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Abstract
D4.8: User Acceptance assesses user requirements, concerns and expectations with a view to ensure their acceptance and trust. This is achieved by means of a multi-country online survey targeting naïve users, which enquires about the users' perspective towards a selection of services tested in AUTOPILOT. This report introduces the survey design and summarises the results of the user evaluation. The findings are translated into actionable recommendations for future research projects.

Legal Disclaimer

Abbreviations and Acronyms

Acronym	Definition
AD	Automated driving
CAD	Connected Automated Driving
EC	European Commission
GA	Grant Agreement
IoT	Internet of Things
PO	Project officer
PoI	Point of interest
UK	United Kingdom
WP	Work Package

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Executive Summary

This deliverable summarises the user acceptance evaluation carried out within AUTOPILOT task 4.5 at five European pilot sites.

The aim of the evaluation task 4.5 “User Acceptance” in AUTOPILOT is to analyse requirements, expectations and concerns of potential users of different use cases of automated driving progressed by the Internet of Things (IoT).

The methodology used for the evaluation is twofold: first, the tested scenarios were evaluated from the perspective of potential users (who did not experience the services), based on a multi-country online survey.

Building on the findings of the first analysis, an evaluation of the tests at the pilot sites from the perspective of potential/test users was carried out. By undertaking an exploratory approach to the user evaluation, this report aims at providing insights and recommendations from the user perspective for the future development of IoT-enhanced automated driving functions.

Users have positive expectations towards the tested services, deeming them useful and beneficial for road safety. While they do not expect a change in their existing mobility patterns, they would be willing to use the demonstrated services and would recommend them to their friends and colleagues.

Users are most concerned about system failure, unexpected behaviour or an uncomfortable driving style of the vehicle as well as more specific properties of the driven vehicles, such as the HMI or uncomfortable seatbelts. In addition, users are concerned about the handling of their personal data and liability issues.

The possibility to take over control from the vehicle is an essential requirement for most users. Users furthermore require adequate information that can be customised to their needs and environment.

Based on these findings, the report recommends giving special attention to the provision of fitting information for users of IoT-enhanced automated vehicles, thus enhancing user comfort and trust in the technology. Furthermore, the users’ requirement to take control of the vehicle when desired should be considered during function development. Likewise, concerns over data handling and liability should be respected.

In addition to insights stemming from the collected data, useful lessons were learned by the researchers during the user evaluation. The ambitious set-up of the technical testing proved to be a challenge for the user evaluation, requiring adaptation of the study design.

To mitigate potential challenges in future projects, information silos within the project should be actively avoided by ensuring a direct line of communication between the developers of the tested functions and the evaluators.

When involving users in technically ambitious functionalities that have not reached the consumer market yet, managing user expectations is vital. To this end, special attention should be paid to properly introduce the users not only to the demonstrated technology but also to the specific use case and its limitations.

Lastly, the test area can be of use in introducing users to the piloted technologies.

2 Introduction

Purpose of the document

This document presents the results of an analysis of user requirements, concerns and expectations conducted under task 4.5 led by the FIA.

Terminology

Users	are understood here in a broader definition as "*anyone who uses the AUTOPILOT functions and services*".
Other road users	are road users that are indirectly affected by the use of the AUTOPILOT technology, e.g. cyclist, pedestrian, drivers of conventional vehicles; this group can be also interpreted as a part of the stakeholder groups.
Acceptance	Degree of intention to use or of incorporation of AUTOPILOT services.

Structure of the report

The report is structured as follows:

Chapter 2 gives an overview of the background of the survey, locating it among the existing research on user acceptance, and formulates the aim of the analysis.

Chapter 3 outlines the AUTOPILOT Use Cases that form the basis of the user acceptance survey.

Chapter 4 sets out the underlying methodology, building on the framework delivered in D4.1.

Chapter 5 summarises the results of the survey. Building on the prior analysis published in D4.7, the results are grouped into insights on user requirements, concerns and expectations with regards to the piloted use cases.

Chapter 6 discusses the results in the light of the piloting set-up at the participating Pilot Sites and transcribes these results into concrete recommendations for future projects testing automated and connected driving.

Chapter 7 draws summarising conclusions, highlighting the most striking results and points to future research needs.

3 Background and aim of the user survey

Background

This deliverable examines the user expectations, requirements and concerns with regards to the use cases tested in AUTOPILOT (see chapter 4 for descriptions of all AUTOPILOT use cases). The deliverable forms part of the user acceptance evaluation conducted in Task 4.5.

User acceptance forms a crucial part in the introduction of new technologies, being a determining factor for their potential to gain market traction and be inclusive. User acceptance can be defined as the demonstrable willingness within a user group to employ an information technology for the tasks it is designed to support (Kaan, 2017).

As using the Internet of Things (IoT) to enhance automated driving functions is still a very recent application, both the users' understanding of potential services, and the industry's experiences in designing them are limited. With this limitation in mind and considering the rapid pace at which the domain is evolving, the user acceptance Task in AUTOPILOT evaluated the tested services in a multiple-step process. In the first step, a multi-country online survey with a focus on users' requirements, concerns and expectations towards some of the tested services was conducted before the actual piloting took place. In the second step, the developed and tested services were evaluated in pilot site tests involving potential users of the services.

Therefore, the work in task 4.5 User Acceptance was twofold – the first analysis addressed requirements, expectations and concerns from the perspective of potential users who are not familiar with and have not experienced the services in an international online survey. The results from these analyses are summarised in deliverable D4.7. The second and main part in this task evaluated requirements, expectations and concerns at the test sites, i.e., the evaluation from the perspective of users who experienced the services or part of the services during the pilot tests. This deliverable summarises the results of the latter analysis. The overall content of both deliverables is outlined in table 1.

Seeing that the topics as well as the applied methods of the User Acceptance task overlap with those of Business Impact Assessment (T4.3), Quality of Life Impact Assessment (T4.4), and Legal Issues (T4.6), insights gained from the conducted evaluation were frequently shared with those Tasks.

Table 1: Overview of deliverables in T4.5 User Acceptance

D4.7 – User Requirements	D4.8 – User Acceptance
• General deliverable • Multi-country general public survey • Potential input to T4.3, T4.4, T4.6	• Pilot site deliverable • Tailored focus group interviews • Main output of T4.5

Aim of the public user testing

As established in D4.1, the objectives of user acceptance assessment in AUTOPILOT are to:

- Formulate IoT-related improvements for automated driving functions based on user feedback, and to
- Determine whether there are improvements or added value in automated driving

functionalities with and without the assistance of the IoT regarding user acceptance.

Within this overarching goal, the aim of the following analysis is to evaluate the user requirements, expectations, and concerns with a view to ensuring their acceptance and trust in future IoT-enhanced automated driving functions.

4 Description of Use Cases

As mentioned above, the scenarios follow the storylines summarised in the Pilot simplifying them in order to make them more understandable for the participants. Not all use cases developed and tested in “AUTOPILOT” were considered. The user acceptance task selected only scenarios where IoT plays a crucial role in the service presented.

The following use cases have been tested with users. These short descriptions present the action that the participants in the user-test encountered. More elaborate descriptions, and the way the scenarios in the tests were implemented can be found in Deliverable D3.5, on the testing in the pilot sites. Note that the technical role of IoT is not given in these descriptions, as for the users this was not very important, they were presented with a service, and technical details were not discussed before nor during the tests.

Automated valet parking (Vigo and Tampere, not tested with users in Brainport) - Automated parking at parking space:

- The automated vehicle automatically books a parking place near the drop-off point.
- Cameras check if a parking spot is free and whether there are any obstacles on the route
- The vehicle parks itself in the parking place
- The user sends the request to return the car
- The car drives to the pick-up point

Highway pilot (Brainport and Livorno) - Detection of road incidents and obstacles to ensure safe automated driving on highways:

- Cars with sensors and roadside camera detect obstacles, potholes, bumps, and other hazards
- Information is sent to traffic management, which determines when traffic should be informed
- Semi-automated vehicle receives a message about a hazard and adapts its driving (i.e. braking, lane-change)

Platooning (Brainport and Versailles) - Automated (short-distance) following of vehicles for more efficient traffic and comfort:

- In Brainport:
    - Via app, two vehicles make contact to drive in a platoon
    - Both get information on the meeting point and speed advice
    - When the vehicles meet, they drive in a platoon on the highway, the lead car driving manually, the following vehicle driving in automated mode
    - At the destination, or in case of interfering traffic, the platoon is broken

- In Versailles:
  - The fleet management systems tell the fleet operator which vehicles have to be moved to another car-sharing station
  - The following automated vehicles are positioned behind the lead vehicle
  - The lead vehicle drives manually while the following vehicles are operating in automated mode
  - The platoon drives through the city centre and crosses simple and complicated intersections
  - The vehicles are dropped off at the destination station

Urban driving (at all pilot sites) - Detection of pedestrians and cyclists, and managing traffic lights with automated driving:

- In Brainport:
  - An automated vehicle is called via the app
  - The vehicle arrives at the call point
  - The vehicle drives automated to destination
  - Vehicle detects pedestrians (not visible, e.g. standing around a corner) and adjusts driving behaviour (stops or slows down), by picking up smartphone signal
  - The Vehicle detects crowds by picking up smartphone signals and adjusts its route
- In Tampere and Vigo:
  - An Automated vehicle approaches a traffic light, gets a signal state and adapts vehicle speed
  - The vehicle detects a pedestrian and waits for them to cross
  - The vehicle starts moving when the pedestrian has crossed
- In Livorno:
  - An automated vehicle is driving and other road users, including connected bicycles, notify their presence to the AD vehicle
  - A bicyclist falls down
  - The AD vehicle, informed by IoT of the dangerous situation, smoothly decreases its speed and stops before reaching the accident area
  - The automated vehicle uses signals from smart traffic light to adjust driving behaviour according to the presence of other road users
- In Versailles:
  - Automated vehicle drives in the palace garden
  - Receives tourist information at points of interest
  - A pedestrian walks in the middle of the road in front of the vehicle
  - A bicycle crosses the road in front of the vehicle
  - Vehicle adjust driving behaviour (stops or slows down)

5 Methodology

Research approach

As the services and features considered in AUTOPILOT were in an early development phase, the evaluation of the user acceptance in terms of willingness to use the technology followed a user-centric approach. Participation of users in the design process can take place at different levels including conducting surveys with potential users about their wishes and needs and letting users testing prototypes and giving feedback to the researchers (Friedhof, 2016). As mentioned above, the user acceptance study in AUTOPILOT integrates two main parts for the evaluation of the developed services – the first one is assessing user preferences of the general public in an online user survey (D4.7) and the second one is using the results as recommendations for developers and as input for pilot testing of the developed services with potential users within the "AUTOPILOT" projects (the focus of this deliverable).

Many studies on user acceptance in the context of automated and connected driving are based on theoretical approaches on acceptance of new technologies, such as the Technology Acceptance Model (TAM) developed by Davis (1985) and the Unified Theory of Acceptance and Use of Technology (UTAUT; Venkatesh et al., 2003). This study is not directly based on this approach. However, it is in line with its main concepts, which suggest that user acceptance (in terms of willingness to use a service or function) is determined by evaluation of the usefulness and the ease of use of the technology.

Following this approach, the report identifies functions or features of services that use IoT which are desirable for the users and which are the main concerns or acceptance barriers related to them. Thus, the assessment focusses on how services can be developed in a way to be perceived as useful and easy to use from a user perspective. In this sense, an explorative pre-phase assessment of user acceptance determinants was added by addressing the expectations and requirements of potential users in the development stage of new services. Since the focus of the study is on the IoT part of services and IoT primary enables exchange of information and data, we explore deeper the requirements of the users on required information (e.g., real-time traffic or vehicle operation information) as well as concerns related to data exchange (e.g., data privacy or cybersecurity).

Finally, conclusions from the analyses were derived about how IoT will enhance, enable and accelerate AD when considering user acceptance and user expectations, requirements, and concerns.

In summary, the assessment focusses on how services can be developed in a way to be perceived as useful and easy to use from a user perspective using a user-centric participatory approach.

Methodological Approach

Public testing of the technologies developed in AUTOPILOT was carried out at five European test sites across the first 6 months of 2019, as set out in Table 1. These were preceded by pilot tests (with employees of project partners) designed to test the method in late 2018, the findings of which informed refinement of the process for public testing.

Table 2: Public Testing carried out in AUTOPILOT

	Automated Valet Parking	Urban Driving	Highway Pilot	Platooning
Brainport	n/a	April 2019	March 2019	June 2019
Livorno				
Tampere	October 2018	May 2019		
Versailles		April 2019		July 2019 (no surveys)
Vigo	First iteration: February 2019 Second iteration: June 2019	First iteration: May 2019 Second iteration: July 2019		

It was important to ensure (as far as possible) that the tests were uniform across all sites and use cases, so that data could be pooled across all tests for high-level observations. As such a Pilot Site Protocol was developed (see Appendix 1). The intended audience for this was the pilot site leaders who were responsible for organizing the user tests and the technology developers who would be involved in running the tests, as well as the evaluators from WP4 involved in the tests. The protocol was tailored for each pilot site/ use case which may have had region- or technology-specific restrictions or opportunities.

In addition to the user tests, short questionnaires were handed out to visitors of the AUTOPILOT demonstrations during the European ITS Congress, 3rd – 6th June 2019 in Brainport, NL. The survey involved 47 ITS visitors, and questions were asked about the ranking of the service, the importance of IoT in the development of automated driving, the concerns of automated driving using IoT, and future impacts of the service. In addition, at the public event on 2 June short questionnaires were collected from 20 members of the general public who attended a general AUTOPILOT demonstration.

Data Collection

Data to assess user acceptance of the AUTOPILOT services was gathered through surveys of members of the general public who had experienced one of the AUTOPILOT services in a controlled test at the AUTOPILOT pilot sites.

The intention was also to survey the professional/safety drivers of the AUTOPILOT technologies, as detailed in the Protocol. However, there was not the opportunity to do so as they had tight schedules and were involved in technical adjustments between tests. They were asked to note any technical issues that occurred during tests.

