/2021	10:00:00 AM	18/11/2021

11/24/2021 17:07:14	Pilot 4 - Shared connected transport	10	1	Car didn´t read the lines because the roads were dirty	Very foggy	5	One person double booked and one didn´t show up.	10:00:00 AM	19/11/2021	1:30:00 PM	19/11/2021	
11/30/2021 9:32:27	Pilot 3 - Autonomous bus line	1.1	1	Un coche adelantó cambiándose de carril en el túnel, y el bus frenó un poco brusco.	5		9:15:00 AM	30/11/2021	9:30:00 AM	30/11/2021		
11/30/2021 9:48:00	Pilot 3 - Autonomous bus line	1.2	1	perdió señal varias veces			4		9:30:00 AM		9:47:00 AM	
11/30/2021 9:50:01	Pilot 3 - Autonomous bus line	1.2	1	Pérdida de cobertura	-	Soleado	4	-	9:32:00 AM	30/11/2021	9:49:00 AM	30/11/2021
11/30/2021 10:31:29	Pilot 3 - Autonomous bus line	2.1	1				6		10:15:00 AM	30/11/2021	10:30:00 AM	30/11/2021
11/30/2021 11:09:05	Pilot 3 - Autonomous bus line	2.2	1				4		10:30:00 AM		10:50:00 AM	
11/30/2021 11:44:55	Pilot 3 - Autonomous bus line	3.1	1	Pérdida de cobertura en varias ocasiones (3) con necesidad de resetear el vehículo en las	-	Soleado	4	Viaje no finalizado	11:15:00 AM	30/11/2021	11:44:00 AM	30/11/2021

				paradas (2). Necesidad del modo uso manual para mover el vehículo a zonas de no alteración del tráfico.								
12/16/2021 9:36:57	Pilot 3 - Autonomous bus line	1.1	2				4		9:15:00 AM		9:32:00 AM	
12/16/2021 9:47:58	Pilot 3 - Autonomous bus line	1.2	2	Ninguno	Dos paradas por vehículos mal aparcados	Frío y soleado	2		9:31:00 AM	16/12/2021	9:47:00 AM	16/12/2021
12/16/2021 10:31:14	Pilot 3 - Autonomous bus line	2.1	2				4		9:15:00 AM		9:28:00 AM	
12/16/2021 10:45:04	Pilot 3 - Autonomous bus line	2.2	2	Todo bien	Parada por un coche mal aparcado	Frío y soleado	2		10:30:00 AM	16/12/2021	10:45:00 AM	16/12/2021
12/16/2021 11:44:01	Pilot 2 - Autonomous driving training	3.1	2		frenada de emergencia porque han adelantado al bus quedándose cerca de este	1		9:15:00 AM		9:28:00 AM		

12/16/2021 12:34:11	Pilot 3 - Autonomous bus line	4.1	2				1		12:15:00 PM		12:32:00 PM	
12/16/2021 12:47:16	Pilot 3 - Autonomous bus line	4.2	2	Frenazo con rápida reanudación	Todo bien	Frío y soleado	2		12:30:00 PM	16/12/2021	12:47:00 PM	16/12/2021
12/16/2021 13:47:32	Pilot 3 - Autonomous bus line	5.2	2	Todo bien	Todo bien	Soleado y frío	4		1:30:00 PM	16/12/2021	1:47:00 PM	16/12/2021
12/16/2021 13:58:27	Pilot 3 - Autonomous bus line	5.1	2				2		1:15:00 PM		1:35:00 PM	
12/16/2021 15:47:08	Pilot 3 - Autonomous bus line	7.1	2				2		3:15:00 PM		3:35:00 PM	
12/16/2021 15:47:38	Pilot 3 - Autonomous bus line	6.1	2				2		2:15:00 PM		2:38:00 PM	
2/3/2022 9:31:24	Pilot 3 - Autonomous bus line	1.1	3				2		9:15:00 AM	03/02/2022	9:27:00 AM	
2/3/2022 9:46:05	Pilot 3 - Autonomous bus line	1.2	3				3		9:26:00 AM	03/02/2022	9:46:00 AM	
2/3/2022 10:35:56	Pilot 3 - Autonomous bus line	2.1	3				6		10:15:00 AM		10:28:00 AM	

2/3/2022 11:30:02	Pilot 3 - Autonomous bus line	3.1	3				2		11:15:00 AM		11:28:00 AM	
2/3/2022 12:29:36	Pilot 3 - Autonomous bus line	4.1	3				4		12:15:00 PM		12:28:00 PM	
2/3/2022 12:44:38	Pilot 3 - Autonomous bus line	4.2	3				3		12:28:00 PM	03/02/2022	12:45:00 PM	
2/3/2022 13:34:45	Pilot 3 - Autonomous bus line	5.1	3				5		1:18:00 PM		1:33:00 PM	
2/3/2022 13:56:48	Pilot 3 - Autonomous bus line	5.2	3	ha habido una parada de emergencia		6		1:33:00 PM	03/02/2022	1:55:00 PM		
2/3/2022 14:35:00	Pilot 3 - Autonomous bus line	6.1	3				2		2:17:00 PM		2:32:00 PM	
2/3/2022 14:48:42	Pilot 3 - Autonomous bus line	6.2	3				4		2:32:00 PM	03/02/2022	2:48:00 PM	
2/3/2022 15:34:04	Pilot 3 - Autonomous bus line	7.1	3				6		3:16:00 PM	03/02/2022	3:31:00 PM	
2/3/2022 15:47:35	Pilot 3 - Autonomous bus line	7.2	3				6		3:33:00 PM		3:47:00 PM	

2/4/2022 9:31:32	Pilot 3 - Autonomous bus line	8.1	3				1		9:15:00 AM		9:31:00 AM		
2/4/2022 9:47:56	Pilot 3 - Autonomous bus line	8.2	3				2		9:31:00 AM	04/02/2022	9:46:00 AM		
2/4/2022 10:31:06	Pilot 3 - Autonomous bus line	9.1	3				2		10:15:00 AM		10:30:00 AM		
2/4/2022 10:47:45	Pilot 3 - Autonomous bus line	9.2	3				2		10:31:00 AM	04/02/2022	10:48:00 AM		
2/4/2022 11:32:24	Pilot 3 - Autonomous bus line	10.1	3				1		10:15:00 AM	04/02/2022	11:32:00 AM		
2/4/2022 11:52:31	Pilot 3 - Autonomous bus line	10.2	3				2		11:32:00 AM		11:50:00 AM		
2/4/2022 12:46:57	Pilot 3 - Autonomous bus line	11.2	3				4		12:28:00 PM		12:46:00 PM		
2/4/2022 12:51:16	Pilot 3 - Autonomous bus line	11.2	3				5		12:15:00 PM	04/02/2022	12:29:00 PM		
2/4/2022 13:48:30	Pilot 3 - Autonomous bus line	11.2	3				5		1:29:00 PM	04/02/2022	1:48:00 PM		

2/4/2022 14:08:29	Pilot 3 - Autonomous bus line	12.1	3				6		1:15:00 PM		1:28:00 PM	
2/4/2022 14:35:49	Pilot 3 - Autonomous bus line	13.1	3				5		2:15:00 PM		2:30:00 PM	
2/4/2022 14:45:58	Pilot 3 - Autonomous bus line	13.2	3				4		2:31:00 PM	04/02/2022	2:46:00 PM	
2/21/2022 15:17:32	Pilot 2 - Autonomous driving training	8	4	no one	no one	day 1: windy storm; day 2: sunny; day 3: sunny; day 4: cloudy	92		8:30:00 AM	07/02/2022	4:30:00 PM	11/02/2022

Annex III: Survey Results from Pilots

Pilot 1

Q1 - Are you

Field	Choice Count
Female	27
Male	28
Other	1
Prefer not to say	1
Total	57

Q2 – Tell us your age

Field	Choice Count
18	1
20	1
21	1
22	1
24	2
26	4
27	1
29	3
30	2
32	1
33	4
34	1
36	1
37	1

38	1
39	2
40	2
42	2

Q5 - Do you have a visual impairment?

Field	Choice Count
No	50
I am blind	6
I have a visual impairment	1
I am blind and deaf	0
Total	57

Q6 - When did your visual impairment first occur?

Field	Choice Count
I was born visually impaired	6
The visual impairment occurred later in life	1
Total	7

Q7 - How would you describe your freedom of mobility?

Field	Choice Count
I can travel alone	25
I can travel alone, but I have difficulties	4
I can only travel with someone else	1
Total	30

Q8 - What kind of Connected and/or Automated Vehicle (CAV) haveyou tried?

Field	Choice Count
Navigation & routing services (GoogleMaps, Waze,...)	53
Bike-, Scooter-, Car-sharing services (ShareNow, Free2Move, Lime,...)	20
Ride-sharing (Uber, Cabify, taxi apps,...)	24
Carpooling (BlaBlaCar, Leadmee,...)	11
Connected features (next stop indicator in buses,...)	29
Driver assistance (speed limit indicator, blind spot detection, lane assist,...)	29
Adaptative cruise control (the vehicle controls the speed according to traffic)	23
Automatic steering (autonomous parking or vehicle keeping itself in lane)	19
I don't know	2
I have never tried a CAV before	3
Total	213

Q9 - Were you a passenger and/or a driver in the Connected andAutomated Vehicle (CAV)?

Field	Choice Count
A passenger	30
A driver	4
Both	20
Total	54

Q10 - Was the CAV you have tried an autonomous shuttle service?

Field	Choice Count
Yes	23
No	26
I don't know	5
Total	54

Q11 - How many times have you ever used a CAV?

Field	Choice Count
Never	9
Only once	11
Rarely	17
Occasionally	11
Systematically	6
Total	54

Q12 - How confident are you with CAVs?