Description of Pilot Sites and AUTOPILOT services

There were six pilot testing sites involved in the AUTOPILOT project (see Figure 3). These were Tampere in Finland, Brainport in the Netherlands, Vigo in Spain, Livorno in Italy and Versailles in France. An associated test site in South Korea was not involved in the User Tests.

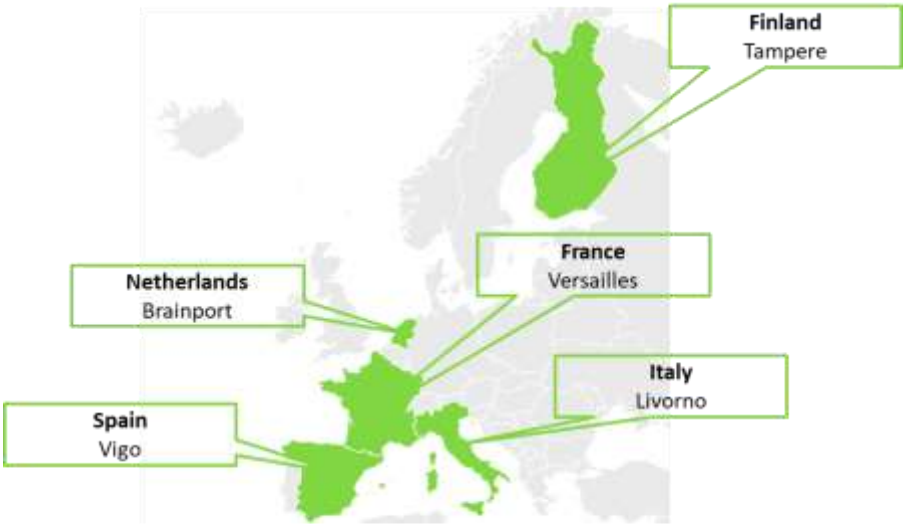

Figure 1: Location of Pilot Sites

Each site operated independently, led by different project partners/technology developers, though there were five common technology use cases (hereafter termed 'services') which exemplified the benefit of IoT for AD. A short description of each service is provided in Table 2, though the reader is advised for more detail on the pilot sites and services to refer to the Deliverables of Work Package 3:

- D3.1 - Initial Pilot Sites Specifications
- D3.2 – Pilot Test Specifications
- D3.3 – Pilot Site Adaptation Validation Report
- D3.4 – Pilot Tests Reports
- D3.5 – Pilot sites tests activity report (period 2)

Table 3: AUTOPILOT Services generic and site-specific specifications (Adapted from D1.1 Tables 1 and 2)

	Automated Valet Parking	**Urban Driving**	**Highway Pilot**	**Platooning**
Generic				
Enabled by IoT	Routing and scheduling of vehicles	Road condition and hazards monitoring	Optimization of platoon planning	Speed optimisation for road network with multiple intersections; Prevention of VRU interactions
Enhancements by IoT	Reduced parking time, more efficient use of parking locations	AD adaptation relatively to road conditions and hazards; Controlled transition from AD to manual driving	Platoon forming process and platooning performance	Improve VRU collision avoidance
Accelerated development by IoT	Reduced vehicle sensor set required	Reaching AD performance level fulfilling user expectations	Electronic lane allocation	Earlier deployment of V2I functions
Main end-user benefit	Effortless drop-off and just-in-time vehicle delivery	Comfortable and reassuring automated driving under all conditions	Platoon management service and trading	Vehicle rebalancing services
Pilot Site Specific				
Tampere, Finland	Parking lot	n/a	n/a	Controlled Intersections
Versailles, France	Road-side dedicated parking	Car sharing VRU (pedestrian & cyclist) detection and Points of Interest (PoIs) notifications	n/a	Road network, controlled intersections
Livorno, Italy	n/a	Integration with real Highway Traffic Control Centre	n/a	Controlled intersections
Brainport, Netherlands	Parking lot	Motorway	3 vehicle variants, 100 km/h, ‘meet up’ function	VRU smartphone detection
Vigo, Spain	Parking garage	n/a	n/a	Controlled intersections

Pilot User Testing

In line with standard experimental procedures, the user tests were subjected to pilot testing before public user testing. In a pilot test, the procedure, experience and survey were carried out with internal participants (e.g. employees of partner organisations not involved in AUTOPILOT), in order to identify if the evaluation procedure works in the way it was designed or if any improvements can be made. Pilot tests were not for technical evaluation or validation, though technical leaders were able to gather technical data if needed.

At Brainport, pilot testing of all four services was carried out with employees of organisations working at the Brainport Automotive Campus in December 2018. As a result, the evaluation team and the technical partners were much more acquainted with the procedure and able to better predict technical problems which may arise in the public testing. It appeared that all of the use cases still had technical problems which had to be solved before the real user testing could take place. Furthermore, the survey was found to take too long and have some technical problems with the display of questions on the iPad. This resulted in streamlining and adaptations of survey questions.

The data from these pilot tests were not included in the final analyses.

User Tests not carried out

A number of planned user tests were not taken to final public testing due to technical difficulties.

- In Brainport, AVP was cancelled at the last minute as technical staff could not attend from Germany, pilot site leaders would not be present and appropriate legal permissions had not been obtained.
- In Livorno, the last user testing was cancelled because of technical problems with the vehicle. Conducting the user test at a later time point was not considered any more as the data would come too late to be considered in the final analyses.
- In Versailles, no platooning was carried out with users in the vehicle, due to security concerns and the length of the platooning test runs (ca. 1 hour).
- In Vigo, UD was not tested with the public due to safety reasons. Tests were performed with CTAG employees at the CTAG test track.

General overview of user test experience

Reports on each user test are available in Appendix 2. The number of participants and tests carried out per user test varied by service and pilot site but is detailed in the user test report. Some tests were held over numerous consecutive days. At all sites, the primary language used was the native language of the country, with an additional English version of the questionnaire provided to international participants.

Upon arrival at the test site, participants were given a briefing of the AUTOPILOT project and introduction to the technology that they were going to experience. This was led by T4.5 partners. Following this, the participants read and signed consent forms (available in the test report) and were given a participant number. They were then asked to fill in a “Pre-Test” Survey, which assessed their expectations towards the technology/experience.

The Use Case leader of the technology being tested would then lead the participants through the actual test experience. They were taken to the AV equipped with the IoT technology and given a short further briefing with an opportunity to ask any questions. Participants would then experience the technology individually or in small groups (as appropriate). A Professional Test Driver was seated behind the wheel (a regulatory safety requirement in all countries), and participants would generally be seated in the back seat. At some sites, participants viewed the technology in operation rather than seated in the vehicle. Use Case Leaders were required to note the participant numbers in each separate test and report on any technical issues which occurred in each test. In this way, for those tests which experienced serious technical errors (and so the participant did not have the full Use Case experience), their survey responses could be eliminated from the analysis. Both the Use Case Leader and the Test Driver were advised to avoid detailed discussions on the technical operations of the use case.

When the experience was completed the participants returned to the briefing room and completed two more surveys: a “post-test” survey to capture their reactions to the experience and future use of the technology and a “background” survey to gather socio-demographic information. If time allowed and participants were willing, informal discussions on the technologies may have taken place.

Participants were then thanked for their time with a small gift (e.g. at Brainport a reusable water bottle as well as raffle of dinner and movie vouchers and two movie tickets at Tampere). The whole experience lasted approximately 1-2 hours.

Livorno pilot site user tests

A different procedure was used at the Livorno pilot site as the only user tests were conducted as a part of a public event organized by the pilot site. Here, the experience with the technology and the use case was an indirect one – in a short demonstration or using a video which introduces the use case to the participants. All participants received the same introduction to the use case. After the demonstration, the participants had to fill out the “post-test” questionnaire (a paper-pencil survey). The incentive for the general public was participating in this public event and a lunch on the pilot site.

Vigo pilot site user tests

In Vigo, AVP users filled in the questionnaire online through SurveyMonkey. These respondents were end users, recruited via CTAG’s external participant database. The test was performed in the parking lot pertaining to the Vigo city hall. No incentives were provided to the participants, who joined the tests out of interest in the demonstrated technology.

The tests for UD were performed on CTAG test track with CTAG employees only, using an online questionnaire as well.

General overview of the survey

As explained in the previous section there were three parts to the user survey. These three parts address expectations, requirements and concerns of potential users. The majority of questions were categorical and/or interval (either qualitatively or Likert scales), with a small number of free-text answers. The survey was co-designed with Task 4.4 (Quality of Life), with input from T4.3 (Business Impact) and T4.6 (Legal Assessment). So that answers across surveys could be collated, the first question on each test was to provide the participant number. To see the original survey questions for each user test, see Appendix 3.

Although an initial common questionnaire protocol for survey questions was developed (see Appendix 1), in reality, there was a need to tailor these to each region, pilot site and use case. As a result, there was deviation between pilot sites. A full list of questions included across all use test surveys is available in Appendix 4. As can be seen in Table 2, despite a large number of questions in total, there is ultimately a limited number which is common across all (or all but 1) user tests. When focusing on the three areas of investigation we see that the common questions are even more limited. There are only 6 common questions for expectations, 8 for concerns and none for requirements. Additionally, concerns are not all directly comparable due to differing categorical response options.

Table 4: Common Questions across user tests

	Number of Questions across all 8 user tests *(free text/categorical)*	**Number of Common Questions**	**Number of extra Common Questions with 7 user tests**
PRE	9 *(3/6)*	5 *(0/5)*	n/a
POST	208 *(11/197)*	10 *(2/8)*	18 *(1/17)*
BACKGROUND	102 *(0/102)*	13 *(0/13)*	7 *(0/7)*
TOTAL	**319** ***(14/305)***	**28** ***(2/26)***	**25** ***(1/24)***
Expectations	55 *(0/55)*	2 *(0/2)*	4 *(0/4)*
Requirements	64 *(3/61)*	0	0
Concerns[1]	33 *(3/30)*	5 *(1/4)*	3 *(0/3)*
All[2]	27 *(7/20)*	8 *(0/8)*	11 *(1/10)*
Other[3]	140 *(0/140)*	13 *(0/13)*	7 *(0/7)*
TOTAL	**319**	**28**	**28**

(excludes participant number question)
[1]Although question is common, answers were termed differently so not directly comparable
[2]Relevent to all three assessment areas
[3]Not relevant to assessment areas (technology development or background questions)

Surveys were conducted in different ways at the pilot sites, depending on local resources. These differences may have some impact on variances between user tests. All surveys were collected using an online survey tool, “Lime Survey”, using the same framework, though adapted for each user test. The data is stored in the Lime Survey online data repository, with data downloaded for analysis by each T4.5 partner (and stored on their organisational networks). To ensure GDPR adherence, no identifiable personal data (e.g. name, contact details) of any participant was included in these surveys. This data was held separately by Pilot Site Leaders.

- In Brainport, the surveys were collected on hand-held tablets (iPads), individually by participants.
- In Tampere, desktop PCs were used
- In Vigo, the surveys were filled in by each participant in an online questionnaire

using SurveyMonkey.

- In Versailles, questionnaires were filled in by hand and later transcribed by to an online survey based on LimeSurvey
- In Livorno, the survey was conducted as a paper-pencil survey

Pre-Test

The pre-test survey was a short semantic differential questionnaire. Participants were asked to rate their expectations of the test experience (after they had been briefed but before they started with the test) on 5-point scales: positive/negative; exciting/boring; safe/dangerous, relaxing/stressful, as well as rating the service useful/useless. These questions were repeated in the Post Test survey to assess how the experience of the Use Case compared to the expectations.

For all but the Brainport user tests, participants were also given an opportunity to describe their motivations for taking part in the study and any other comments or expectations. These were removed from the Brainport testing following the pilot tests. As iPads were used it was felt that free-text answers should be limited due to the relatively complex and time-consuming typing on tablets.

Two user tests also had additional pre-test questions:

- *Tampere UD* recorded if the participant had also taken the AVP user test
- *Vigo AVP* asked about city parking concerns

Post-Test

The post-test survey was specific to the use case but was designed to capture the expectations, requirements and concerns of the participants. Only a limited number of the questions were common across all use cases. All post-test surveys consisted of three basic sections: the experience of use; future use and future development.

Experience of use

The first questions of the post-test surveys related to the experience of use. This was related to the actual experience of the technology or service that the user had just witnessed. All user tests, first of all, gave participants the opportunity to describe their immediate reaction to the test experience and report anything that made them feel uncomfortable. Following this, they were asked to rate the experience using the same 5-point Van der Laan Scale (Van der Laan et al., 1997) as the pre-test (except Vigo AVP who changed safe/dangerous to timesaving/ consuming). This allowed an estimate of how the technology may meet expectations. An extension of the Van der Laan test is the rating of 9 areas that allows an estimation of technology satisfaction and usefulness (useful/useless; pleasant/unpleasant; bad/good; nice/annoying; effective/superfluous; irritating/likeable; assisting/worthless; undesirable/ desirable; raising alertness/ sleep-inducing). All user tests but Vigo AVP included these survey questions.

Still, regarding the experience of use, questions were then asked about how *comfortable* the participants felt regarding various aspects of the vehicle behaviour, using a 5-point scale (ranging from “very comfortable” to “very uncomfortable”). None of these was common across all sites, though three were only missing from one user test (smoothness; acceleration; braking). Other aspects included:

- distance kept from road markings, obstacles, potholes, pedestrians, following/preceding vehicle;
- behaviour approaching pedestrians/cyclists;
- turning behaviour, speed.

These were selected based on the use case. For two user tests, participants were also given the opportunity to provide detail on any other behaviour that made them feel uncomfortable.

From comfort, the survey then turned to *concerns*. Using a similar 5-point scale, participants were asked how concerned they were about topics related to IoT:

- data privacy;
- data security;
- in-vehicle safety;
- liability.

All surveys included these four topics. In addition, four of the user tests asked about the safety of VRUs and other vehicles. However, not all of these can be directly compared due to differences in the categorization of responses. For Brainport, the scale was unconcerned/neutral through degrees of concern towards very concerned. For other sites, the scale had “neutral” in the middle of the five-point scale. The difference is due to language and understanding – the concept of “unconcerned” cannot be gradated into slightly or very as unconcerned is a fundamentally neutral stance. However, in some languages, the translated concept can be assigned degrees of “unconcern”. For Brainport Urban Driving, there was an additional question regarding the smartphone app that was used in the user test, which was requested by the technology designers.

Future Use

Participants were then asked various questions regarding potential future use of the technology or service, given the scenario that the use case was fully operational and available on the road. The first set of questions was focused on potential travel behaviour change. Participants were presented with various five-point scales that could describe how they felt their current behaviour could be affected by the availability of this technology or service. These were designed in such a way that they could be related to the current travel habits of the participants that are captured in the background survey. Some questions were worded slightly differently in between surveys due to survey technology restrictions, language translation and by streamlining/improved usability of questions following pilot testing. Only two questions were common across all user tests, with an additional question missing only at one user test. Others may be comparable during analysis. The categories assessed were:

- increase/decrease –
    - number of trips;
    - private car use;
    - urban car use;

- peak hour car use;
- walking/cycling;
- public transport use;
- taxi use;
- pedestrian safety;
- user safety;
- travel comfort;
- driving stress;
- motor way use;
- trip length (time);
- trip length (distance)

Related to this, the participants were also asked how beneficial the technology or service would be for different trip types, which could also be related directly to the background questions.

Regarding *Requirements*, participants were asked how important certain features of the technology or service would be. This was again on a five-point scale, with “neutral” as a mid-point choice. The features were generally specific to use case, but include:

- receiving information in own language;
- personalize information;
- take control whenever you want;
- control vehicle speed;
- control vehicle distance;
- choose parking spot;
- park yourself.

For three user tests, participants were also given the opportunity to comment on other features they would like.

Across all user tests except from Vigo AVP, participants were asked how likely they would use the service themselves or recommend to a friend (Again on a 5 point scale), and if they were willing to pay for it (yes/no/not sure – as a service or included within the car purchase price). For most tests, participants were also given the opportunity to explain their answers. Depending on the use case, participants were also asked how much they would pay – compared to conventional services or extra to car base price, and what was too expensive.
There were a number of future use questions which applied to only one user test. Brainport Platooning asked about incentives to be a platoon leader and usefulness as a platoon follower in certain circumstances. The usefulness of services specific to the use case was also asked at both Tampere user tests.

Future Development

Although there were many questions asked across all of the surveys about future development, these were on the whole very specific to the use case. The majority of the questions were related to the importance of information and features, again rated on a five-point scale. In the majority of the user tests, participants were also given the opportunity to specify any other information that they would like.

Importance of information (Very Important – Neutral – Very Unimportant) included:

- detected hazards and vehicle response *(Highway Pilot, in Brainport and Livorno);*
- route guidance;
- wait time;
- data requirements;
- time to destination;
- time left in platoon;
- headway;
- assistance available;
- time to manual driving;
- leader messages (*Platooning, in Brainport*);
- route guidance and monitoring;
- arrival time;
- upcoming manoeuvres;
- detected VRUs;
- traffic lights;
- waiting time;
- parking status;
- point of interest;
- parking fees.

Importance of Features *(only Platooning in Brainport):*

- adjust headway;
- stop platooning;
- communicate with others;
- take control.

For two user tests, there were questions added on future use that were requested by the use case leaders for their technology development:

- Brainport Highway Pilot – "*How would you expect the vehicle to react to certain road defects?"*
- Brainport Urban Driving – functionality of smartphone application regarding crowds

Finally, for the majority of user tests (other than Versailles UD and Vigo AVP), participants were given the opportunity to provide any other feedback to the developers of the system.

Background questions

The final survey carried out was designed to gather socio-demographic details of the participants, including current travel habits, personal preferences and relevant experience. This background data was important in order to understand the post-test questions related to how the tested technology may influence travel habits, as well as to identify any population clustering or significant correlation to socio-demographic characteristics, past experience or preferences. Identification of this could be a significant input into the future technological design or business model development.

Participants were first asked about their access to/ use of a car, and subsequently about their *current travel habits* for commuting trips, non-commuting trips and short-business trips. The original protocol allowed participants to choose up to three transport modes (Car, Bus/Train, Taxi/Uber, Motorbike/Scooter, Bicycle/Walk), and non-commuting trips were further divided into errands and leisure activities. This approach was adopted at the Tampere pilot site user tests. It was adapted by the Brainport task force to include only one option and additionally asked frequency of use. This was based on pilot test findings – when considering the analysis, it was realized that the original format was not useful for relating to the post-test questions. Versailles, Vigo and Livorno adopted a mix of the original and adapted questions. Related to this, participants were also asked about how often they drive on specific road types (motorway, rural, urban).

Experience of new systems asked participants if they have access to and their frequency of use of new automotive technology systems (parking assist, self-parking, cruise control, adaptive cruise control, navigation) and new mobility services (taxi/Uber, shared bikes, shared vehicles). These can be used to cluster populations and also identify any correlation with technology acceptance.

There were many questions related to *driving preferences* (e.g. parking habits, driving decision factors, congestion experience, and motion sickness). These however varied widely across all user tests due to specific relation to the use case being tested. In terms of *Driving experience,* most user tests captured years of driving, annual mileage and expected next car purchase type.

Finally, standard socio-demographic information on age, gender, household size and income were gathered.

Variances between user tests

There are a number of variances between the user tests that may inhibit cross- and meta-analysis of the data. Some of these have already been mentioned in the previous section but are summarised here.

Pilot site-specific issues

As the pilot sites were located in five different EU countries, there were language and cultural differences that required adjustment to the protocol survey questions.

Use Case specific

Although all use cases use IoT to enhance AD, they have adopted different approaches and were developed by different technology partners. Each type of use case was a service or technology for a particular situation and would thus have different baselines for comparison – e.g. AVP is comparative to non-automated parking whereas platooning is comparative to long-distance driving. Further, even use cases carried out at different pilot sites were developed separately, focusing on different technological challenges – e.g. UD at Tampere was concerned with signalized intersections, but at Brainport the focus was the detection of VRU smartphones.

Survey technology

Due to pilot site resource restrictions, surveys were carried out in different ways (see section 1.2.6). This required adjustment of the questions to the capability of the software.

Collaboration with use case teams / pilot site leaders / other T4.5 partners

There were different relationships between partners of the use case developers, pilot sites and T4.5 partners at each pilot site. This was due to organizational factors but also related to the necessity to have evaluators who speak the local language. In some cases, these were all from the same organization (which aided communication), whereas at others these were all different organisations. As such there were different levels of engagement with the user tests and surveys.

Study Sample

The initial target of participants across all user sites was over 1.000 public users. However, due to delays in use case technology development, it became clear that this would not be realistic to achieve this within the timeframe and pilot site engagement that was available. In reality, 199 public participants took part in user tests across the AUTOPILOT project, as demonstrated in Table 5.

Table 5: Public Testing carried out in AUTOPILOT

	Automated Valet Parking	Urban Driving	Highway Pilot	Platooning
Brainport		43	37	20
Livorno			12	
Tampere	29	27		
Versailles		20		
Vigo*	11			
ITS Congress	47 congress visitors (for different/combined use case demonstrations) and 20 members of the general public (for a general AUTOPILOT demonstration)			

* Note: In Vigo, users participating in the UD testing were not from the general public but employees of CTAG.

Recruitment of participants

Members of the public were recruited to take part through different processes at each Pilot Site:

- *Brainport* - mainly through local print media, the “City of Helmond” facebook page as well as the SmartWayz “Travellers Panel”
- *Livorno* – organized by the pilot site team as a public event for selected experts and potential users (general public)
- *Tampere* - general public participants were recruited by an external company (Testaamo) which is specialised on user testing and recruiting
- *Versailles* – users were mainly recruited via social media and own professional and personal networking
- *Vigo* – Participants in the AVP pilot were recruited from CTAG’s external participant database. Participants for the UD pilot were recruited internally (CTAG employees).

Study sample characteristics

Table 6 gives an overview of the socio-demographic characteristics of the participants on each pilot site.

Table 6: Demographics of study samples (in brackets: regional average)

		Brainport		Versailles	Tampere		Livorno	Vigo	
		HP (n=35)	**PT** (n=20)	**UD** (n=20)	**UD** (n=27)	**AVP** (n=29)	**HP** (n=12)	**AVP** (n=42)	**UD** (n=49)
Gender	Male	57% *(50%)*	75% *(50%)*	68% *(51%)*	59%	48%	58% (7/12)	68% (51%)	82% (51%)
	Female	43% *(50%)*	25% *(50%)*	31% *(49%)*	41%	52%	17% (2/12)	32% (49%)	18% (49%)
	Missing values						25% (3/12)		
Age	>60	15% *(30%)*	60% *(43%)*	12% *(22%)*	0	7%	8% (1/12)	12% (20%)	0% (20%)
	50-60	21% *(19%)*	35% *(28%)*	19% *(13%)*	33%	21%	58% (7/12)	19% (17%)	0% (17%)
	40-50	24% *(20%)*	5% *(29%)*	14% *(13%)*	26%	24%	16% (2/12)	14% (14%)	5% (14%)
	30-40	9% *(16%)*	n/a	14% *(15%)*	19%	28%	8% (1/12)	14% (13%)	45% (13%)
	20-30	32% *(15%)*	n/a	26% *(17%)*	22%	21%	8% (1/12)	26% (13%)	50% (13%)
	<20	n/a	n/a	14% *(20%)*	0	0	0	15% (23%)	0% (23%)
Household Income	> €100,000	6%	10%	10%	4%	7%	n/a	10%	0%
	€60-99,000	26%	20%	24%	30%	28%	n/a	25%	5%
	€20-59,000	56%	70%	39%	48%	45%	n/a	39%	73%
	<€20,000	12%	0	27%	15%	17%	n/a	26%	22%
Household size	4+	20%	20%	33%	30%	21%	n/a	33%	27%
	3	17%	5%	7%	22%	28%	n/a	7%	24%
	2	43%	7%	38%	30%	31%	n/a	39%	39%
	1	20%	5%	21%	19%	21%	n/a	21%	10%

Data Analysis

Individual User Tests

Following each user test, the data gathered in the surveys were subjected to a descriptive analysis report (available in Appendix 2) following a template, which included the following sections:

- *Background* – Detailing the time and place of the test and the number of participants
- *Test Protocol* – Describing the process carried out during the test
- *Technical Problems* – Stating any technical issues that occurred during the test that may affect the analysis of results
- *Results* – Charts visualizing the answers to each categorical question, lists of free-text answers and descriptive highlights of findings

Analysis of Expectations, Requirements and Concerns

The User Test Reports were then analysed in relation to the three analysis areas of Expectations, Requirements and Concerns. The full list of questions across all user tests was separated into these areas, and common questions for these were identified, as in Table 2 in Section 1.2.5, and are available in Appendix 4. This also details if the question is categorical or free text. Categorical questions were subjected to quantitative analysis and free text questions subjected to qualitative analysis.

Qualitative Analysis

For each user test, open coded thematic analysis of answers to free text questions was carried out separately in the context of each specific analysis area, in order to identify any themes that may emerge across use cases. These were then considered across all pilot sites. Any unique or exemplifying quotes were noted, as were any free text that was relevant to other analysis areas. The themes that emerge can be used to interpret the understanding of the analysis area.

Quantitative Analysis

For each common question related to the analysis area, the charts from individual user test report were collated and compared descriptively. Where it was possible to compare directly, the relevant data was collated for consideration at a higher level as per the individual questions.

Analysis Restrictions

- Problem of low numbers (individually and overall)
- Problem of inconsistencies between sites and use cases (survey and process)
- Above lead to limited questions that are consistent across sites

6 Results

The full reports for each publicly tested use case at each site are available in appendix 2. In this section, we summarise the overall insights on the areas of requirements, expectations and concerns of potential users on the tested use cases/ services.

Requirements

Overall

In the survey, the participants had to evaluate the relevance/ importance of different types of requirements – first, requirements on information provided by the system and features enabled due to the connectivity of the vehicle and second, requirements of the users about options of control over the system and the vehicle.

The first group of requirements focused on the following information/ features that can be provided by the service:

- Information about external factors (e.g. traffic situation, road constructions or other hazards on the road etc.)
- Information about the vehicle operation (e.g. what the car is doing or about to do)
- support information (e.g. how the system/ service works)
- Information related directly with the use of the service (e.g. estimated waiting time, travel time, price, route etc.)
- personalizing options (e.g. language or route)

The second group of requirements focused on the following requirements on the vehicle operation and especially on control functions:

- Requirements on the type and detail of information – do users want to get the same information that the vehicle receives as a basis for its decisions (especially such information that is available due to IoT)
- Requirements on options to take back the control over the vehicle/system if needed or wanted

The particular information, the features and options for control can differ across the use cases as some of them are not relevant for all use cases.

Common to all pilot sites and services was that the majority of the users (> 88%) found it (**very) important to have the option to take back control over the vehicle at any time** (see Fig. 4).

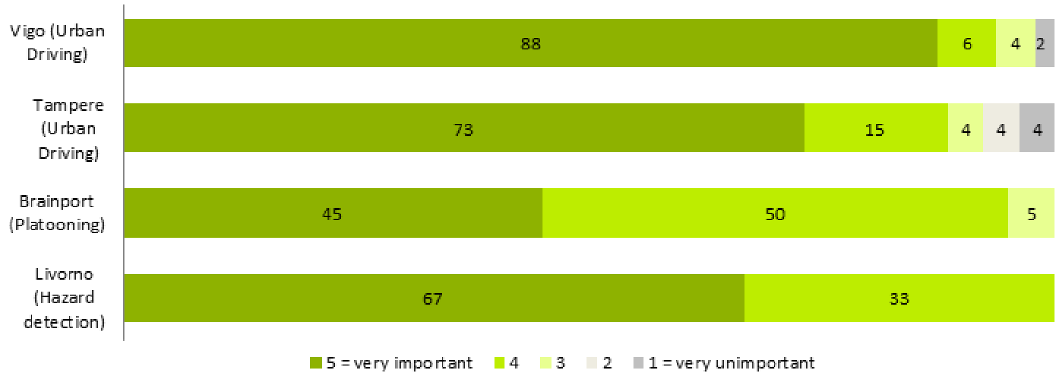

Figure 2. Evaluation of the option to take over the control over the vehicle at any time

Also, various **information that makes the trip safer and comfortable**, as well as such that makes travel time predictable (especially information on possible hazards, waiting time), was evaluated as an important/ a relevant one across all pilot sites. Last but not least, requirements on **customization options,** especially that the information is provided in the own language, were also an important feature from the user's point of view.