Field	Choice Count
Not confident at all	1
Barely confident	10
Medium confident	27
Very confident	18
Total	56

Q13 - Do you regularly use a smartphone or a computer?

Field	Choice Count
Yes	53
No	3
Total	56

Q14 - How long have you been using it?

Field	Choice Count
I have recently started	4
From 1 to 3 years	12
From 3 to 5 years	5
More than 5 years	32
Total	53

Q15 - Do you use one or several of the following applications?

Field	Choice Count
Routing and guidance application	47
Shared mobility application	18
Public transport application	35
No, I don't	2
Total	102

Q16 - Do you have a full driving license?

Field	Choice Count
Valid for motorcycles (Type A)	4
Valid for cars (Type B)	39
Valid for both, cars and motorcycles (Types A-B)	8
Valid for trucks (Type C)	2
None	10
Total	63

Q17 - How long have you owned a full driving license?

Field	Choice Count
I don't have one	10
1-5 years	8
5-10 years	6
10-15 years	6
15+ years	26
Total	56

Q18 - What educational level do you have? Please choose thehighest educational qualification you have achieved so far.

Field	Choice Count
School finished without school leaving certificate	1
Still at school	2
Elementary or lower secondary school qualification	2
Middle School, High School or Secondary School or equivalent qualification	7
Completed apprenticeship	2
Advanced Vocational Certificate of Education, vocational baccalaureate diploma, technical diploma	1
A levels, high school diploma or other university entrance qualification	7
Polytechnic degree, university of applied sciences degree, other university degree	34
Total	56

Q19 - What is your monthly net income approximately?

Field	Choice Count
less than € 250	4
€ 250 to under € 1000	2
€ 1000 to under € 2000	3
€ 2000 to under € 3000	12
€ 3000 to under € 5000	12
€ 5000 and over	9
I do not want to answer that	14
Total	56

Q20 - Which is your current main occupation?

Field	Choice Count
Student	4
Full-time work (over 30 h a week)	35
Part-time work (30 h per week or less)	6
Currently not employed	1
Retired	8
Other	2
Total	56

Q21 - How often did you travel to work or to your place of educationprior to the COVID-19 pandemic?

Field	Choice Count
Less than once a week	1
Once a week	2
2-6 times per week	19
Everyday	22
More often than once a day	3
Total	47

Q22 - Which system did you usually use for commuting/daily transportprior to the COVID-19 pandemic?

Field	Choice Count
Public transport	23
Private vehicle (car, motorcycle, etc.)	27
Sharing services	5
Light vehicles (bicycle, electric bicycle, etc.)	8
Walking	14
None of the above	0
Total	77

Q23 - What was the average one-way distance for this trip?

Field	Choice Count
Up to 5 km	14
5-15 km	20
16-25 km	5
26+ km	8
Total	47

Q24 - How were your feelings during the "autonomous driverlessexperience"?

Field	Choice Count
Trustful	18
Insecure	5
Safe	20
Nervous	10
Curious	41
Unaffected	7
Total	101

Q25 - Was this experience as you had anticipated?

Field	Choice Count
Positively surprised	23
Negatively surprised	6
It was as I expected	25
I don't know	2
Total	56

Q26 - Was the experience comfortable compared with a conventionalbus ride?

Field	Choice Count
More comfortable	22
Less comfortable	4
No difference	26
I don't know	4
Total	56

Q27 - Which potential benefits do you see in using autonomousbuses?

Field	Choice Count
Increased safety (e.g. lower risk of accidents, less harsh manouvers)	30
Increased convenience	14
Increased punctuality	27
Better service	7
Lower price	15
Less congestion	9
Lower pollution	35
Time saving	11
None of the above	4
Total	152

Q28 - Which potential shortcomings do you see about usingautonomous buses?

Field	Choice Count
Decreased safety (e.g. higher risk of accidents, more harsh manouvers)	3
Worse service (difficulties in boarding/allighting)	16
Less information onboard	12
Loss of jobs	28
Less security	7
Higher price	8
None of the above	13
Total	87

Q29 - Could you see yourself using autonomous buses in the future?

Field	Choice Count
Certainly	27
Probably	15
Depends on how technology evolves	13
Probably not	1
Not at all	0
Total	56

Q30 - Would you let other members of your family or close circle useautonomous buses?

Field	Choice Count
Certainly	29
Probably	13
Depends on how technology evolves	12
Probably not	1
Not at all	1
Total	56

Q31 - How did you find entering/exiting the bus at the stop, compared to a conventional bus?

Field	Choice Count
Easier	8
More difficult	5
Stressing	4
No difference	39
Total	56

Q32 - Do you think that emergency situations will be more difficult tohandle without a driver?

Field	Choice Count
Yes	36
No	7
No difference	3
I don't know	10
Total	56

Q33 - Would you feel stressed without a driver whom you can ask forinformation?

Field	Choice Count
Yes	19
No	23
No difference	3
I don't know	11
Total	56

Q34 - Do you think that users of autonomous buses will be morevulnerable to robbers/pickpocketing/violent passengers?

Field	Choice Count
Yes	24
No	9
No difference	13
I don't know	10
Total	56

Q35 - Do you think that on-demand contact with the control centrefrom the bus is important?

Field	Choice Count
Yes	51
No	2
No difference	3
I don't know	0
Total	56

Q36 - How do you think autonomous buses will affect the lives ofpeople with disabilities?

Field	Choice Count
Improve them	9
May cause some problems	32
No difference	10
I don't know	3
Total	54

Q37 - Did you feel at risk when the bus started moving without avisible driver during the "autonomous driverless experience"?

Field	Choice Count
Yes	6
No	48
Total	54

Q38 - Did you feel at risk when the bus was approaching the stops?

Field	Choice Count
Yes	3
No	50
I didn't notice	1
Total	54

Q39 - Did you feel at risk when the bus performed a suddenemergency braking or obstacle avoiding manoeuvre?

Field	Choice Count
Yes	3
No	13
I didn't notice	11
Total	27

Q40 - Did you feel at risk when the bus stopped in the middle of theline?

Field	Choice Count
Yes	2
No	23
I didn't notice	7
Total	32

Q41 - Did you feel at risk when the bus stopped, but the doors did notopen as expected?

Field	Choice Count
Yes	13
No	14
I didn't notice	0
Total	27

Q42 - Did the IT solutions help increase your confidence during the"autonomous driverless experience"?

Field	Choice Count
Yes	13
No	2
I didn't notice	5
I don't know	10
Total	30

Q43 - Did the voice announcements help increase your confidence during the "autonomous driverless experience"?

Field	Choice Count
Yes	43
No	7
I didn't notice	0
I don't know	1
Total	51

Q44 - If autonomous buses were available I would use them.

Field	Choice Count
I would be willing to switch to autonomous buses.	19
I would be willing to switch to autonomous buses only if IT support was available on the bus (e.g., allowing to connect to control centre).	27
I would not like to use autonomous buses.	0
I would try to avoid autonomous buses as much as possible.	5
Total	51

Q45 - Please imagine that large sections of the population would use autonomous buses. To what degree do the following statements applyto you?

Field	Choice Count
The idea that large sections of the population use autonomous buses feels bad.	3
The idea that large sections of the population use autonomous buses feels good.	33
I think it is great if large sections of the population use autonomous buses.	21
Total	57

Q46 - Do you think autonomous buses can significantly improve citizens' everyday mobility (make public transport more attractive)?

Field	Choice Count
Yes	29
No	7
I don't know	15
Total	51

Pilot 2

Q1 - Are you

Field	Choice Count
Female	7
Male	81
Other	1
Prefer not to say	1
Total	90

Q2 - Please tell us your age

Field	Choice Count
1	2
24	2
29	2
30	2
31	1
32	2
33	3
34	2
35	2
36	1
37	3
38	5
39	6
40	11
41	5

42	7
43	6
44	9
45	3
46	4
47	1
49	2
51	1
52	1
53	1
56	1
157	1
58	3
61	1

Q3 – Which country do you currently live in?

Field	Choice Count
Italy	90
Total	90

Q4 - Which city do you currently live in?

Which city do you currently live in?
Roma
ROMA
MILANO
MONZA
MILANO

Q5 - What kind of Connected and/or Automated Vehicle (CAV) haveyou tried before?

Field	Choice Count
Navigation & routing services (GoogleMaps, Waze,...)	57
Bike-, Scooter-, Car-sharing services (ShareNow, Free2Move, Lime,...)	4
Ride-sharing (Uber, Cabify, taxi apps,...)	1
Carpooling (BlaBlaCar, Leadmee,...)	1
Connected features (next stop indicator in buses,...)	4
Driver assistance (speed limit indicator, blind spot detection, lane assist,...)	16
Adaptative cruise control (the vehicle controls the speed according to traffic)	11
Automatic steering (autonomous parking or vehicle keeping itself in lane)	9
I don't know	0
I have never tried a CAV before	8
Total	111

Q5a - Were you a passenger and/or a driver in the Connected andAutomated Vehicle (CAV)?

Field	Choice Count
A passenger	11
A driver	44
Both	27
Total	82

Q5b - How many times have you ever used a CAV?

Field	Choice Count
Never	11
Only once	16
Rarely	17
Occasionally	24
Systematically	14
Total	82

Q6 - How confident are you with CAVs?

Field	Choice Count
Not confident at all	5
Barely confident	9
Medium confident	56
Very confident	20
Total	90

Q7 - Do you regularly use a smartphone or a computer?

Field	Choice Count
Yes	88
No	2
Total	90

Q7a - In case you have answered ""yes"" to the question above, howlong have you been using it?

Field	Choice Count
I have recently started	2
From 1 to 3 years	1
From 3 to 5 years	10
More than 5 years	75
Total	88

Q7b - Do you use one or several of the following applications?

Field	Choice Count
Routing and guidance application	73
Shared mobility application	5
Public transport application	3
No, I don't	8
Total	89

Q8 – Do you have a full driving license?