Looking into specific functions of the services, almost every participant who experienced the hazard detection (HD) use case in Brainport found **Information on detected hazards** and on **what the vehicle will do about the hazards** most relevant, being rated as (very) important by 36 and respectively 35 out of 38 of the potential users. The survey in Livorno came to similar results – all 12 participants evaluated information on hazards as important and 7 out of 9 require having information on the upcoming manoeuvres of the vehicle. Equally important is the option to take control over the vehicle at any time, it is rated as (very) important by all participants. These results indicate that not only the information itself or the function of the service to detect hazards is important, but considering potential users, developers can ensure trust in the service (at least in the early stages of implementation) by also providing information on the decision of the system based on this information. Further information that users would require in this use case is **general information about the traffic situation** as well as **information on other road users**. Additional information that single users reported to require from the system was acoustic/ tactile signal, Information on traffic jams, unexpected road lane changing users, moving objects, alternative routes, speed cameras, police, fire brigade, ambulance, hazards like ghost riders, slow riders, unreliable road users, large water ponds, upcoming emergency services, unusual crowds on fixed routes. The listed options suggest that users would like to see a join between the service and existing traffic systems.

Looking into another potential use case in highway traffic environment – the platooning – two perspectives were considered – the one of the platoon leader and the one of the person sitting in the following car. As a platoon leader i**nformation on estimated waiting time** to form a platoon and **information on road guidance** is (very) important for all respondents surveyed in Brainport (n=20). Furthermore, **adjusting the distance between the cars** is a (very) important feature to nearly every (16 out of 20) participant. Regardless of the perspective, **the possibility to stop the platooning anytime** is considered (very) important for almost all respondents. As a follower, the **information on estimated waiting time** is rated (very) important by nearly all participants as well, while information on road guidance seems to be slightly less important as a follower. However, from the follower's perspective, it is (very) important to **receive a pre-warning about manual driving** and **to be able to drive the vehicle yourself at any time**. These results indicate a demand for control options when using the service.

In an urban environment, features that improve travel time reliability and increased safety, but also control functions were evaluated overall as (very) important. In Brainport, 70% of participants (30 out of 43) reported that the **information on crowds of pedestrians that could affect the route of the car was (very) useful** but **information on said crowds for other reasons than route was rated rather useless or neutral by 60%** (26 out of 43) of the respondents. Other desired information mentioned by the participants includes **information about waiting/travel time** and **information on what the car does and why**. In Tampere, for the majority of participants (23 to 26 out of 27) **information on route monitoring**, **estimated arrival time, detected pedestrians and cyclists** and **traffic light status is (very) important**. Furthermore, 23 to 24 participants consider **driving the vehicle whenever they want** as well as **controlling the speed and the distance to the car in front** of them (very) important. Similar results can be found in Vigo - for the majority of participants (> 40 out of 48) information on detected pedestrians or cyclists and on upcoming driving manoeuvres as well as the possibility of driving the vehicle manually at any time and receiving all information in your own language are considered (very) important.

The use case tested in Versailles was a special use case of UD as it represents a touristic experience matched together with a carsharing service. Also, the automated driving part of the use case takes place in the Gardens of the castle in Versailles and not on city streets. For almost every respondent (at least 18 out of 19) i**nformation about parking space availability** and **location**, **detected hazards, estimated waiting time** in case no vehicle is available and **estimated time left in self-driving mode**, as well as route guidance, is (very) important. Additionally, respondents assess features like **receiving information in one's language** and being able to **take control of the vehicle** at any time as relevant. These findings indicate that easier access to the service, customization as well as control options are important features of the service.

For the AVP, in Tampere as well as in Vigo, information on the parking process and parking availability is considered as important. In Tampere, **confirmation that the car is successfully** parked is rated very important by most participants (25 out of 28). In addition, **information on estimated waiting time** in case no parking space is available and **waiting time** to retrieve the car on return are considered (very) important by almost every respondent as well (27 out of 28). A quarter of respondents find it important to get **information in their own language** and to **be able to stop the parking process** and park the car themselves. In Vigo, similar to Tampere, the majority of participants (>35 out of 41) believed that **information about the estimated waiting time** in case no parking spot was available and **waiting time** to retrieve the car on return as well as confirmation that the car is successfully parked would be (very) important.

Use Case Observations

Hazard detection (HD)

The main function of the service – detection of hazards and provision of information of detected hazards – is considered as an important one by the users. Still, users require additional information about what the vehicle will do about the hazards suggesting that potential users would like to remain in control over the driving situation. This result suggests also the attached high importance to the option to take over the control at any time.

Platooning (PL)

Potential users evaluated the waiting time for a platoon match as important information which they would like to receive from the service. Additionally, users would like to have the option to stop/disconnect the platooning at any time and take back control over the vehicles if needed/ wanted. These results might indicate that platooning might be a useful or desirable service when it is reliable and easy to use as well as when people still have certain flexibility when using it.

Urban Driving (UD)
Driving in an urban environment is a complex task which requires a high level of concentration by the drivers and interaction with different other road users. The results of the AUTOPILOT surveys suggest that potential users of urban driving require having the option to drive the vehicle whenever they want as well as controlling the speed and the distance to the car in front of them. At the same time, users evaluate as very relevant/ important receiving information on detected VRU and/or other potential hazards. These results indicate a willingness to remain in control over the driving task but the importance of assisting functions such as the provision of additional traffic and driving-related information enabled by IoT. Last but not least, people attach high importance to receiving relevant information in their own language.

Automated Valet Parking (AVP)
Similar to the other use cases, potential users of AVP require remaining in control over the driving task, in this case, the parking procedure. High importance is consequentially attached to the option to stop the parking process and park the car themselves if needed/ wanted, to receive a confirmation that the car is successfully parked, and to get information on waiting time. In this use case, receiving the information in the own language is, similarly to the other use cases, required by a high percentage of the potential users.

Expectations

<u>Overall</u>

Expectations before the actual user testing (see Fig. 5) were collected. The variation is not great among pilot sites (mean value range no more than .5). Users expected their participation to be safe in all UCs, meaning they trusted the researchers. The usefulness of the different services is univocally positive.

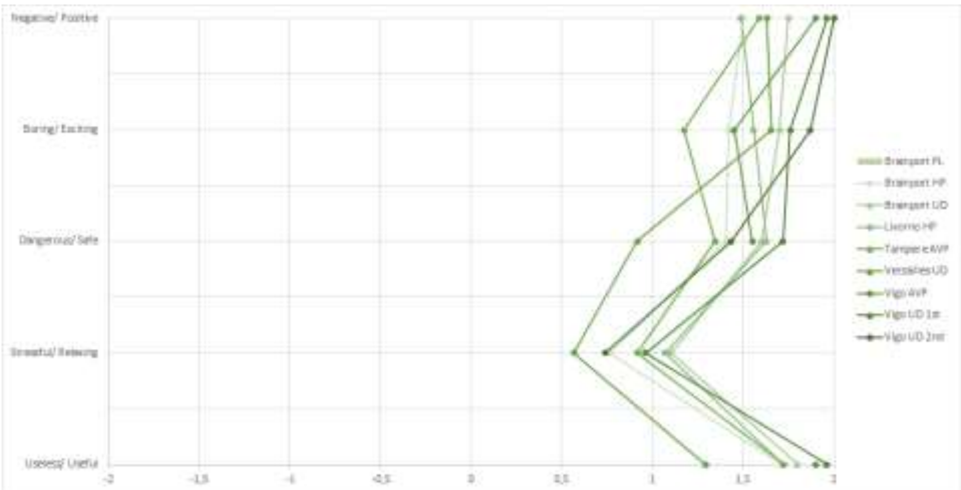

Figure 3: Mean expectations score per pilot site

The evaluation across pilot sites and UCs is positive with higher mean variation noted in expected stress and excitement. **A very small increase is expected to happen in the use of cars in urban areas** mainly when the AVP service will be used. In addition, **no change is anticipated in the use of public transport**. **A difference between Vigo UD and Brainport UD** was found; in the first site **no changes in taxi taking habits are anticipated but in the second a slight decrease is expected**. **UD services**, overall, **are expected to increase more the traffic safety of VRUs compared to AVP services**. In addition, they might **expect to get faster, even if their routes will be longer**.

Similarly, the use of UD services as found in Brainport and Vigo will not affect their existing habits of walking and or cycling. Expected **perceived safety is probably the greatest positive increase across pilot sites** and in the analysis on UC level. **Comfort is expected to increase for services** and UCs but more for UD related services. In addition, the **comfort is expected to change very little for the leader of a platoon formation**; maybe because they will be still in the driving seat. **Parking related stress is expected to decrease most** because of using the AVP service; however, **all stress is expected to decrease** apart from the l**eader's in the platoon formation, which is expected to slightly increase**. Users do believe that using IoT services, regardless of the services, will increase their safety. This finding is important when investigating professional users' trust in the IoT solutions.

No change is expected in existing mobility patterns and use of transport modes across pilot sites and UCs, apart from Versailles UD pilot, where an increase in walking/cycling, as well as an increase in the use of public transport and a decrease in passenger cars is anticipated. Tourists might be easier to change their habits as a tourist when they are away from their established mobility habits. Users believe that the use of UD services would **decrease the use of the motorway** and that they will **certainly be able to take up other activities** when the car is in self-driving mode (based on results collected only in Vigo UD pilot). UD services were perceived as **more beneficial for commuting and short business trip**s, but all UC services were reported beneficial for non-commuting trips. Most users (88%) believe that the **AVP services are beneficial to run errands** compared to 53% of UD services. Users believe that **the UD and AVP services are beneficial for leisure activities** (65% and 64%, respectively) and over half the users (56%) stated that they believe the **AVP service is beneficial for travel trips** and over 75% that are beneficial for **business trips.** Users believe that **AVP services will be very beneficial for long-term parking** (97%).

Users across pilots and UCs are **willing to use the services in the future and especially the UD services (84%)** and **recommend the service to their friends and colleagues**. Most users are willing to pay for the AUTOPILOT services. However, in Brainport pilot, many users (45%) were not sure if they would pay for the HP service as well as another 55% were not sure if they would pay for the platooning service. 60% of users are willing to pay between 100 and 1000 Euros for the addition of such functionalities when purchasing a new car, while14% do not want to pay. Users would pay up to 5 Euros to use the services with almost 40% of them not wanting to pay. Users are willing to pay for the integration into the vehicle but not much if the service was offered as an extra option to a vehicle bought new.

No change in the frequency of use of public transport, passenger car, walking/cycling, taking a taxi or driving in urban environments is reported.

Use Case Observations

Highway Pilot (HP)

In the Highway Pilot users are willing to increase the number of trips they take because of using the respective service. No increase in car use and private car use is expected. The highest increase in perceived safety is anticipated when compared to other pilot sites (see Fig. 6) Users are willing to use and recommend the services, but 45% of them (Brainport) are not sure if they would pay for the service

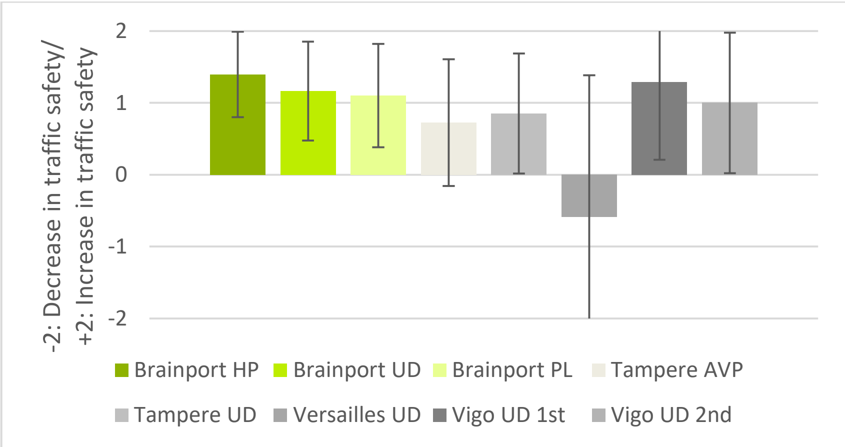

Figure 4: Mean change in perceived traffic safety across pilot sites

Platooning (PL)

The platooning service is expected to bring small change to trips taken. Car use is not increasing because of using this service. A slight decrease in public transport use is expected (-.49±.98) in a -2 to 2 scale. Expectations about changes in duration and distance of trips taken were recorded only for the Brainport PL pilot. A very small decrease in duration is expected (-0.16±1.01) with a small increase in distance (.25 ± .79), meaning users expect to get faster to their destination, even if potentially re-routes occur and even if they decide to go to a destination further away. The smallest increase in travel comfort (-.15 ± .93), but with great variation was reported for the leader role in the platoon formation in the Brainport PL pilot (see Fig. 7). As for comfort, stress is slightly increasing for the leader of the platoon formation but decreases for all other services and the users of the UCs are neutral about the benefit of the service for commuting trips (Brainport PL; 21/39). Users are willing to use and recommend the services but 55% of them (Brainport) are not sure if they would pay for the service. In the Highway Pilot in Brainport, almost 60% of users are willing to pay between 100 and 1000 Euros on top the cost of the car in order to have the HP service. 14% of them do not want to pay and another 14% are not sure if they want to pay or not.