Field	Choice Count
Valid for motorcycles (Type A)	4
Valid for cars (Type B)	24
Valid for both, cars and motorcycles (Types A-B)	26
Valid for trucks (Type C)	37
Total	91

Q9 – How long have you owned a full driving license?

Field	Choice Count
I don't have one	1
1-5 years	1
5-10 years	6
10-15 years	16
15+ years	66
Total	90

Q10 – What educational level do you have? Please choose the highest educational qualification you have achieved so far.

Field	Choice Count
Still at school	7
Elementary or lower secondary school qualification	1
Middle School, High School or Secondary School or equivalent qualification	3
Advanced Vocational Certificate of Education, vocational baccalaureate diploma, technical diploma	23
A level, high school diploma or other university entrance qualification	40
Polytechnic degree, university of applied sciences degree, other university degree	16
Total	90

Q11 - What is your monthly net income approximately?

Field	Choice Count
less than € 250	0
€ 250 to under € 1000	0
€ 1000 to under € 2000	6
€ 2000 to under € 3000	1
€ 3000 to under € 5000	0
€ 5000 and over	0
I do not want to answer that	83
Total	90

Q12 - Which is your current main occupation?

Field	Choice Count
Student	1
Full-time work (over 30 h a week)	73
Part-time work (30 h per week or less)	1
Currently not employed	1
Retired	1
Other	13
Total	90

Q12a - How often did you travel to work or to your place of educationprior to the COVID-19 pandemic?

Field	Choice Count
Less than once a week	12
Once a week	18
2-6 times per week	16
Everyday	33
More often than once a day	9
Total	88

Q12b - Which system did you usually use for commuting/dailytransport prior to the COVID-19 pandemic?

Field	Choice Count
Public transport	8
Private vehicle (car, motorcycle, etc.)	75
Sharing services	0
Light vehicles (bicycle, electric bicycle, etc.)	1
Walking	4
None of the above	1
Total	89

Q12c - What was the average once-way distance for this trip?

Field	Choice Count
Up to 5 km	10
5-15 km	24
16-25 km	14
26+ km	40
Total	88

Q13 – How did you feel while traveling in a CAV?

Field	Choice Count
Trustful	24
Careful	11
Insecure	3
Safe	26
Nervous	4
Curious	20
Critical	7
Unaffected	3
Total	98

Q14 – How did you feel while traveling in a CAV?

Field	Choice Count
Positively surprised	62
Negatively surprised	4
It was as I expected	17
I don't know	7
Total	90

Q15 – How well do you think that the partially-automated car performed regarding steering, acceleration and braking?

Field	Choice Count
Better than a human driver	36
Same as a human driver	16
Worse than a human driver	11
Just different	27
Total	90

Q16 – How do you describe the partially-automated car reactions?

Field	Choice Count
Very good	23
Safe	45
Neutral	12
Unpredictable	9
Dangerous	1
Total	90

Q17 - Which was your reaction to cars manouvers?

Field	Choice Count
No reaction	16
I followed the training	60
I had a different reaction	14
Total	90

Q18 - How difficult and stressful was to use a real partially-automatedcar?

Field	Choice Count
Very difficult	9
Moderately difficult	18
Not very difficult	33
Not difficult at all	29
Total	89

Q19 - Did you notice any difference in your behaviour compared to the simulation?

Field	Choice Count
No difference	51
I followed the instructions I had received during the training	28
I reacted differently	10
Total	89

Q20 – Did you notice any difference in the car behaviour compared to the simulation?

Field	Choice Count
No difference	54
Yes	21
No	14
Total	89

Q21 – Do you think that the training received improved your reactions?

Field	Choice Count
Yes	67
Partially	18
No	1
I don’t know	3
Total	89

Q22 - Do you think that the training received was adequate?

Field	Choice Count
Yes	72
Partially	9
No	4
I don't know	4
Total	89

Q23 - After this experience, would you use a partially-automated carfor your daily trips?

Field	Choice Count
Certainly	41
Probably	32
Depends on how technology evolves	11
Probably not	3
Not at all	2
Total	89

Q24 - Would you encourage your family or friends to use partially-automated cars?

Field	Choice Count
Certainly	42
Probably	33
Depends on how technology evolves	12
Probably not	1
Not at all	1
Total	89

Q25 - Would you advise others to follow a similar training?

Field	Choice Count
Yes	65
No	5
I don't know	18
Total	88

Q26 - Would you advise others to follow a similar training?

Field	Choice Count
More affordable	35
No difference	15
More expensive	25
I don’t know	13
Total	88

Q27 - If partially-automated cars were available, I would use them.

Field	Choice Count
I am willing to accept the effort to switch to partially-automated cars (e.g. special courses).	50
The switch to partially-automated cars is unacceptable.	23
I would not like to use partially-automated cars.	9
I would try to avoid partially-automated cars as much as possible.	6
Total	88

Q28 - Please imagine that large sections of the population would use partially-automated cars . To what degree do the following statementsapply to you?

Field	Choice Count
The idea that large sections of the population use partially-automated cars feels bad.	25
The idea that large sections of the population use partially-automated cars feels good.	44
I think it is great if large sections of the population use partially-automated cars.	19
Total	88

Q29 - What is the current state of legislation in Italy concerning CAVs?

Field	Choice Count
It is allowed to use cars with the highest level of autonomous driving on roads open to traffic	36
The use of cars equipped with the maximum level of autonomous driving on roads open to traffic is allowed only by test drivers in possession of a specific license	21
It is not allowed to use cars with a maximum level of autonomous driving on roads open to traffic	30
Total	87

Q30 - Which are the autonomous driving levels?

Field	Choice Count
0 to 3	38
0 to 5	36
0 to 10	13
Total	87

Pilot 3.1 Survey Bus Users

Q1 - Are you

Field	Choice Count
Female	71
Male	81
Other	1
Prefer not to say	3
Total	156

Q2 - Please tell us your age

Field	Choice Count
18	23
19	11
20	6
21	17
22	5
23	6
24	8
25	3
26	6
27	8
28	2
29	1
30	2

32	2
33	1
34	1
35	1
36	3
37	2
39	2
40	1
41	1
42	1
43	5
45	4
46	2
47	1
48	1
49	3
50	1
51	1
52	1
53	4
54	3
55	4
57	1
59	4
60	1
62	2
64	2
65	1
70	2

Q3 - What country do you currently live in?

Field	Choice Count
Spain	156
Total	156

Q4 - Which city do you currently live in?

Field	Choice Count
Madrid	156
Total	156

Q5 - What kind of Connected and/or Automated Vehicle (CAV) have youtried before?

Field	Choice Count
Navigation & routing services (GoogleMaps, Waze,...)	118
Vehicle sharing services (ShareNow, Zity, Lime, BiciMAD,...)	57
Ridesharing (Uber, Cabify, Taxi-apps,...)	112
Carpooling (BlaBlaCar, Leadmee,...)	45
Connected features (Next stop indicator in buses,...)	103
Driver assistance (Speed limit indicator, Blind spot detection, Lane assist,...)	75
I don't know	1
I have never tried a CAV before.	14
Adaptative cruise control (the vehicle controls the speed according to traffic)	45
Automatic steering (autonomous parking or vehicle keeping itself in lane)	24
Total	594

Q5a - Were you a passenger and/or a driver in the Connected andAutomated Vehicle (CAV)?

Field	Choice Count
A passenger	102
A driver	4
Both	36
Total	142

Q5b - How many times have you ever used a CAV?

Field	Choice Count
Only once	33
Rarely	24
Occasionally	52
Systematically	26
Never	7
Total	142

Q6 - How much confidence do you have in CAVs?

Field	Choice Count
No trust at all	2
Barely trusting	14
Medium trusting	95
Very trusting	45
Total	156

Q7 – What educational level do you have? Please choose the highest educational qualification you have achieved so far.

Field	Choice Count
School finished without school leaving certificate	1
Still at school	2
Elementary or lower secondary school qualification	0
Middle School, High School or Secondary School or equivalent qualification	6
Completed apprenticeship	2
Advanced Vocational Certificate of Education, vocational baccalaureate diploma, technical diploma	5
A levels, high school diploma or other university entrance qualification	40
Polytechnic degree, university of applied sciences degree, other university degree	100
Total	156

Q8 - What is your monthly net income approximately?

Field	Choice Count
less than € 250	52
€ 250 to under € 1000	11
€ 1000 to under € 2000	41
€ 2000 to under € 3000	17
€ 3000 to under € 5000	14
€ 5000 and over	3
I do not want to answer that	18
Total	156

Q9 - Which is your current main occupation?

Field	Choice Count
Student	71
Full-time work (over 30 h a week)	14
Part-time work (30 h per week or less)	67
Currently not employed	1
Retired	2
Other	1
Total	156

Q9a - How often did you travel to work or place of education prior to theCOVID-19 pandemic?

Field	Choice Count
Less than once a week	5
Once a week	1
2-6 times per week	38
Everyday	104
More often than once a day	4
Total	152

Q9b - What was the average once-way distance for this trip?

Field	Choice Count
Up to 5 km	43
5-15 km	48
16-25 km	33
26+ km	28
Total	152

Q10 - Which mode of transport do you use the most?

Field	Choice Count
Private car	50
Public transport - Bus	35
Public transport - Subway	60
Walking	8
None of the above	2
Total	155

Q11 - Do you regularly use a smartphone or a computer?

Field	Choice Count
Yes	153
No	2
Total	155

Q11a - How long have you been using it?

Field	Choice Count
I have recently started	7
From 1 to 3 years	13
From 3 to 5 years	13
More than 5 years	120
Total	153

Q11b - Do you use one or several of the following applications?

Field	Choice Count
Routing and guidance application	138
Shared mobility application	45
Public transport application	119
No, I don't	2
Total	304

Q12 – In a typical month, how often do you use public transport?

Field	Choice Count
Less than once a week	45
Once or twice a week	22
Daily	70
Never	18
Total	155

Q13 – How did you feel while traveling in a CAV?

Field	Choice Count
Trustful	68
Careful	44
Insecure	2
Safe	45
Nervous	7
Curious	96
Critical	19
Unaffected	9
Total	290

Q14 – Was using a CAV the experience you had anticipated?

Field	Choice Count
Positively surprised	82
Negatively surprised	5
It was as I expected	63
I don’t know	4
Total	154

Q15 - Do you think this kind of vehicle is safe to use for vulnerable users? (wheelchair users, visually impaired persons, the elderly, injuredpersons)

Field	Choice Count
Yes	100
No	9
It does not make a difference	22
I don't know	23
Total	154

Q16 - Have you witnessed that the autonomous bus shuttle you have just tried influences the traffic conditions of the surrounding road users?

Field	Choice Count
Yes, it influenced public transport	38
Yes, it influenced other cars	91
Yes, it influenced pedestrians	28
Yes, it influenced cyclists	6
I have not witnessed any influence on the traffic conditions	48
Total	211

Q16a - What kind of influence have you witnessed?

Field	Choice Count
Increased traffic congestion (more traffic jams, bottlenecks, queues)	57
Decreased traffic congestion (less traffic jams, bottlenecks, queues)	3
Increased safety conditions on the road (lowered risk of collision, safer overtaking, less risky manoevres, etc.)	32
Decreased safety conditions on the road (higher risk of collision, dangerous overtaking, risky manoevres, etc.)	17
Increased degree of road anger and/or anxiety in other road users	35
Decreased degree of road anger and/or anxiety in other road users	4
Other road users do not respect the corridor defined for the autonomous shuttle	36
Other road users respect the corridor defined for the autonomous shuttle	24
Increased availability of parking spaces	9
Decreased availability of parking spaces	8
Total	225

Q17 - Would you let other members of your family or close circle use anautonomous shuttle service?

Field	Choice Count
Certainly	101
Probably	37
Depends on how technology evolves	16
Probably not	0
Not at all	0
Total	154

Q18 - Do you think that information inside the autonomous shuttle issufficient for your usual trips?

Field	Choice Count
Yes	126
No	17
It does not make a difference	11
Total	154

Q18a - What additional information should ideally be available onboard the autonomous shuttle?

What addtional information should ideally be available onboard the autonomous shuttle?
Visualisation of the route on a map

Q19 - Are you missing any features onboard the autonomous shuttle?

Field	Choice Count
Yes	27
No	107
I don't know	19
Total	153

Q19a - Which features in particular are you missing?

Field	Choice Count
Seatbelts	0
Radio / Music	11
Information	15
Alarms	4
Other (Please specify):	15
Total	45

Q20 - Do you believe that CAVs can lower emissions and contribute tomaking transport networks more sustainable?

Field	Choice Count
Yes	137
No	1
It does not make a difference	6
I don't know	7
Total	151

Q21 - Would you pay for using an autonomous shuttle service?

Field	Choice Count
I would not pay for this kind of service	25
Yes, I would be willing to pay a seperate fee	21
Yes, if the fee was included in my monthly ticket (public transport pass)	106
Total	152

Q22 - Do you believe that the transport system as a whole can beimproved by the integration of such kind of autonomous shuttle services?

Field	Choice Count
Yes	124
No	4
It does not make a difference	6
I don't know	18
Total	152

Q23 - If the autonomous shuttle were available to me, I would use it.

Field	Choice Count
I am willing to accept the effort to switch to autonomous shuttles (e.g. special courses).	138
The switch to autonomous shuttles is unacceptable.	6
I would not like to use autonomous shuttles.	3
I would try to avoid autonomous shuttles as much as possible.	9
Total	156

Q24 - Please imagine that large sections of the population would use theautonomous shuttle. To what degree do the following statements apply to you?

Field	Choice Count
The idea that large sections of the population use autonomous shuttles feels bad.	2
The idea that large sections of the population use autonomous shuttles feels good.	97
I think it is great if large sections of the population use autonomous shuttles.	71
Total	170

Q25 - Do you have any additional comments or suggestions?

Do you have any additional comments or suggestions?
The bus is slow and inefficient. More frequent, two-way routes would be nice.
Too slow, too little frequency and a few more lines to shorten the duration.
When a car is badly parked, the bus should be able to go around it.

Pilot 3.2 Road Co-Users

Q1 - Are you

Field	Choice Count
Female	27
Male	25
Other	1
Prefer not to say	0
Total	53

Q2 – Please tell us your age.

Field	Choice Count
18	11
19	6
20	4
21	11
22	4
23	4
24	2
25	1
26	1
27	1
28	4
29	2
34	1
87	1

Q3 – Which country do you currently live in?

Spain	53

Q4 - Which city do you currently live in?

Madrid	53

Q5 - What kind of Connected and/or Automated Vehicle (CAV) have youtried before?

Field	Choice Count
Navigation & routing services (GoogleMaps, Waze,...)	36
Vehicle sharing services (ShareNow, Zity, Lime, BiciMAD,...)	21
Ridesharing (Uber, Cabify, Taxi-apps,...)	44
Carpooling (BlaBlaCar, Leadmee,...)	19
Connected features (Next stop indicator in buses,...)	36
Driver assistance (Speed limit indicator, Blind spot detection, Lane assist,...)	19
I don't know	2
I have never tried a CAV before.	2
Adaptative cruise control (the vehicle controls the speed according to traffic)	5
Automatic steering (autonomous parking or vehicle keeping itself in lane)	4
Total	188

Q5a - Were you a passenger and/or a driver in the Connected andAutomated Vehicle (CAV)?

Field	Choice Count
A passenger	33
A driver	1
Both	16
Total	50

Q5b - How many times have you ever used a CAV?

Field	Choice Count
Only once	2
Rarely	17
Occasionally	21
Systematically	10
Total	50

Q5b - How much confidence do you have in CAVs?

Field	Choice Count
No trust at all	0
Barely trusting	6
Medium trusting	30
Very trusting	16
Total	52

Q7 – What educational level do you have? Please choose the highest educational qualification you have achieved so far.

Field	Choice Count
School finished without school leaving certificate	0
Still at school	0
Elementary or lower secondary school qualification	1
Middle School, High School or Secondary School or equivalent qualification	0
Completed apprenticeship	0
Advanced Vocational Certificate of Education, vocational baccalaureate diploma, technical diploma	3
A levels, high school diploma or other university entrance qualification	22
Polytechnic degree, university of applied sciences degree, other university degree	26
Total	52

Q8 - What is your monthly net income approximately?

Field	Choice Count
less than € 250	32
€ 250 to under € 1000	4
€ 1000 to under € 2000	11
€ 2000 to under € 3000	1
€ 3000 to under € 5000	0
€ 5000 and over	0
I do not want to answer that	4
Total	52

Q9 - Which is your current main occupation?

Field	Choice Count
Student	38
Full-time work (over 30 h a week)	5
Part-time work (30 h per week or less)	8
Currently not employed	0
Retired	1
Other	0
Total	52

Q9a - How often did you travel to work or place of education prior to theCOVID-19 pandemic?

Field	Choice Count
Less than once a week	3
Once a week	2
2-6 times per week	10
Everyday	31
More often than once a day	5
Total	51

Q9b - What was the average once-way distance for this trip?

Field	Choice Count
Up to 5 km	13
5-15 km	24
16-25 km	5
26+ km	9
Total	51

Q10 - Which mode of transport do you use the most?

Field	Choice Count
Private car	11
Public transport - Bus	9
Public transport - Subway	31
Walking	1
None of the above	0
Total	52

Q11 - Do you regularly use a smartphone or a computer?

Field	Choice Count
Yes	52
No	0
Total	52

Q11a - How long have you been using it?

Field	Choice Count
I have recently started	9
From 1 to 3 years	14
From 3 to 5 years	11
More than 5 years	18
Total	52

Q11b - Do you use one or several of the following applications?

Field	Choice Count
Routing and guidance application	43
Shared mobility application	15
Public transport application	47
No, I don't	0
Total	105

Q12 - In a typical month, how often do you use public transport?

Field	Choice Count
Less than once a week	6
Once or twice a week	7
Daily	22
Never	17
Total	52

Q13 - Would you let other members of your family or close circle useautonomous shuttle services?

Field	Choice Count
Certainly	26
Probably	16
Depends on how technology evolves	7
Probably not	2
Not at all	0
Total	51

Q14 - Have you noticed a different behaviour in traffic flows around theUniversidad Autónoma area in the last few months?

Field	Choice Count
Yes, there is less traffic	3
Yes, there is more traffic	9
No	25
I don't know	14
Total	51

Q15 - Have you witnessed that the autonomous bus shuttle influences the traffic conditions of the surrounding road users?

Field	Choice Count
Yes, it influenced public transport	4
Yes, it influenced other cars	17
Yes, it influenced pedestrians	9
Yes, it influenced cyclists	3
I have not witnessed any influence on the traffic conditions	25
Total	58

Q15a - What kind of influence have you witnessed?

Field	Choice Count
Increased traffic congestion (more traffic jams, bottlenecks, queues)	10
Decreased traffic congestion (less traffic jams, bottlenecks, queues)	5
Increased safety conditions on the road (lowered risk of collision, safer overtaking, less risky manoevres, etc.)	8
Decreased safety conditions on the road (higher risk of collision, dangerous overtaking, risky manoevres, etc.)	1
Increased degree of road anger and/or anxiety in other road users	7
Decreased degree of road anger and/or anxiety in other road users	3
Other road users do not respect the corridor defined for the autonomous shuttle	3
Other road users respect the corridor defined for the autonomous shuttle	7
Increased availability of parking spaces	3
Decreased availability of parking spaces	3
Total	50

Q15b - Do you believe that an autonomous shuttle service sharing theroad with you is dangerous?