Urban Driving (UD)

Increase in anticipated trips taken because of UD and AVP services are positive but still small with great variations. The increase in car use is too small to be of consideration. Expectations for change in frequency of car use in urban environments were investigated in only in Tampere UD plot. Driving in urban areas like the city centre is expected to increase (.85±0.91) because of the use of the UD service. A small increase is anticipated in using cars during peak hours. In addition, users do not anticipate that the UD service will affect their existing habits of walking or cycling. No change in walking or cycling is expected because of the UD services in Brainport (-.14 ± .74). In fact, a very small decrease is anticipated. Perceived safety increases in all cases, except the Versailles pilot (UD), where the users thought that it would slightly decrease it (-.59±1.97) (see Fig. 6). No change in public transport use is anticipated based on Vigo pilot results. In Brainport UD, a slight decrease in taxi taking is anticipated (-.44±1.16; scale -2 to 2) but in Vigo, in both pilot phases (1st and 2nd), users are not expecting to change their taxi-taking habits. Overall, no change in public transport use apart from Versailles, where an increase is expected (12/18). In other words, they might believe that the mode they experienced was perceived as public or at least for public use. Again, no change of car use is expected, apart from Versailles UD site, where most users reported expected decrease of use the passenger car and/or taxi and use of motorways and increase in walking and cycling.

This finding is mostly related to the car-sharing service offered to tourists. However, we need to keep in mind that tourists might not often select to drive when visiting a foreign country and any related mobility behaviour might differ from their existing and already daily mobility patterns. However, an increase in driving in urban environments is not expected. Users responded that the use of the UD service in Vigo would certainly allow users to take up other activities when the car is in self-driving mode (strongly agree N=12/13). The UD services were perceived as more beneficial (N=90/117; 77%) for business trips than the platooning (14/45; 31%) or the AVP services (15/29; 52%). They are beneficial for commuting and non-commuting trips alike. More than half the users (53%) believe that the UD services are beneficial for running errands and for any other leisure activities (65%). Users across pilots and UCs are willing to use the services in the future and especially the UD services (84%) and to pay for the service (57% of users would pay extra to use the UD services). The maximum price expected a user to pay for UD services is 7 Euros with variation across sites, as the services considerably differ. In Versailles, a mean price for the UD service of 12 Euros would be regarded as expensive.

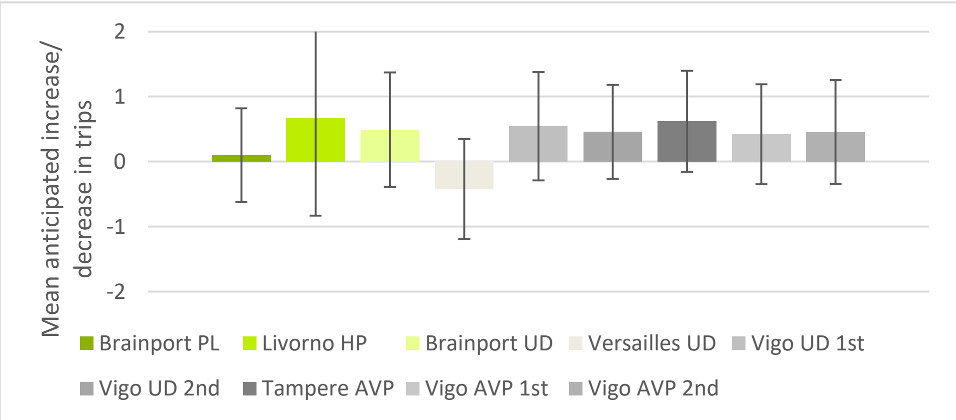

Figure 5: Mean anticipated increase/decrease of trips per user testing pilot

Overall, an increase in the safety of other VRUs is expected more for UD services (see Fig. 8).

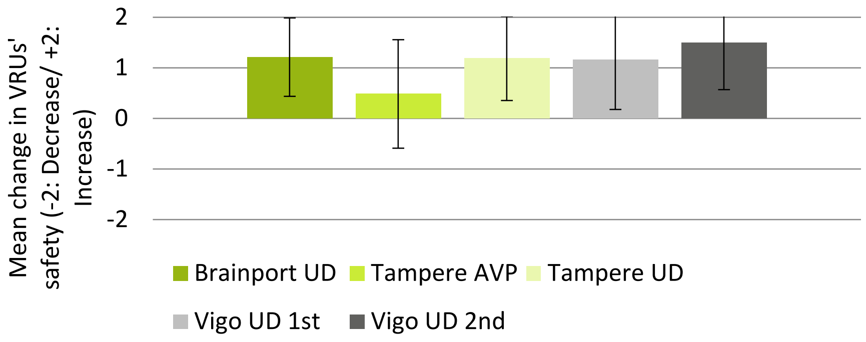

Figure 6: Mean perceived change in safety of pedestrians and cyclists per pilot

No site reported a decrease in travel comfort (see Fig. 9). The highest increase was found in Vigo UD pilots in both phases (1.71±.46 and 1.63±.58).

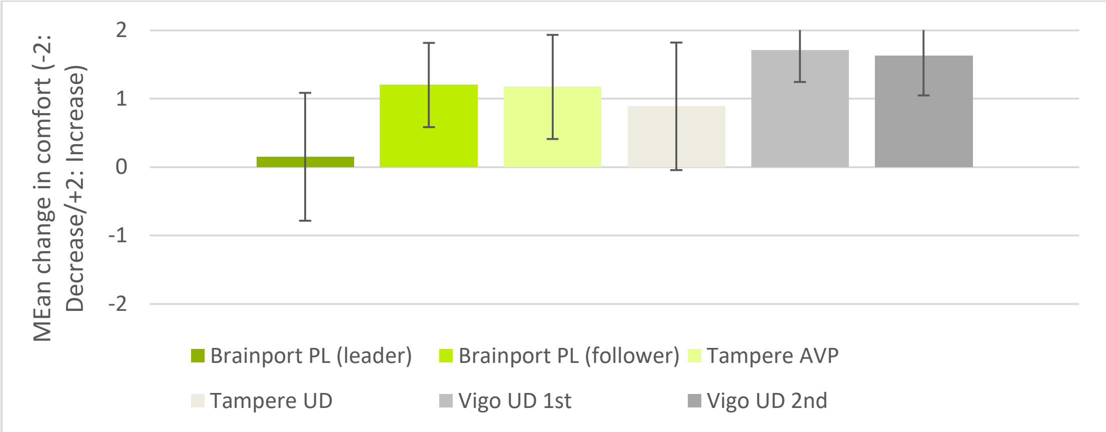

Figure 7: Change in comfort across pilot sites

Automated Valet Parking (AVP)

Users testing the Automated Valet Parking (AVP) in Tampere, expect to take an increased number of trips compared to their current trip frequency. Increase of car use is expected because of AVP. A small increase is anticipated in using cars during peak hours. A small increase in perceived traffic safety is expected (see Fig. 6). Safety of other VRUs is expected to increase less for AVP services (.48±1.07) (see Fig. 8). Parking related stress is anticipated to decrease most (Tampere AVP; 1.48±.87) (see Fig. 10). No change in public transport use is anticipated. The service is beneficial for commuting, non-commuting trips, leisure activities, but mostly for running errands (88% of users). Over half the users (56%) stated that they believe the AVP service is beneficial for travel trips. 78% of users in both Vigo AVP pilots stated that the service is beneficial for business trips and 97% users believe they are beneficial for long-term parking (Tampere). Users are willing to use and recommend the services and to pay for the service (51% would pay extra to use the AVP services with a maximum of 5 Euros). Specifically, in Tampere, a mean price of 6 Euros for the AVP service would be considered expensive. In Vigo pilot, users were willing to use the AVP service with bonus options (74% and 59% per pilot phase respectively).

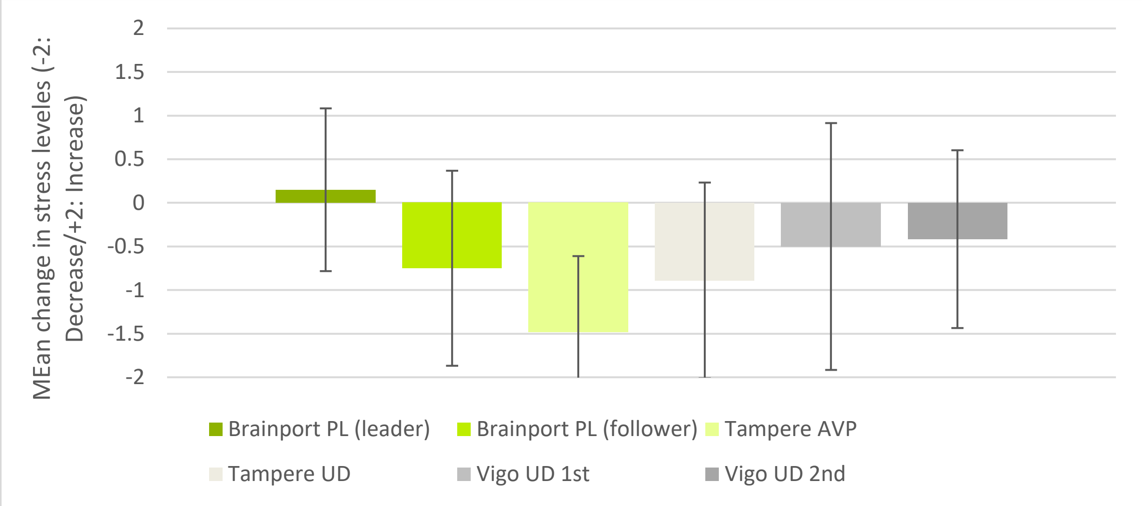

Figure 8: Change in levels of stress across pilot sites

Users were asked to elaborate on their reasons (i.e. free text answers) for being interested to use the services at each pilot site. The answers have been clustered to the categories shown in Table 7. Overall, it appears their experiences were positive, as it was expected before testing took place (see Fig. 5).

Table 7: Reasons for interest in service (free text analysis; dominant topics)

INTEREST IN SERVICE								
Brainport HP	Brainport UD	Brainport PL	Vigo UD 1st	Vigo UD 2nd	Vigo AVP 1st	Vigo AVP 2nd	Tampere AVP	Versailles UD
• Improves road safety • Pleasant and comfortable experience • Increase visibility/ Conspicuity, reduces traffic congestion, increases relaxation • Automated braking and steering are prerequisites for use • Use is cost-dependent • Possibility to intervene gives sense of control • Added value for patients or confectioners (especially carrying fragile/	• Environmental impact • Lower car ownership • No waste of time • Seamless operation, safer and more relaxed experience • Easiness to use • Useful for older travelers/drivers • Students prefer a bike • Advantages of public transport and private car in one vehicle • Cheaper and more convenient than a taxi • Avoid taxi chit chat and can focus on work (in-car work activity) • Alternative to car but not to public transport or bike	• Smoother traffic flow • Pleasant experience • Flexibility to turn on/off system • Leader does not relax but follower does • Added value for traffic jams or long journeys	• Opportunity for other in-vehicle activities • Useful for driving in road contexts that users avoid (e.g. by a cliff). • Road curvature and geometry are affecting the decision to use • Use in certain affective states' conditions (e.g. tired, sick, stressed) • TLA and speed assist is a prerequisite for use	• Thrill of driving will negatively affect the service use • Willingness to use increases if journey duration is long, road context is monotonous or on demanding busy, urban roads • A system responds better than a person and thus more desirable • Reliable and comfortable experience but still the driver needs control of the vehicle	• Liability and malfunctions are perceived as great hindrances • Personal comfort • Decreases damages to your own car (e.g. scratches) when trying to squeeze in a small parking space • Optimal use of parking space	• Service is Interesting, saves time, decreases stress, increases comfort • Maturity of service is an obstacle in acceptance • Use it in urban environment • Increased added value for older users	• Increased potential for use in large parking and working spaces • Fees should not exceed much existing parking fees in order for the service to be attractive • Eases parking space search and saves time • Pleasant • Reduce parking related accidents • For families with children will be very useful • User has not to remember the location of the parking space and	Pleasant, comfortable, Receiving information (i.e. PoI notifications) increases the pleasantness of the trip.

INTEREST IN SERVICE								
sensitive load) • Users with visual impairment would benefit from a car that "sees" for them • Increased usefulness to unfamiliar road contexts • Added value for commuting and long-distance journeys							loses time trying to find it. • Vicinity of service to where the person works and/or lives is important for potential use	

Concerns

Overall

The participants were asked with an open question whether something happened during the drive that made them feel unsafe or uncomfortable. The question was asked at all pilot sites and respective use cases, and 90 participants answered the question. The answers were open coded to identify common topics among the responses and five main themes could be identified:

- worry that the system will fail in some way (e.g. detection of objects, hitting pedestrians)
- unexpected or harsh braking or accelerations
- otherwise uncomfortable driving style (e.g. cut-ins, lane change, jerks, swaying, slow speed, driving close to objects)
- technical failure of the system (e.g. navigation, take-over, manual braking)
- properties of vehicle or automation/service (e.g. uncomfortable seat belts, turning of the steering wheel, HMI, automatic gear shift)

The distribution of main themes according to the pilot site and use case is presented in Figure 9. For the use case AVP (Tampere and Vigo) most of the participants worried that the system would fail in some way. The answers do not allow concluding any similarities among the other use cases. However, in Brainport most of the comments related to the driving style which was otherwise uncomfortable and in Versailles, most comments were related to unexpected or harsh braking and accelerations. For UD in Tampere, most participants mentioned unexpected or harsh braking and accelerations and an otherwise uncomfortable driving style and UD in Vigo most comments related to either an uncomfortable driving style or technical failure of the system.