Field	Choice Count
Yes	4
No	39
I don't know	8
Total	51

Q16 - Would you feel comfortable sharing the road with an autonomousshuttle service?

Field	Choice Count
Yes, in all traffic conditions	13
Yes, in low traffic areas	18
Yes, if the CAV has a dedicated lane	10
Yes, if the CAV drives slowly (<20 km/h)	5
No	2
I don't know	3
Total	51

Q17 - Do you believe that the transport system as a whole can beimproved by the integration of autonomous shuttle services?

Field	Choice Count
Yes	39
No	1
It does not make a difference	6
I don't know	5
Total	51

Q18 - If the autonomous shuttle service were available to me, I woulduse it.

Field	Choice Count
I am willing to accept the effort to switch to autonomous shuttles (e.g. special courses).	43
The switch to autonomous shuttles is unacceptable.	4
I would not like to use autonomous shuttles.	4
I would try to avoid autonomous shuttles as much as possible.	0
Total	51

Q19 - Please imagine that large sections of the population would useautonomous shuttle services. To what degree do the following statements apply to you?

Field	Choice Count
The idea that large sections of the population use autonomous shuttles feels bad.	4
The idea that large sections of the population use autonomous shuttles feels good.	32
I think it is great if large sections of the population use autonomous shuttles.	15
Total	51

Pilot 4

Q1 - Are you

Field	Choice Count
Female	34
Male	66
Other	1
Prefer not to say	1
Total	102

Q2 - Please tell us your age

Field	Choice Count
22	1
23	1
24	2
25	8
26	7
27	7
28	4
29	7
30	12
31	4
32	3
34	5
35	3

36	3
37	2
38	4
39	2
40	3
41	2
42	2
43	2
44	2
45	1
46	3
47	2
48	1
49	1
50	1
51	2
54	2
56	1
57	1
67	1

Q3 - What country do you currently live in?

What country do you currently live in?
Luxembourg
Deutschland
France

Q4 - Which city do you currently live in?

Which city do you currently live in?
Grevenmacher
Bitburg
Villerupt
Belvaux
Niederanven

Q5 - What kind of Connected and/or Automated Vehicle (CAV) have youtried before?

Field	Choice Count
Navigation & routing services (GoogleMaps, Waze,...)	77
Bike-, Scooter-, Car-sharing services (ShareNow, Free2Move, Lime,...)	47
Ride-sharing (Uber, Cabify, taxi apps,...)	51
Carpooling (BlaBlaCar, Leadmee,...)	41
Connected features (next stop indicator in buses,...)	49
Driver assistance (speed limit indicator, blind spot detection, lane assist,...)	61
Adaptative cruise control (the vehicle controls the speed according to traffic)	56
Automatic steering (autonomous parking or vehicle keeping itself in lane)	36
I don't know	1
I have never tried a CAV before	9
Total	428

Q5a - Were you a passenger or/and a driver in the Connected andAutomated Vehicle (CAV)?

Field	Choice Count
A passenger	25
A driver	44
Both	28
Total	97

Q5b - How many times have you ever used a CAV?

Field	Choice Count
Never	14
Only once	31
Rarely	24
Occasionally	15
Systematically	9
Total	93

Q6 – How confident are you with CAVs?

Field	Choice Count
Not confident at all	3
Barely confident	16
Medium confident	48
Very confident	35
Total	102

Q7 – Do you have a full driving license?

Field	Choice Count
Valid for motorcycles (Type A)	6
Valid for cars (Type B)	79
Valid for both, cars and motorcycles (Types A-B)	26
Valid for trucks (Type C)	4
None	0
Total	115

Q8 – How long have you owned a full driving license?

Field	Choice Count
I don’t have one	0
1-5 years	15
5-10 years	23
10-15 years	27
15+ years	37
Total	102

Q9 - What educational level do you have? Please choose the highest educational qualification you have achieved so far.

Field	Choice Count
School finished without school leaving certificate	0
Still at school	2
Elementary or lower secondary school qualification	0
Middle School, High School or Secondary School or equivalent qualification	2
Completed apprenticeship	2
Advanced Vocational Certificate of Education, vocational baccalaureate diploma, technical diploma	5
A levels, high school diploma or other university entrance qualification	8
Polytechnic degree, university of applied sciences degree, other university degree	83
Total	102

Q10 - What is your monthly net income approximately?

Field	Choice Count
less than € 250	0
€ 250 to under € 1000	2
€ 1000 to under € 2000	1
€ 2000 to under € 3000	38
€ 3000 to under € 5000	27
€ 5000 and over	10
I do not want to answer that	23
Total	101

Q11 - Which is your current main occupation?

Field	Choice Count
Student	9
Full-time work (over 30 h a week)	88
Part-time work (30 h per week or less)	0
Currently not employed	0
Retired	2
Other	2
Total	101

Q11a - How often did you travel to work or to your place of educationprior to the COVID-19 pandemic?

Field	Choice Count
Less than once a week	3
Once a week	2
2-6 times per week	42
Everyday	50
More often than once a day	2
Total	99

Q11b - What was the average once-way distance for this trip?

Field	Choice Count
Up to 5 km	18
5-15 km	25
16-25 km	29
26+ km	27
Total	99

Q12 - Do you regularly use a smartphone or a computer?

Field	Choice Count
Yes	100
No	1
Total	101

Q12a - In case you have answered "yes" to the question above, howlong have you been using it?

Field	Choice Count
I have recently started	1
From 1 to 3 years	9
From 3 to 5 years	2
More than 5 years	88
Total	100

Q12b - Do you use one or several of the following applications?

Field	Choice Count
Routing and guidance application	93
Shared mobility application	44
Public transport application	72
No, I don't	3
Total	212

Q13 - Which type of shared connected vehicle did you try?

Which type of shared connected vehicle did you try?Tesla
Tesla
Audi Etron
Mercedes ECQ

Q14 - Which was the level of automation of the vehicle?

Field	Choice Count
I don’t know	13
Driver assistance (navigator, speed limit indicator, blind spot detection)	25
Partial automation: the car was able to brake/accelerate OR change direction, but not both things at the time (adaptative cruise control, lane assistance)	43
The car could accelerate/brake AND change direction at the same time (auto-pilot)	46
Total	127

15 - How did you feel while traveling in a CAV?

Field	Choice Count
Trustful	39
Careful	61
Insecure	11
Safe	30
Nervous	19
Curious	56
Critical	9
Unaffected	1
Total	226

Q16 – Was using a CAV the experience you had anticipated?

Field	Choice Count
Positively surprised	58
Negatively surprised	5
It was as I expected	33
I don’t know	5
Total	101

Q17 – Was using a CAV the experience you had anticipated?

Field	Choice Count
More comfortable	59
Less comfortable	10
No different	28
I don’t know	4
Total	101

Q18 – How well do you think that the self-driving car performed regarding steering, acceleration, brake?

Field	Choice Count
Better than a human driver	18
Same as a human driver	33
Worse than a human driver	21
Just different	29
Total	101

Q19 – How do you describe the self-driving car reactions?

Field	Choice Count
Very good	30
Safe	45
Neutral	29
Unpredictable	14
Dangerous	2
Total	120

Q20 - Which was your reaction to the car manouvers?

Field	Choice Count
I was totally confident	15
I watched carefully but let the car take control	77
I took back the control	9
Total	101

Q21 - How difficult did you find it to book and access the sharedconnected vehicle?

Field	Choice Count
Very difficult	0
Moderately difficult	2
Not very difficult	34
Not difficult at all	65
Total	101

Q22 - How difficult and stressful was to use the shared connected vehicle?

Field	Choice Count
Very difficult	1
Moderately difficult	12
Not very difficult	43
Not difficult at all	45
Total	1

Q23 - How difficult and stressful was to return the shared connectedvehicle?

Field	Choice Count
Very difficult	1
Moderately difficult	5
Not very difficult	35
Not difficult at all	60
Total	101

Q24 - After this experience, would you use a shared connected vehicle foryour daily trips?

Field	Choice Count
Yes	50
No	9
Depends on how technology evolves	34
I don't know	8
Total	101

Q25 - Would you encourage your family or friends to use sharedconnected vehicles?

Field	Choice Count
Yes	60
No	6
Depends on how technology evolves	32
I don't know	3
Total	101

Q26 - Would you pay a higher price for a shared vehicle with autonomousfeatures?

Field	Choice Count
Yes	24
No	33
Depends on how technology evolves	33
I don't know	11
Total	101

Q27 - Which potential benefits do you see in using a shared fleet composed of CAVs?

Field	Choice Count
Increased safety	62
Increased punctuality	40
Better service	26
Lower price	34
Less congestion	27
Lower pollution	50
Time savings	42
None of the above	11
Other (please specify):	9
Total	301

Q28 - Which potential shortcomings do you see about using a shared fleetcomposed of CAVs?

Field	Choice Count
Decrased safety	21
Worse service	4
Less information onboard	4
Loss of jobs	16
Less security	21
Higher price	65
None of the above	14
Other (please specify):	6
Total	151

Q29 - If a shared fleet composed of CAVs were available, I would usethem.

Field	Choice Count
I am willing to accept the effort to switch to a shared fleet composed of CAVs (e.g. special courses).	86
The switch to a shared fleet composed of CAVs is unacceptable.	0
I would not like to use a shared fleet composed of CAVs .	11
I would try to avoid a shared fleet composed of CAVs as much as possible.	4
Total	101

Q30 - Please imagine that large sections of the population would use shared fleets of CAVs. To what degree do the following statements apply to you?

Field	Choice Count
The idea that large sections of the population use a shared fleet composed of CAVs feels bad.	13
The idea that large sections of the population use a shared fleet composed of CAVs feels good.	58
I think it is great if large sections of the population use a shared fleet composed of CAVs.	36
Total	107

Pilot 5.1 Field Testing

Q1 - Are you

Field	Choice Count
Female	93
Male	72
Other	0
Prefer not to say	0
Total	165

Q2 - Please tell us your age

Field	Choice Count
17	4
18	25
19	13
20	8
21	13
22	11
23	9
24	8
25	2
27	1
29	1
30	1
32	2

33	3
34	1
35	2
36	3
37	1
41	1
43	1
44	2
45	2
46	1
47	1
48	1
49	3
50	1
51	1
52	2
53	1
54	2
57	1
58	2
60	1
61	1
64	1
66	1
69	2
70	1
71	1
72	2
73	2
74	3
75	1
76	3

78	4
80	4
81	3
82	1
84	1
87	1
88	2

Q3 - What country do you currently live in?

Field	Choice Count
Spain	156
Total	156

Q4 - Which city do you currently live in?

Field	Choice Count
Madrid	156
Total	156

Q5 - Were you a passenger and/or a driver in the Connected andAutomated Vehicle (CAV)?

Field	Choice Count
A passenger	91
A driver	26
Both	13
Total	130

Q5a - What kind of Connected and/or Automated Vehicle (CAV) have youtried before?

Field	Choice Count
Navigation & routing services (GoogleMaps, Waze,...)	87
Vehicle sharing services (ShareNow, Zity, Lime, BiciMAD,...)	29
Ridesharing (Uber, Cabify, Taxi-apps,...)	67
Carpooling (BlaBlaCar, Leadmee,...)	21
Connected features (Next stop indicator in buses,...)	54
Driver assistance (Speed limit indicator, Blind spot detection, Lane assist,...)	24
I don't know	0
I have never tried a CAV before.	7
Adaptative cruise control (the vehicle controls the speed according to traffic)	14
Automatic steering (autonomous parking or vehicle keeping itself in lane)	10
Total	313

Q5b - How many times have you ever used a CAV?

Field	Choice Count
Only once	17
Rarely	36
Occasionally	47
Systematically	30
Total	130

Q6 - How much do you trust CAVs?

Field	Choice Count
No trust at all	7
Barely trusting	11
Medium trusting	91
Very trusting	56
Total	165

Q7 – What educational level do you have? Please choose the highest educational qualification you have achieved so far.

Field	Choice Count
School finished without school leaving certificate	3
Still at school	0
Elementary or lower secondary school qualification	8
Middle School, High School or Secondary School or equivalent qualification	10
Completed apprenticeship	2
Advanced Vocational Certificate of Education, vocational baccalaureate diploma, technical diploma	14
A levels, high school diploma or other university entrance qualification	42
Polytechnic degree, university of applied sciences degree, other university degree	86
Total	165

Q8 - What is your monthly net income approximately?

Field	Choice Count
less than € 250	45
€ 250 to under € 1000	39
€ 1000 to under € 2000	31
€ 2000 to under € 3000	10
€ 3000 to under € 5000	3
€ 5000 and over	1
I do not want to answer that	36
Total	165

Q9 - Which is your current main occupation?

Field	Choice Count
Student	86
Full-time work (over 30 h a week)	8
Part-time work (30 h per week or less)	17
Currently not employed	3
Retired	42
Other	9
Total	165

Q9a - How often do you travel to work or place of education

Field	Choice Count
Less than once a week	15
Once a week	8
2-6 times per week	37
Everyday	54
More often than once a day	6
Total	120

Q9b - What is the average once-way distance for this trip?

Field	Choice Count
Up to 5 km	40
5-15 km	31
16-25 km	16
26+ km	33
Total	120

Q10 - What distance do you feel safe to travel on your own?

Field	Choice Count
<1 km	9
1-3 km	10
3-7 km	11
>7 km	135
Total	165

Q11 - Which mode of transport do you use the most?

Field	Choice Count
Private car	49
Public transport - Bus	63
Public transport - Subway	39
Walking	12
None of the above	2
Total	165

Q12 - Do you regularly use a smartphone or a computer?

Field	Choice Count
Yes	161
No	4
Total	165

Q12a - How long have you been using it?

Field	Choice Count
I have recently started	22
From 1 to 3 years	24
From 3 to 5 years	20
More than 5 years	95
Total	161

Q12b - Do you use one or several of the following applications?

Field	Choice Count
Routing and guidance application	116
Shared mobility application	24
Public transport application	117
No, I don't	11
Total	268

Q13 - In a typical month, how often do you use public transport?

Field	Choice Count
Less than once a week	46
Once or twice a week	58
Daily	40
Never	21
Total	165

Q14 - When using public transport for your urban trips, how often are you facing unexpected obstacles?

Field	Choice Count
Very often	35
Sometimes	49
Rarely	64
Never	17
Total	165

Q15 - Do you think that the current transport network offers sufficientaccessibility and information?

Field	Choice Count
Totally sufficient	6
Very sufficient	31
Sufficient	62
Not sufficient	66
Total	165

Q16 - Is being able to travel independently important for you?

Field	Choice Count
Very important	104
Important	45
Less important	9
Not important	5
I don't know	2
Total	165

Q17 - Do you think that a connected transport environment will help youuse public transport independently?

Field	Choice Count
Yes	139
Partially	16
No	5
I don't know	5
Total	165

Q18 - Which information do you consider important in a connected trip?

Field	Choice Count
Station/stop information (accessibility level, elevator, distance to lane, etc.)	125
Accessible routes inside stations	101
Real-time information about arrivals	113
Learn in advance if the station/stop is fully-accessible, partially-accessible or non-accessible	99
Routing adapted to the type of non-conventional user (e.g. maximum walking distance, etc.)	79
Total	517

Q19 - Would you share information with other users regardingaccessibility conditions (e.g. broken elevators)?

Field	Choice Count
Yes	157
No	1
I don't know	7
Total	165

Q20 - Would you use connected transport applications in the future?

Field	Choice Count
Yes	144
No	2
I don't know	19
Total	165

Q21 - Do you think these applications will save you time in your dailylife?

Field	Choice Count
Yes	102
possibly	47
No	8
I don't know	8
Total	165

Q22 - Would you pay for using a connected transport environment?

Field	Choice Count
I would not pay for this kind of service	88
<5 Euros per month	51
5 to 10 Euros per month	22
>10 Euros per month	4
Total	165

Q23 – If CAVs were available to me, I would use it.

Field	Choice Count
I am willing to accept the effort to switch to CAVs (e.g. special courses).	98
The switch to CAVs is unacceptable.	3
I would not like to use CAVs.	6
I would try to avoid CAVs as much as possible.	58
Total	165

Q24 - Please imagine that large sections of the population would useCAVs. To what degree do the following statements apply to you?

Field	Choice Count
The idea that large sections of the population use CAVs feels bad.	11
The idea that large sections of the population use CAVs feels good.	53
I think it is great if large sections of the population use CAVs.	108
Total	172

Pilot 5.2 FDGs

Q1 – Are you

Field	Choice Count
Female	21
Male	32
Other	1
Prefer not to say	0
Total	54

Q2 - Please tell us your age.

Field	Choice Count
17	1
20	1
21	2
23	1
24	1
27	1
33	1
34	1
39	1
43	1
44	1
46	2
47	1

49	1
50	2
51	2
52	2
55	4
56	3
57	3
58	3
59	2
60	1
61	3
63	1
64	1
65	4
66	1
68	1
71	1
75	3
78	1

Q3 - What country do you currently live in?

What country do you currently live in?
Italy

Q4 - Which city do you currently live in?

Which city do you currently live in?
Napoli
Roma
Milano
Bologna

Q5 - Are you blind or partially sighted?

Field	Choice Count
No	2
I am blind	41
I am partially sighted	11
I am deaf-blind	0
Total	54

Q5 – When did your visual impairment start?

Field	Choice Count
I was born visually impaired	33
The visual impairment occurred later in life	21
Total	54

Q7 - How would you describe your freedom of mobility?

Field	Choice Count
I can travel alone	28
I can travel alone, but I have difficulties	20
I can only travel with someone else	6
Total	54

Q8 – Have you ever tried a Connected and Automated Vehicle (CAV)?

Field	Choice Count
No	41
Yes, as a passenger	15
Yes, as a driver	1
Total	57

Q8a - Were you a passenger and/or a driver in the CAV?

Q8 – What kind of CAV have you tried?

Field	Choice Count
Driver assistance (navigator, speed limit indicator, blind spot detection)	1
Partial automation: the car was able to brake/accelerate OR change direction, but not both things at the time (adaptative cruise control, lane assistance)	1
The car could accelerate/brake AND change direction at the same time (auto-pilot)	8
I don't know	5
Total	15

Q8b - How many times have you ever used a CAV?

Field	Choice Count
Only once	2
Rarely	4
Occasionally	3
Systematically	1
Never	3
Total	13

Q9 – How confident are you in CAVs?

Field	Choice Count
Not confident at all	3
Barely confident	12
Medium confident	26
Very confident	13
Total	54

Q10 – What educational level do you have? Please choose the highest educational qualification you have achieved so far.

Field	Choice Count
School finished without school leaving certificate	0
Still at school	1
Elementary or lower secondary school qualification	2
Middle School, High School or Secondary School or equivalent qualification	23
Completed apprenticeship	0
Advanced Vocational Certificate of Education, vocational baccalaureate diploma, technical diploma	3
A levels, high school diploma or other university entrance qualification	6
Polytechnic degree, university of applied sciences degree, other university degree	19
Total	54

Q11 - What is your monthly net income approximately?

Field	Choice Count
less than € 250	3
€ 250 to under € 1000	4
€ 1000 to under € 2000	25
€ 2000 to under € 3000	6
€ 3000 to under € 5000	2
€ 5000 and over	1
I do not want to answer that	13
Total	54

Q12 - Which is your current occupation?