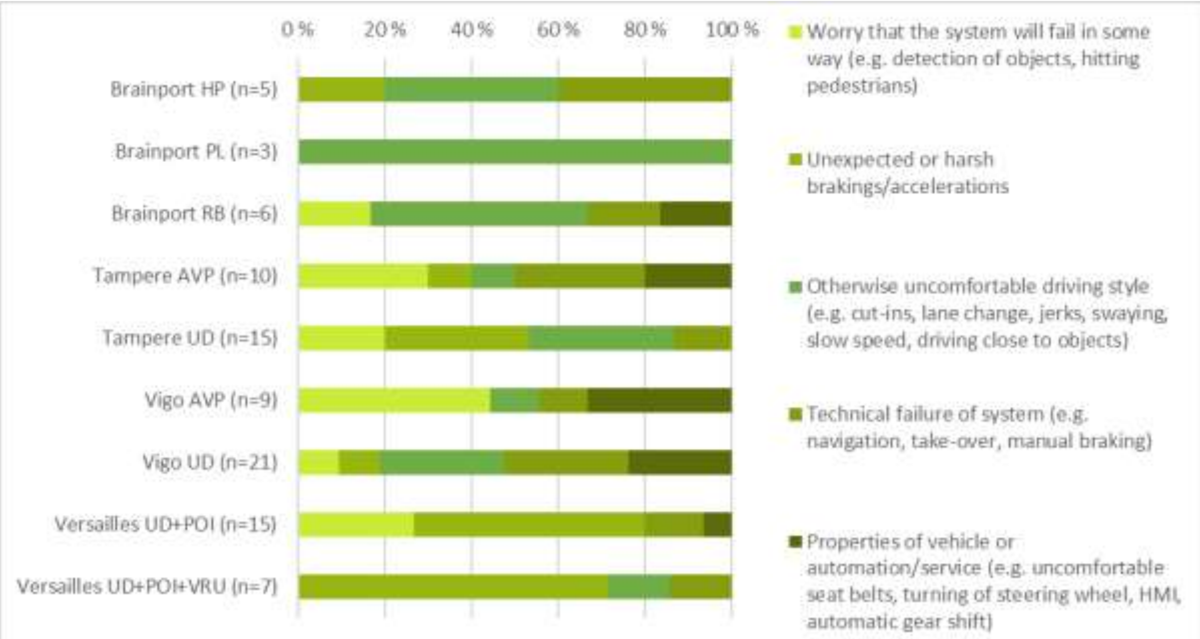

Figure 9: Common themes in other occurrences that made participants feel unsafe or uncomfortable during the test according to pilot site and use case

Participants were asked to comment on their concerns about various aspects of the service. The same question was asked at all test sites and use cases but it included different aspects. The aspects were ranked on a five-point scale, but the scales differed among pilot sites. In Vigo and Brainport the scale was: Not at all concerned/Neutral; slightly concerned; Somewhat concerned; Moderately concerned; Extremely concerned. In Versailles and Tampere, they were ranked from Very concerned to Not at all concerned, with Neutral as a central choice. Since different scales were used the answers were compared based on the share of maximum concern on the respective scales which were: extremely concerned (Vigo and Brainport) and very concerned (Tampere & Versailles). Common for pilot sites and use cases were the following aspects: privacy of my data, security of my data, Security of the self-driving vehicle (Brainport: My safety in the vehicle) and Liability in case of accident or malfunction.

The distribution of responses for the concern Privacy of my data is presented per pilot site and use case in Figure 10. No use case-specific similarities were found for the results, instead, the share of maximum concern seems to depend more on the pilot site. The share of maximum concern was 20–21% in Vigo, 5–9% in Brainport, 10% in Versailles and 12–19% in Tampere.

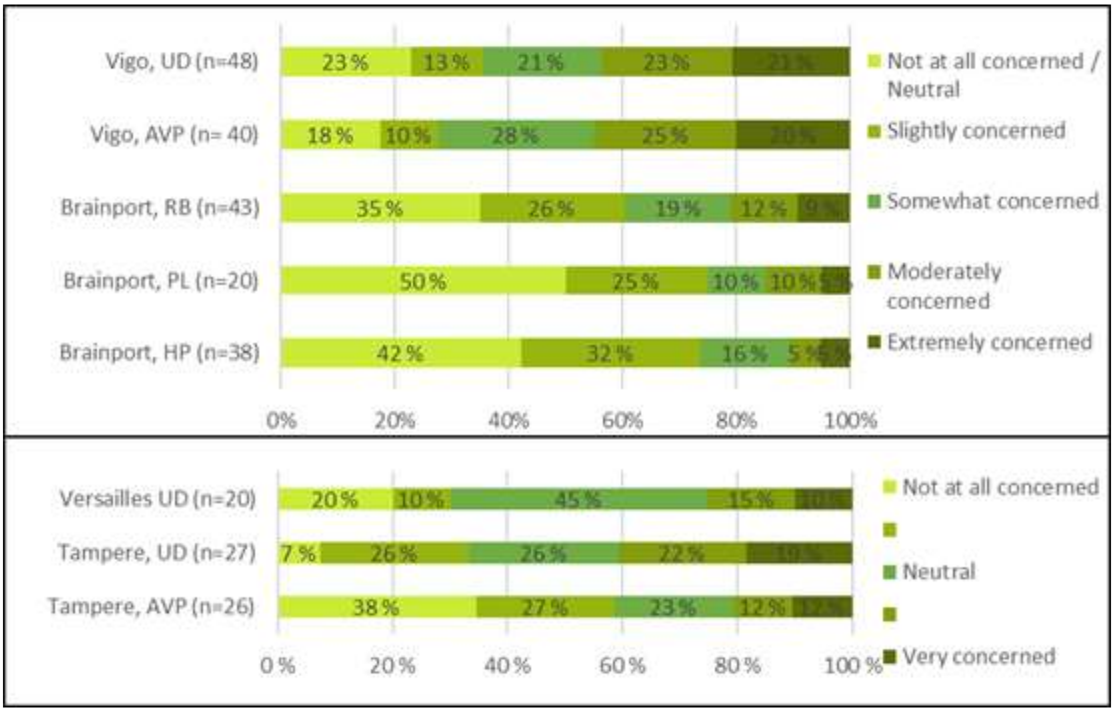

Figure 10: Concerns related to the tested service: Privacy of my data

The distribution of responses for the concern "Security of my data" is presented per pilot site and use case in Figure 11 . No use case-specific similarities could be drawn, instead, the share of maximum concern seems to depend more on the pilot site. The share of maximum concern was 23–27% in Vigo, 5–14% in Brainport, 15% in Versailles and 7–16% in Tampere.

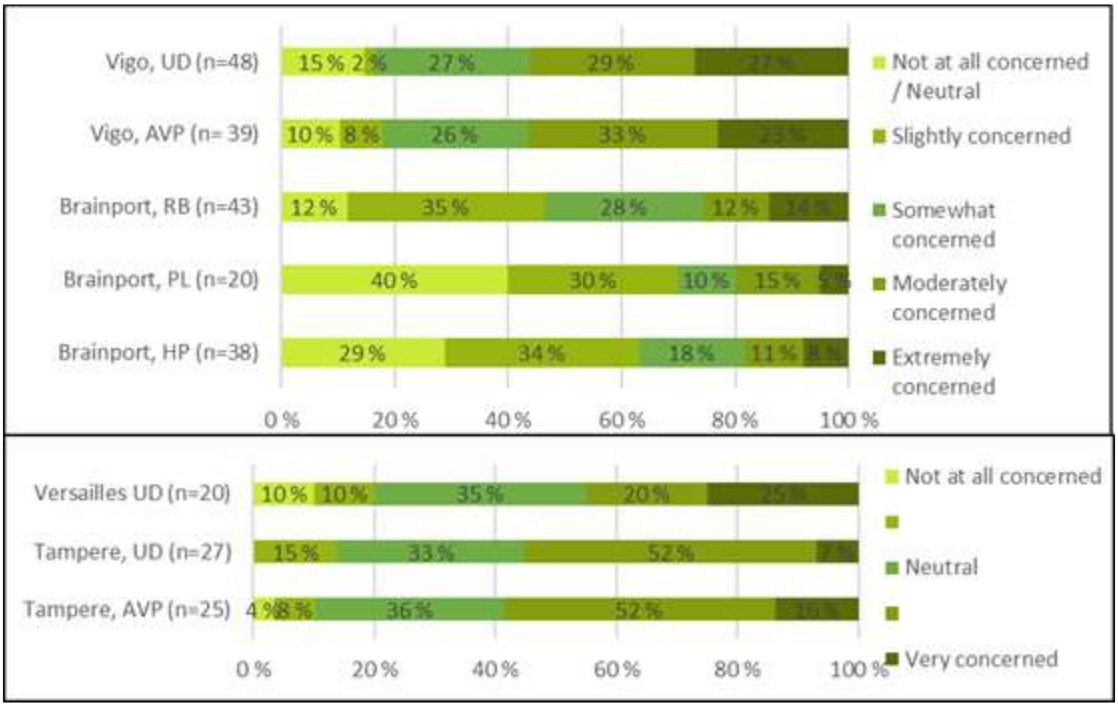

Figure 11: Concerns related to the tested service: Security of my data

The distribution of responses regarding “Security of the self-driving vehicle” and “My safety in the vehicle” are presented per pilot site and use case in Figure 12. No use case-specific similarities were identified for the results, instead, the share of maximum concern seems to depend more on the pilot site. The share of maximum concern was 28–33% in Vigo, 0–5% in Brainport, 47% in Versailles and 7–12% in Tampere.

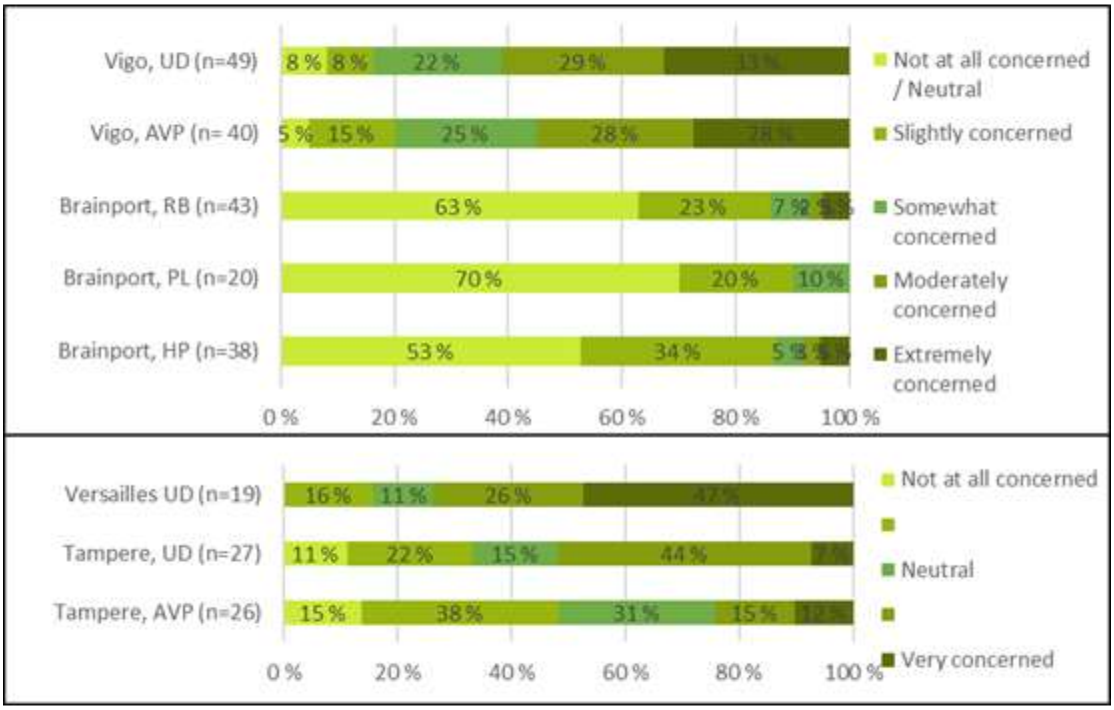

Figure 12: Concerns related to the tested service: Security of the self-driving vehicle (Vigo and Tampere) / My safety in the vehicle (Brainport)

The distribution of responses regarding Liability in case of accident or malfunction is presented per pilot site and use case in Figure 13. No specific similarities were found for the use cases, instead, the share of maximum concern seems to depend more on the pilot site. The share of maximum concern was 0–10% in Vigo, 0–5% in Brainport, 30% in Versailles and 4–7% in Tampere.

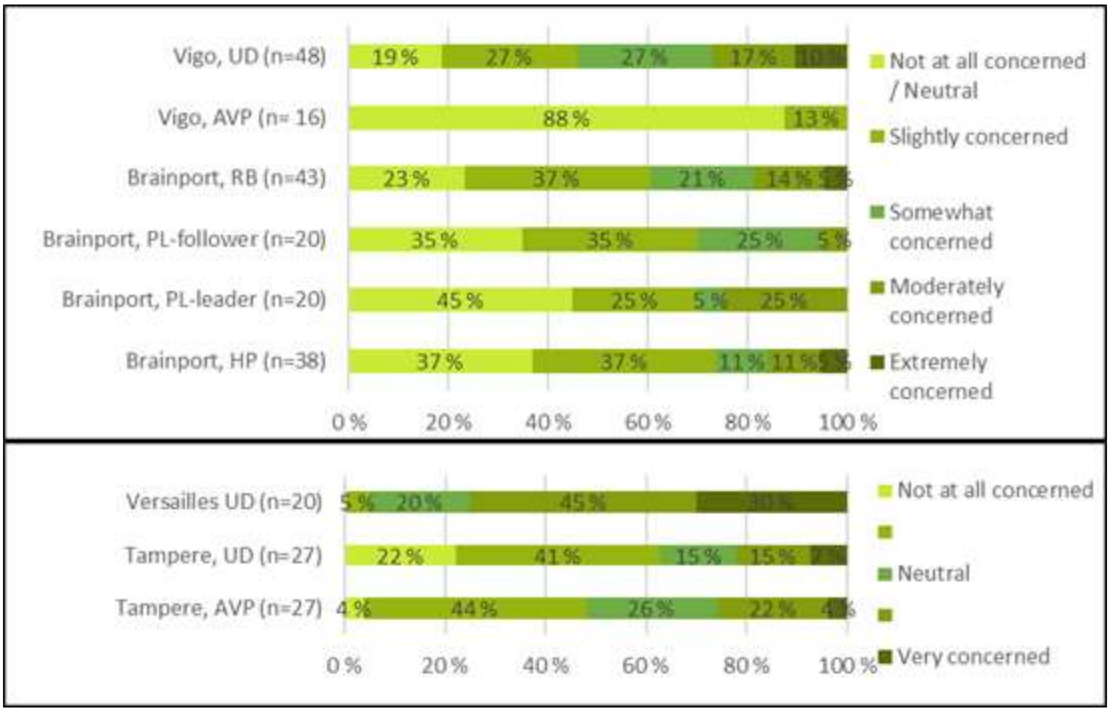

Figure 13: Concerns related to the tested service: Liability in case of accident or malfunction

The participants were asked about their concerns regarding five additional aspects in Vigo, Versailles, and Tampere:

- Safety of driver and passengers inside the vehicle
- Safety of pedestrians and/or cyclists/VRUs
- Safety of passengers in other vehicles
- Security of payment
- GPS tracking

A different scale was used in Vigo (as indicated above), so the answers were compared based on the share of maximum concern on the respective scales which were: extremely concerned (Vigo) and very concerned (Tampere & Versailles). The share of responses for the different concerns is presented per pilot site and use case in Table 8. No use case-specific conclusions could be identified. The highest share of very/extremely concerned was for UD in Vigo for security of payment, for AVP in Vigo for GPS tracking, for UD in Versailles for safety of pedestrians and cyclists and for UD in Tampere for Safety of driver and passengers inside the vehicle. Overall the share of very concerned was substantially higher in Versailles than in the other pilot sites.