Field	Choice Count
Student	5
Full-time work (over 30 h a week)	24
Part-time work (30 h per week or less)	3
Currently not employed	2
Retired	19
Other	1
Total	54

Q12a - How often did you travel to work or to your place of educationprior to the COVID-19 pandemic?

Field	Choice Count
Less than once a week	1
Once a week	0
2-6 times per week	8
Everyday	16
More often than once a day	8
Total	33

Q12b - What was the average one-way distance for this trip?

Field	Choice Count
Up to 5 km	15
5-15 km	9
16-25 km	4
26+ km	5
Total	33

Q13 - Do you feel safe to travel on your own?

Field	Choice Count
No	2
Only known routes, for short distances	12
Known routes any distance	28
Yes, even unknown routes	12
Total	54

Q14 - Which is your preferred transport mode?

Field	Choice Count
Private car	19
Public transport - Bus	10
Public transport - Subway or train	17
Walking	5
None of the above	3
Total	54

Q15 – Do you regularly use a smartphone or computer?

Field	Choice Count
Yes	53
No	1
Total	54

Q15a - How long have you been using it?

Field	Choice Count
I have recently started	0
From 1 to 3 years	3
From 3 to 5 years	2
More than 5 years	48
Total	53

Q15b - Do you use one or several of the following applications?

Field	Choice Count
Routing and guidance application	30
Shared mobility application	10
Public transport application	41
No, I don't	5
Total	86

Q16 - How often do you leave your home?

Field	Choice Count
Several times a day	32
Once a day	6
4 to 6 days a week	8
2 to 3 days a week	4
Once a week	1
Less than once a week	3
Total	54

Q17 - Do you use one or more of the following tools (multiple answerspossible)?

Field	Choice Count
I do not use any tools.	4
Stick	40
GPS	33
Guide dog	7
sighted assistance	31
Other (please specify)	0
Total	115

Q18 - In a typical month, how often do you use public transport?

Field	Choice Count
Less than once a week	5
Once or twice a week	15
Daily	28
Never	6
Total	54

Q19 - Is being able to travel independently important for you?

Field	Choice Count
Very important	48
Important	5
Less important	1
Not important	0
I don't know	0
Total	54

Q20 - Do you think that the current transport network offers sufficientaccessibility and information?

Field	Choice Count
Totally sufficient	1
Very sufficient	4
Sufficient	26
Not sufficient	23
Total	54

Q21 - When using public transport for your urban trips, how often areyou facing unexpected obstacles?

Field	Choice Count
Very often	23
Sometimes	30
Rarely	1
Never	0
Total	54

Q22 - Do you think that a connected transport environment will help youuse public transport independently?

Field	Choice Count
Yes	41
Partially	9
No	0
I don't know	4
Total	54

Q23 - Which information do you consider important in a connected trip?

Field	Choice Count
Station/stop information (accessibility level, elevator, distance to lane, etc.)	40
Accessible routes inside stations	26
Real-time information about arrivals	42
Learn in advance if the station/stop is fully-accessible, partially-accessible or non-accessible	29
Routing adapted to the type of non-conventional user (e.g. maximum walking distance, etc.)	22
Total	159

Q24 – Wqould you share information with other users regarding accessibility conditions (e.g., broken elevators)?

Field	Choice Count
Yes	54
No	0
I don't know	0
Total	54

Q25 - Would you use connected transport applications in the future?

Field	Choice Count
Yes	47
No	0
I don't know	6
Total	53

Q26 - Would you pay for using a connected transport environment?

Field	Choice Count
I would not pay for this kind of service	5
<5 Euros per month	14
5 to 10 Euros per month	18
>10 Euros per month	16
Total	53

Q27 - If driverless vehicles were available, I would use them.

Field	Choice Count
Certainly	29
Probably	2
Depends on how technology evolves	19
Probably not	2
Not at all	1
Total	53

Pilot 5.3 UI/UX Testing

Q1 – Please tell us your age.

Field	Choice Count
17	1
20	3
21	3
22	2
24	1
60	1
63	1
65	1
75	1
77	1
78	1
80	1
83	1
85	2
89	1

Q2 - Do you regularly use a smartphone or a computer?

Field	Choice Count
Yes	16
No	5
Total	21

Q3 - How long have you been using the smartphone and/or computer?

Field	Choice Count
I have recently started	5
From 1 to 3 years	0
From 3 to 5 years	0
More than 5 years	11
Total	16

Q4 - Do you use one or several of the following applications

Field	Choice Count
Routing and guidance application	14
Shared mobility application	5
Public transport application	14
No, I don't	1
Total	34

Q5 - Were you able to complete the task "Find and read the tutorial"?

Field	Choice Count
Yes, without a problem	16
I was able to complete it but I had some trouble	5
No	0
Total	21

Q5a - What problems did you have while completing the task "Find and read the tutorial"?

What problems did you have while completing the task "Find and read the tutorial"?

Q6 - Were you able to complete the task "Find stations"?

Field	Choice Count
Yes, without a problem	12
I was able to complete it but I had some trouble	7
No	2
Total	21

Q6a - What problems did you have while completing the task "Find stations"?

What problems did you have while completing the task "Find stations"?
I can only search for a station using the magnifying glass if I want to make a route. The other way is to search the map but sometimes I may not know where exactly that station is.
I find it difficult to know what the coloured buttons are for as they don't have text. Sometimes I would look at the tutorial to find out what they do.
Sometimes, it does not mark the specific station but a nearby street. It would be nice if there was a symbol indicating that it is a station.

Q7 - Were you able to complete the task "Calculate routes"?

Field	Choice Count
Yes, without a problem	16
I was able to complete it but I had some trouble	4
No	1
Total	21

Q7a - What problems did you have while completing the task "Calculate routes"?

What problems did you have while completing the task "Calculate routes"?

I have not found it at all easy to know how to choose the user's disability, as well as the type of transport he/she wants to use. The reason is because the menu where both the disability and the mode of transport are indicated is not easy to find. I think that using larger icons would make this easier.

Q8 - Were you able to complete the task "Report incidences"?

Field	Choice Count
Yes, without a problem	12
I was able to complete it but I had some trouble	7
No	2
Total	21

Q8a - What problems did you have while completing the task "Report incidences"?

What problems did you have while completing the task "Report incidences"?

Blank screen when pressing the "report issues" button. Model iPhone 7. I posted a comment at Cuatro Caminos subway station and the comment was not registered.

It would be nice to be able to search directly for a station in the search engine without having to generate a route. I understand that this function makes more sense when you are at the specific station and in that case the where am I would be enough. However, one may later remember to report. And in that case, a search engine is more useful than navigating the map.

At first I didn't know how to report the incident, and it took me a while to realize that it is by clicking on the station that you can report incidents and leave your comments.

Impossibility to search for the subway stop without entering a route.

It is difficult to search for stations on the map because it takes a long time to load and to display the green, yellow and red dots.

Q9.1 - Please indicate whether you agree or disagree with the statements below.

Field	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree	Total
This application has much that is of interest to me.	9	8	3	0	1	21
It is difficult to move around this application.	4	4	2	6	5	21
I can quickly find what I want on this application.	11	8	0	2	0	21
This application seems logical to me.	15	5	1	0	0	21
This application needs more introductory explanations.	8	6	2	3	2	21
The pages on this application are very attractive.	9	6	4	0	2	21
I feel in control when I'm using this application.	8	7	2	3	1	21
This application is too slow.	2	12	2	1	4	21
This application helps me find what I am looking for.	12	7	1	1	0	21
Learning to find my way around this application is a problem.	3	6	2	7	3	21

Q9.2 - Please indicate whether you agree or disagree with the statements below.

Field	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree	Total
I don't like using this application.	1	1	5	5	9	21
I can easily communicate the incidences I find on this application.	6	5	4	5	1	21
I feel efficient when I'm using this application.	5	9	6	1	0	21
It is difficult to tell if this application has what I want.	1	2	4	7	7	21
Using this application for the first time is easy.	7	7	2	1	4	21
This application has some annoying features.	0	4	4	7	6	21
Remembering where I am on this application is difficult.	0	3	5	3	10	21
Using this application is a waste of time.	0	0	0	3	18	21
I get what I expect when I click on things on this application.	8	9	1	3	0	21
Everything on this application is easy to understand.	5	11	2	3	0	21

Q10 - Additional comments

Additional comments
I like the use for people who need it.
I have seen a flaw: if I put go from the Zoo to Portazgo by Metro it takes an hour, but if I put in Metro and Bus, which should be equal or faster, it takes 2 hours to complete the route (for a disabled person in both cases). In addition, there is more distance to walk in this second case (1.7 km, vs. 1.3 if it is only by subway).)
I am missing a START ROUTE button (Google Maps style). I would like to be able to schedule trips and know when the subways and buses leave. The buttons with the same icons are a bit confusing. They are only distinguishable by color and sometimes I have to go to the tutorial page to find out what they are for. Sometimes it's annoying to navigate the map with the icons on the right. I would put them in a menu at the bottom. I wrote a comment about the Cuatro Caminos station and it didn't save. I would like to search for a station without having to do a route or looking at where it is on the map. I would remove the bar to adjust the distance you are willing to walk and put buttons with different options: 50m / 100m / 150m / 150m / etc. The yellow color does not give me confidence. I would use icons for metro and bus in the route calculation part.
Positive points Intuitive. Easy to use from the first moment. Good detail of the steps to follow. Easy to register as a user. Negative points Start from my location the route. Detail when looking for a place for example Portazgo, which is not the street but the station itself, mark with a symbol or something like that. Text and not just symbol of the type of reduced mobility you have. The keyboard covers the screen, for the survey and for the App. Excessive detail in the meters to travel. Perhaps intervals of 25 or 50 m or mark in numbers. Lack of detail in reporting incidents. Maybe integrate elevator or escalator map.
I believe that this application can be successful if certain errors can be corrected. On the one hand, I think it is necessary to facilitate access to the menu of how to choose your disability and mode of transport, as well as to report incidents. In addition, I think that adding the feature that shows you the exact time at which the subway or bus passes the application improves a lot. Also the ability to navigate without having to choose a route. Otherwise, I think the app will be a success by correcting these bugs.

It would be a great help to be able to put my location directly at the point of origin because sometimes I don't know where I am exactly. It would also be a great help to be able to search for a metro/bus stop without setting a route. Lastly, it would be nice to be able to give it like to start route seeing how long it takes the subway/bus to arrive, schedules, basically as if I were on a Google maps.

Annex IV: UI/UX testing in Pilot 5

The UI/UX testing of pilot 5 consisted of several smaller tasks, which participants were asked to perform to test whether the application is intuitive and to allow participants to familiarise themselves with the application. Task 1 consisted of finding and opening the tutorial of the application. Furthermore, participants had the time to read the full tutorial during this task. To access it, they had to open the general menu in the upper left corner:

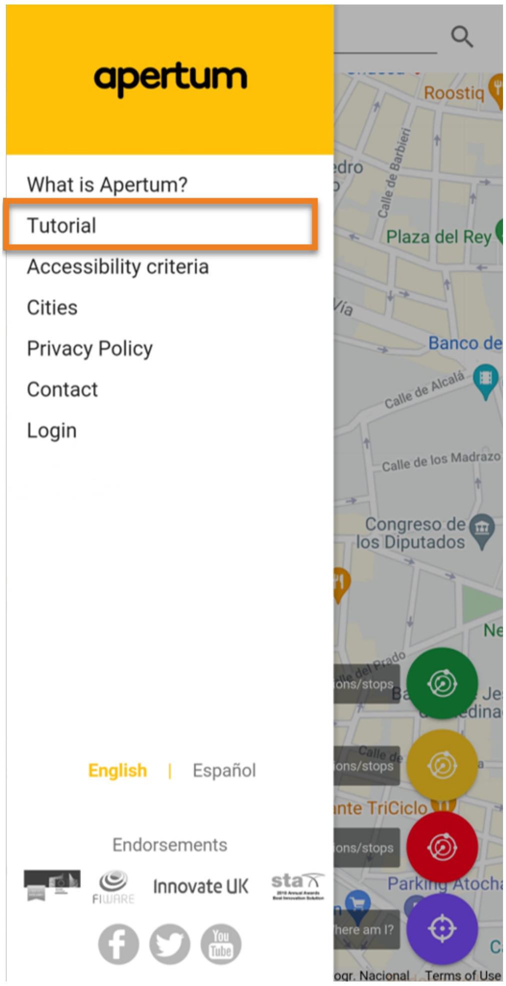


Figure 141 - Pilot 5, UI/UX task 1

To complete task 2, the participants had to locate all accessible stations in the area, which is done by selecting “See accessible stations/stops” on the home screen of the application:

Figure 142 - Pilot 5, UI/UX task 2

The third task consisted of two separate subtasks, asking the participants to modify and adapt all different aspects of the search function. In scenario 1, the task consisted of searching for a route from Príncipe Pio station to Goya station using only Metro and selecting the user profile of an elderly person with less than 200 metres walking range. The second scenario starts at *Portazgo* station and ends in *Nuevos Ministerios* at the centre of Madrid by bus only using the profile of a wheelchair user with 100 metres mobility range:

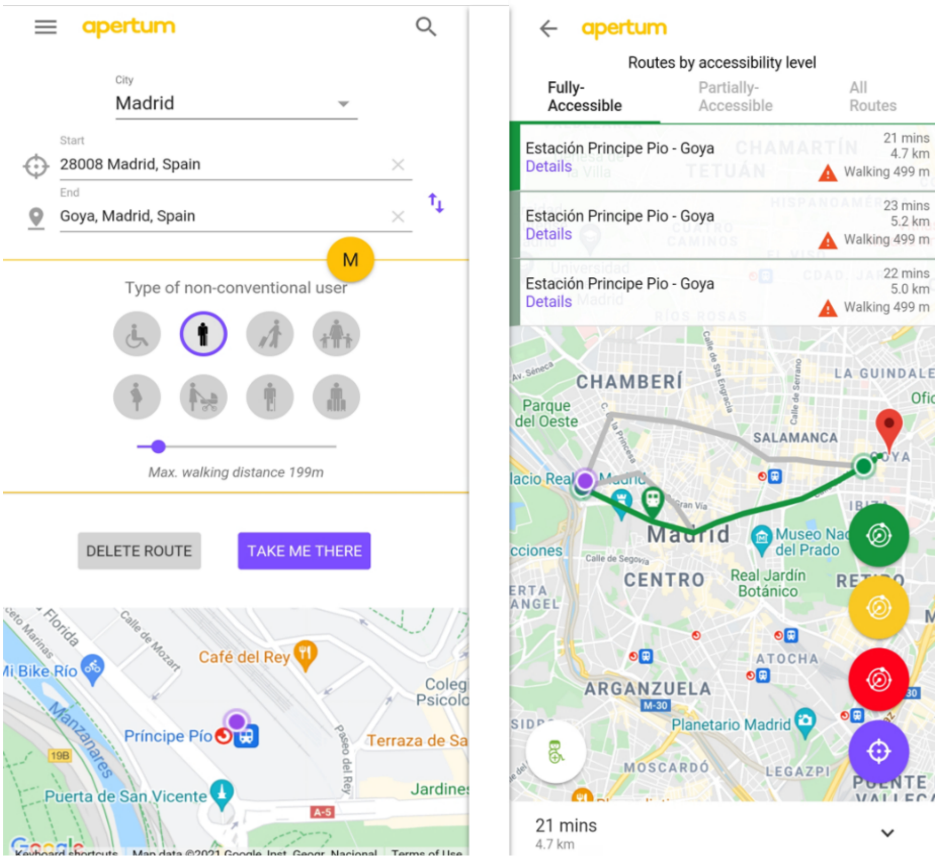


Figure 143 - Pilot 5, UI/UX task 3, scenario 1

Task 4 consisted of reporting an incidence (a broken or non-functional) elevator in Sol station. To complete this task, the participants had to find Sol station, select the station, open a dropdown menu with an overview over all accessibility criteria and fill out a form:

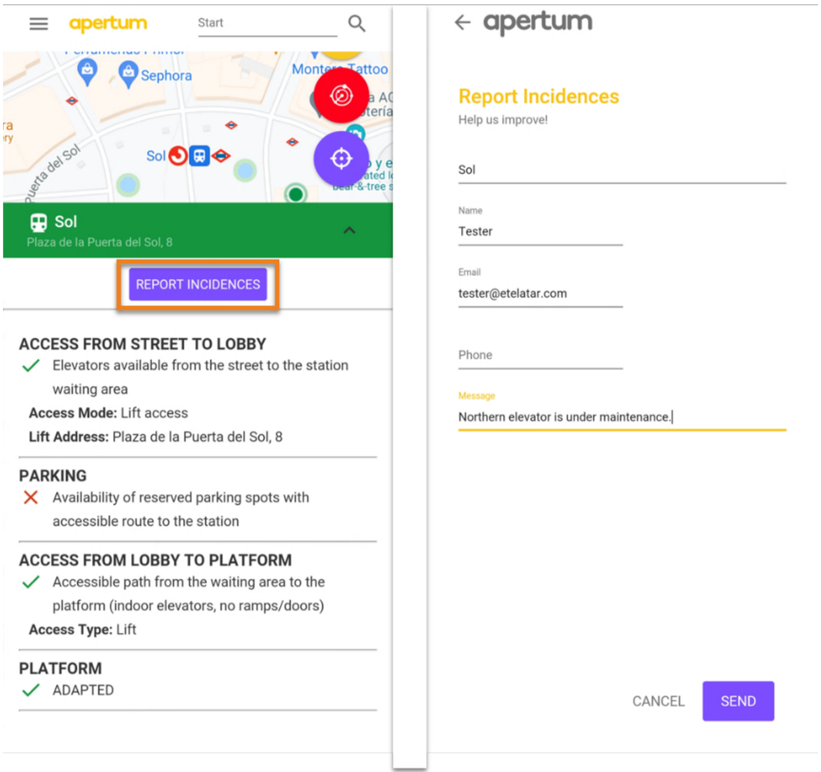


Figure 144 - Pilot 5, Apertum UI/UX task 4

The UI/UX survey, which is the centre piece of this task, has been constructed using the *WAMMI*[46] methodology [6]. The survey asked the participants to self-report on their level of tech-savviness as well as whether they were able to complete each of the tasks without help in the given time frame and whether they struggled in doing so. Finally, the survey consisted of 20 questions specifically towards the interface design and the user experience that users could answer in a scale of 1 to 5 (strongly agree to strongly disagree). The questions asked can be checked in the following table.

Table 21 - Pilot 5, UI/UX WAMMI questionnaire

1	This website has much that is of interest to me.
2	It is difficult to move around this website.
3	I can quickly find what I want on this website.
4	This website seems logical to me.

[46] http://www.wammi.com/questionnaire.html

5	This website needs more introductory explanations.
6	The pages on this website are very attractive.
7	I feel in control when I'm using this website.
8	This website is too slow.
9	This website helps me find what I am looking for.
10	Learning to find my way around this website is a problem.
11	I don't like using this website.
12	I can easily contact the people I want to on this website.
13	I feel efficient when I'm using this website.
14	It is difficult to tell if this website has what I want.
15	Using this website for the first time is easy.
16	This website has some annoying features.
17	Remembering where I am on this website is difficult.
18	Using this website is a waste of time.
19	I get what I expect when I click on things on this website.
20	Everything on this website is easy to understand.