Table 8: Concerns related to tested service: share of participants being Extremely concerned (Vigo) and Very concerned (Versailles and Tampere).

	Vigo UD	Vigo AVP	Versailles UD	Tampere UD
Safety of driver and passengers inside the vehicle	10% (n=48)	11% (n=37)	47% (n=19)	26% (n=27)
Safety of pedestrians and/or cyclists/VRUs	21% (n=43)	21% (n=33)	68% (n=19)	15% (n=27)
Safety of passengers in other vehicles	11% (n=44)	15% (n=34)	58% (n=19)	19% (n=26)
Security of payment	38% (n=48)	15% (n=39)		
GPS tracking		25% (n=37		

To summarise the concerns related to the tested services. Since a different scale was used among pilot sites, the answers were compared based on the share of maximum concern on the respective scales. All in all, it seems that the share of maximum concern depends more on the pilot site than the use case. The highest share of maximum concern was for the aspect Security of the self-driving vehicle in Vigo, the safety of driver and passengers inside the vehicle in Tampere, Safety of pedestrians and cyclists in Versailles and Security of my data in Brainport. Comparing pilot sites among each other, the highest share of maximum concern, in general, was in Versailles whereas the lowest share, in general, was in Brainport.

Related to comfort, participants were also asked to comment on their perceived comfort of various aspects of the service. The same question was asked at all test sites and use cases (except AVP in Tampere) but it included different aspects. The aspects were ranked on a five-point scale from Very comfortable to Very uncomfortable, with Neutral as a central choice. Common for pilot sites and use cases were the following aspects: smoothness of the ride, acceleration behaviour and braking behaviour.

The distribution of responses for the comfort of the smoothness of the ride is presented per pilot site and use case in Figure 14. In general, a majority of participants found the smoothness of ride as comfortable except for or the urban driving in Vigo and Tampere, where 74–82% of participants said they felt uncomfortable. For urban driving in Versailles, no participant indicated feeling uncomfortable.

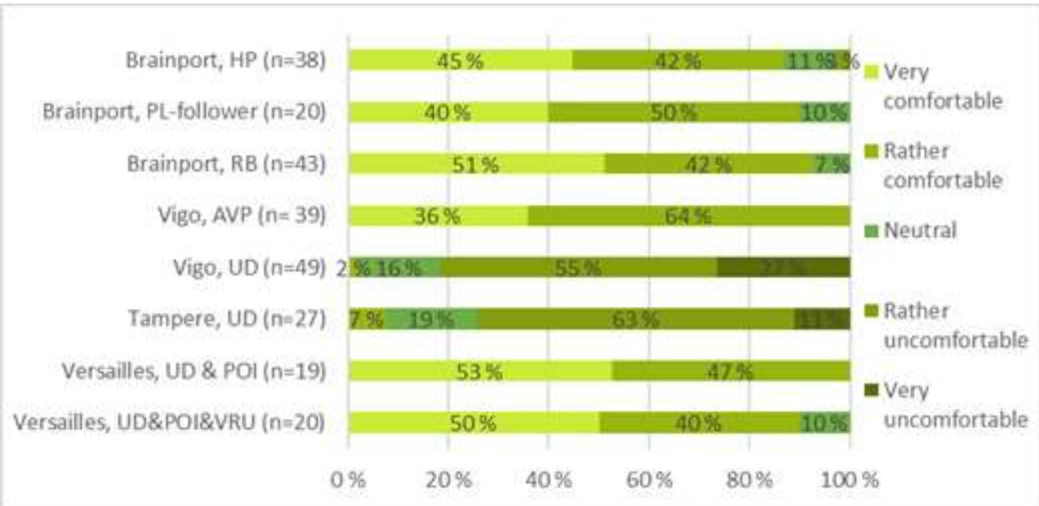

Figure 14: Comfort related to the vehicle behaviour: Smoothness of ride.

The distribution of responses for the comfort of Acceleration behaviour is presented per pilot site and use case in Figure 15. For the urban driving, the share of participants feeling uncomfortable was 74% in Vigo and 23% in Tampere. For urban driving in Versailles and AVP in Vigo, no participant indicated feeling uncomfortable. In Brainport, 7–15% of participants found the acceleration behaviour “uncomfortable”.

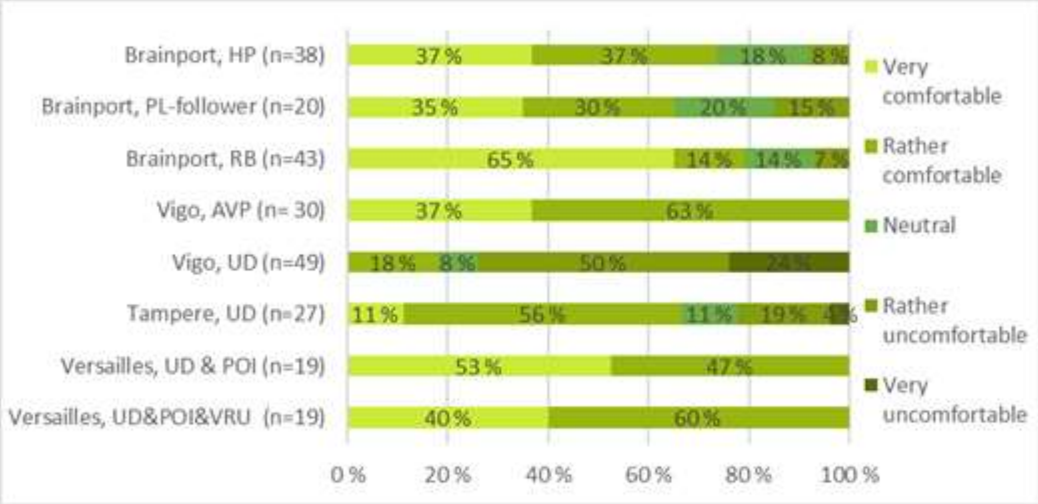

Figure 15: Comfort related to the vehicle behaviour: Acceleration behaviour.

The distribution of responses for the comfort of Braking behaviour are presented per pilot site and use case in Figure 16. For the urban driving, the share of participants feeling uncomfortable was 76% in Vigo, 66% in Tampere and 16–26% in Versailles. In Brainport, 6–13% of participants found the braking behaviour uncomfortable. For AVP in Vigo, no participant indicated feeling uncomfortable

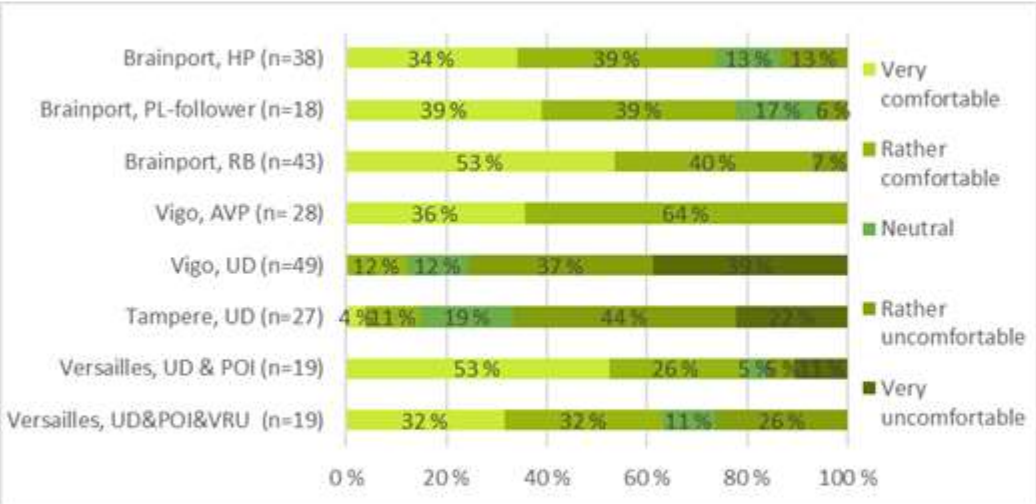

Figure 16: Comfort related to the vehicle behaviour: Braking behaviour.

The participants were asked about their comfort regarding seven additional aspects depending on the pilot site:

- turning behaviour of the vehicle
- distance kept to pedestrians / pedestrians and cyclists
- distance kept from road markings
- distance kept from obstacles
- distance kept from potholes
- distance of the following vehicle (PL leader) / vehicle in front / other vehicles
- behaviour when approaching pedestrians and cyclists at intersection/VRU approaching

behaviour

The share of respondents feeling uncomfortable (responses: rather and very uncomfortable) for the different aspects are presented per pilot site and use case in Table 9. For the turning behaviour, 48% of participants in UD-tests in Vigo felt uncomfortable. For distance kept to pedestrians 71% of participants felt uncomfortable in UD in Tampere. For distance kept to road markings 43–62% of participants felt uncomfortable for UD in Vigo and Tampere. For distance kept from obstacles, 71% of participants for UD in Vigo felt uncomfortable. The share of participants feeling the behaviour when approaching as uncomfortable for urban driving was 72% in Vigo, 42% in Tampere and 11–26% in Versailles.

Table 9: Feeling of uncomfort related to tested service: share of participants feeling rather uncomfortable and very uncomfortable

	Brainport HP	Brainport PL-follow.	Brainport PL-lead.	Brainport RB	Vigo UD	Vigo AVP	Versailles UD +POI	Versailles UD+POI +VRU	Tampere UD
Turning behaviour of vehicle		0% (n=20)			48% (n=48)	0% (n=37)			
Distance kept to pedestrians / pedestrians and cyclists				2% (n=43)		0% (n=15)			71% (n=24)
Distance kept from road markings	8% (n=38)	0% (n=20)			43% (n=49)				62% (n=26)
Distance kept from obstacles	11% (n=38)				71% (n=31)	0% (n=26)			
Distance kept from potholes	26% (n=38)								
Distance of following vehicle (PL leader) / vehicle in front / other vehicles			0% (n=20)	10% (n=20)	43% (n=7)	0% (n=18)			
Behaviour when approaching pedestrians and cyclists at intersection/VRU approaching behaviour					72% (n=18)		11% (n=18)	26% (n=19)	42% (n=26)

To summarise, the comfort related to the tested services, the answers were compared based on the share of participants feeling uncomfortable. It seemed that the use case urban driving, in general, had higher shares of participants feeling uncomfortable but the pilot sites and use cases differed too much to make any use case-specific conclusions. The highest share of participants feeling uncomfortable was for the aspect distance kept from potholes and acceleration behaviour for Brainport; smoothness of ride, acceleration behaviour, braking behaviour and distance kept from obstacles and behaviour when approaching VRU in Vigo; smoothness of ride, braking behaviour and distance kept to pedestrians in Tampere and for braking behaviour and behaviour when approaching

VRU in Versailles.

Participants were also asked if any other behaviour made them feel uncomfortable. This was done for platooning in Brainport, where in total 7/20 participants indicated some behaviour made them uncomfortable, and urban driving in Tampere where in total 12/27 participants responded. The answers were grouped to identify common themes and in total 15 out of 19 responses were related to the driving style of the vehicle e.g. jerks, swaying, unstable, sudden braking and steering, short stopping distance to pedestrian and lack of human touch. In Brainport, one participant mentioned that they felt uncomfortable due to not realizing when they were platooning or not, and another participant due to repetitively joining and leaving the platoon. In Tampere, one participant felt uncomfortable since it seemed that the vehicle would not stop once approaching the pedestrian.

Specific Use Case Observations

The ride balancing function test in Brainport included questions regarding smartphone use whilst using the service. A majority (67%) of respondents indicated that they used the smartphone application whilst using the service. Over half of participants that used the application thought that they would feel slightly or very trustful/ confident. Participants were most confident about the car safety features and the least trustful on phone GPS accuracy.

Role of individual characteristics

Because of the small sample size, no general conclusions regarding individual characteristics can be derived from the pilot tests. However, there were several individual characteristics, which affected the evaluation of the use cases/ services during the tests. Thus, we have presented in the following some of these.

Motion sickness

Participants were asked whether they experienced motion sickness in the urban driving test in Tampere and platooning test in Brainport. Two participants indicated that they experienced motion sickness in Brainport and one in Tampere. They provided the following descriptions of the situation:

- *"Yet I can imagine that this could happen on longer distances, especially in a following car."*
- *"This is mainly caused by sitting in the back."*
- *"I am very sensitive to motion sickness as a passenger, so no wonder if some of such feelings occur in such a situation."*

Considering motion sickness when driving autonomously might be important, especially when evaluating potential time use in the vehicle and potential in-vehicle services. However, we do not have sufficient information on the effect from the pilot site tests, so that potential implications have to be considered in further development phases.

7 Discussion

Results and study set-up discussion

Determining user acceptance of automated and connected vehicles (CAVs) is a complex process. CAVs are far more complex than most systems that have been subject to traditional user acceptance tests. Vehicles do not have simple functions but show a wide variety of behaviours in constant interaction with the environment and other traffic. Moreover, there are hardly any fully automated vehicles that can be tested in real traffic on European roads. In the case of AUTOPILOT, the focus of the evaluation was on IoT, whose functions cannot be easily distinguished from vehicle behaviour by a naive user.

Given the challenges, in AUTOPILOT we have created a rather unique opportunity for interested people from the general public to try out a variety of services enabled by CAVs and IoT. Although many studies have done surveys with large numbers of people, including our own online survey, not many tests have yet been performed where people can really experience driving in such a vehicle. That it is not a simple study was demonstrated by the many difficulties we encountered in obtaining permission to have people inside a CAV from the road authorities, companies providing vehicles and ethical commissions of research partners. This is the reason that most tests were either conducted with participants sitting in the back seat, while the vehicle was being driven by a professional safety driver, or participants were only allowed to observe the vehicle from the outside, except in Versailles where the participants were driving and the professional safety driver was sitting behind and had the possibility to stop the vehicle by pressing a button. Most tests were also not on public roads but were performed on dedicated areas without other traffic (although some driving was done in mixed traffic, such as in the platooning use case in Brainport). In the case of the pilot tests in Livorno, we didn´t get permission from the car provider to give test users the opportunity to sit in the automated vehicle. As a result, the user evaluation was based on an observation of a demonstration of the use case by the potential users which provide a limited real-life experience with the technology.

These set-ups required rather a lot of imagination from the participants on how the services tested could operate in the future in real situations. This was one of the reasons why participants were briefed by using storyboards, presenting a story and pictures on how the service was envisaged. Although this made the user tests quite limited and unrealistic, the AUTOPILOT project still managed to perform a good and unique set of user tests, investigating user acceptance based on experience instead of only descriptions.

Originally, it had been envisaged to use a solid methodology for organising user testing, based on the FESTA methodology for Field Operational Tests (FOT), and using technology acceptance models to formulate questions. During the project, it emerged that the tests could not be performed as FOTs, but more as demonstrations. Participants were briefed that they would experience technology that was not faultless and that their role was to provide feedback, concerns and ideas for improvement, rather than making a final judgement on the service, which is in line with the idea that users are seen as “co-designers” rather than judges in the AUTOPILOT evaluation.

In general, participants were happy to play this role and made many valuable remarks. For most of them, it was a good experience and they were positive about their participation. The positive overall evaluation is also related to the technology being exciting and novel. Most participants were interested in technology and new innovations (and for such reasons showed interest in participating). Although recruitment was different in the different pilot sites, a large proportion of the participants were not familiar with CAD or IoT, although of course, most had an interest in new developments.

User testing was carried out mostly in the spring of 2019, i.e. later in the project. Proper piloting of user tests was not always possible and not all test sessions went according to plan.

There were several reasons why user evaluation encountered severe limitations and delays:

- The technology used in the use cases was often not ready (or only until very late in the project) to be tested by users. Testing acceptance can only be done if the system is functioning properly, with only minor errors. During the tests technical problems were still encountered, which sometimes led to the participant having to be told how the vehicle should have behaved instead of experiencing it for themselves.
- Interfaces were not always very user-friendly, as the technology development did not focus on this, but for user testing, this is not ideal.
- Getting permission to test was sometimes a long process.
- The CAVs were often only available for a very limited time, as well as technical partners and test areas, so participants could only drive for a short amount of time in the vehicles.
- The environment was often quite artificial, for example driving in areas without traffic.
- Driving was usually very slow, for safety reasons, making it not very realistic.
- Although we had initially developed a long questionnaire with lots of relevant questions, piloting showed that it was not possible to ask all questions, so test-sites had to limit the questionnaire, using only questions that were directly relevant for the particular use case in order to avoid participants becoming fatigued, bored, or demotivated, also in proportion with the time they were in the vehicle or observing the service.

Despite all the problems, we still have a very valuable data set. Hopefully, further CAD and IoT projects will be able to build on our experiences and contribute to a growing knowledge base on how users perceive these new technologies and services.

Expectations were in the majority positive, but it is important to keep in mind that people usually are not very consistent about their expectations and even more so about their predictions of what they are planning to do with these services. This notion is emphasized even more by the fact that these technologies and the AVs will not be available in the near future and they are aware of it. Considering transport issues and urban planning, the provision for IoT services in AVs should not increase or create traffic but improve wellbeing.

The results of the pilot tests show that sometimes test users felt uncomfortable due to the driving style of the vehicle, about technical aspects or worry about system failure. This indicates that the technology of automated vehicles still needs development especially regarding braking and steering behaviour.

Furthermore, no use case-specific similarities were found for the results, but instead, the share of maximum concern seems to depend more on the pilot site. This can relate to many things – one might be the type of users.

Regarding the aspect “comfort”, there was a higher share for the use case urban driving. Underlying reasons might be, again, a different type of users or the fact that the user tests were more large scale for urban driving, had a longer route and a more complex environment.

The overall positive evaluation can be also related to the technology being exciting and novel. Most participants were interested in technology and innovations (and therefore showed interest in participating). The channels used for recruitment attract technology-friendly users, but this limitation was accepted as the services were not ready for real-life pilots and also, it can be expected that technology aware users might be among the first user group of the technology, i.e. the early adopters of the technology.

Recommendations for future projects testing automated and connected driving

As discussed above, analysing user acceptance of automated and connected vehicles as a part of field test projects is a challengeable task. On the one hand due to the maturity of the technology developed and tested within research and development projects and on the other due to the challengeable task of presenting the technology to a naïve user and setting a common ground of discussion on requirements and concerns about it.

The following recommendations for future projects can be derived from the experiences and lessons learned with/ from the user evaluation made in the AUTOPILOT project:

Planning the tests:

- ***Challenges:***
    - (regular) exchange with and support from the pilot site team (esp. development team)
    - creating a feasible test protocol
    - developing measurement instruments which allow a comparison between different pilot sites and/ or use cases
    - set up a documentation format
    - gaining test permissions
- ***Recommendations:***
    - when planning pilot tests with potential users from the general public, a close exchange with the pilot site team and the technical validation team is needed in order to ensure (among others) a realistic timeline for the user tests, support for recruiting the users, planning feasible tests, etc. Besides the regular exchange, a clear division of the roles and the tasks between the pilot tests team and the evaluation team is needed, but also a mutual understanding of the needs of each task. Main points to consider include: define the need for exchange, organize regular exchanges, and divide responsibilities; also, a lesson learned from the project is that vehicles, technology and technical teams are often available for a limited time so a time alignment between the test team and the evaluation team is essential
    - when creating a test protocol, the evaluation task has to consider the feasibility of the planned activities – main points to consider are: duration of the full test experience from user perspective (including filling out the questionnaires, interviews, introduction, tests), division of the responsibilities, alignment with the technology progress of the use case – what can be really demonstrated during the pilot tests and what does the user experience during the test
    - in research project such as the AUTOPILOT project, where different pilot sites and additionally different use cases are considered, creating evaluation instruments which allow for comparable results is a challengeable task to do; we still recommend aiming for a common research focus, but allowing for a flexible structure of the instruments which enable considering pilot site or use case-specific issues (for instance, we focus on overarching research questions on how might IoT enhance, enable and/ or improve user experience and acceptance of the technology and

looked at requirements, concerns, and expectations from user perspective, however, we tailored some of the question categories according to the use case or planned tests(demonstrations)
    - prior to the tests, a common documentation format has to be defined by the evaluators in order to ensure that all relevant information is captured during the tests (e.g. ensuring a link between pre and post questionnaires from the same test person, documentation of interview responses, documentation of technical performance); this is especially important when the evaluation activities on a pilot site are considered by pilot site teams not directly involved in the evaluation task
    - Ensure users adequately familiarise with the technologies
    - plan time and resources for gaining test permissions, collect information of relevant requirements in the early planning stage; at EU level: it is important to forward the standardization of the processes for test permissions in order to accelerate the process

Involving the general public in the development process and managing expectations:

- ***Challenges:***
    - managing the expectations regarding the state of development of the technology (e.g. lowering expectations of enthusiasts)
    - motivating people to give constructive improvements suggestions rather than a pure evaluation of the tested use case
- ***Recommendations:***
    - to manage expectations of the users, the goal of the tests, a standard introduction of the use case and a realistic description of what the user can expect to happen during the test is needed; here one should ensure not setting up too high expectations (e.g. by inviting people to experience "real-life" automated driving) or promoting a technology which is in an early development stage; too much information, on the other hand, or too detailed description of what the technology *still cannot do* should also be avoided; focus better on the goal of the tests (testing use cases of the technology), the role of the test users (e.g. as a "co-designer"), and what the test will look like (e.g. a demonstration vs. sitting at the back seat of an automated vehicle)
    - Re-visit acceptance within automation, as the role of the user becomes passive and vague, control and trust might be important parameters to investigate further.

Introduction of the technology to test users:

- ***Challenges:***
    - introducing the use case in a short and understandable way
    - not affecting the evaluation of the participants too much by using evaluative descriptions (such as how "efficient", "useful", or "complex" the use case/ service is)
- ***Recommendations:***
    - use an understandable and simple storyboard which represent the potential real-life use of the technology, avoid very hypothetical and/ or theoretical description
    - when not possible to demonstrate/ experience the full use case, create storyboards with pictures (rather simple text) in order to provide the full story for the valuation to the user
    - provide a standardized description to the test participants in order to compared results from the tests, control (when possible) the information they receive (e.g. in some tests engineers or developers of the technology are available to answer questions of the test users, however, there is a risk to go too much into details about technical details which can distract the users from understanding the use case),

avoid evaluative descriptions; this should be an important part of the test protocol
  - align with the previous point – managing expectations – in order to avoid setting up too high (or too low) expectations on the use case which potentially affect the evaluation of the use case stronger than the experience itself, aim for an objective and simple description
  - adapting communication skills to the technology literacy of the user to ease the understanding and familiarisation process.

Assessing user evaluation of the use case:

- ***Challenges:***
  - a clear definition to the participants of what is evaluated,
  - setting up a baseline,
  - making the current state of the development transparent and understandable (e.g. lack of user-friendly or high-end human-machine-interaction- interfaces because of focus on the technology in the development process)
- ***Recommendations:***
  - make clear what is the object of the assessment by defining the implications for the users (e.g., in the case of AUTOPILOT we had to focus on the benefits of IoT for autonomous driving rather than on the evaluation of the autonomous driving as a use case itself; hence, we build up the questions on the requirements and concerns of the users around the data and information provided as well as on the features enabled due to IoT. In other words, we considered the consequences of the IoT for the users, i.e. what he/ she can observe or receive as a service from the IoT connectivity rather than explaining what IoT is and asking about potential requirements on this connectivity.)
  - make the baseline (if any) clear to the participant – do they have to compare using, for instance, a highway pilot with driving manually on the highway or with riding autonomously without connectivity on the highway? Setting up a baseline is not an easy task and it is sometimes not required, so it is essential to discuss this aspect when developing the concept for the study
  - many participants gave statements that are not directly related to the use case and the focus of the study but rather to the set-up, the vehicle, or usability characteristics of the displays or other human-machine-interaction interfaces. This clearly shows a need to consider these effects in the evaluation and the need to control for such effects. One possible solution is to stress these points explicitly in the introduction as well as in the survey (e.g. stress in the introduction that the focus of the development lied on the technology and not at the HMI parts, ask in the survey different questions on evaluation of the potential experience envisioning the service is available vs. experience of the test itself or separated questions on the evaluation of the service, the test set-up, the vehicle, the HMI). Another recommendation (applied also in our tests) is to accompany the tests very closely and to use more explorative approaches, such as thinking aloud techniques or qualitative interviews besides the questionnaire (e.g. asking not only in an open question the reasons behind the evaluation of the use case, but interviewing the test users about their experience and making a short protocol).
  - test the test user experience first, make sure that you experience the test not only as a researcher but first by putting yourself in the role of potential test user

Potential role of test fields as demonstrator and dialog platform with the society:

- ***Challenges:*** using the tests and demonstrations not only as a research tool but also as a dissemination tool for starting a dialogue with the general public on automated and connected driving

- ***Recommendations:*** test fields of automated and connected driving can be used as a platform for communication with the general public by providing information about the technology and organizing demonstrations for the general public as well as for stakeholders; in order to use the potential of test fields or demonstration as a dialogue platform it is important first to coordinate dissemination activities and second to provide opportunities to involve the general public or experts as "co-designers"; the benefits of such activities are increasing awareness about the technology and the research projects in this field and to collect requirements on the technology from relevant stakeholder groups; examples of such dissemination and demonstration activities within the AUTOPILOT project are demonstration in the framework of the ITS Europe Congress as well as test and organisation of so-called test fests

8 Conclusion

Although there are a lot of differences between the services tested and the way in which they were tested, the outcomes are rather positive and, in many cases, similar. Levels of acceptance vary, but there was no real rejection of the services.

If we look at all the tests and services, some interesting trends emerge:

- **Control:** for many participants, the issue of control was very important. Participants wanted to be able to stop the automated driving and take over control of the vehicle. Also in the information needs, we see that there is a large need for information on what the vehicle is doing (and why), what can be expected, where the vehicle is going, what and how information about other road users is detected, what is being done with their data etc.

  The question here is whether this is because it is all new and people do not fully trust the technology or whether these needs will continue to exist even when automation becomes more commonplace, and people get more experience in using these vehicles. What is important for AUTOPILOT is that IoT enables the fulfillment of these information needs, so that in future services it may be possible to customise the information provided according to the user needs and preferences.

- **Safety and security:** Safety and security were seen as important, in discussions, in focus groups and in the user questionnaires these were seen as important and concerns were raised. Participants were concerned about safety aspects, both for the safety of the automated vehicle and for other road users, specifically pedestrians. These concerns do not always seem related particularly to the specific services but more to the capabilities of automated vehicles. There were also serious concerns about the security of data and liability. These concerns were echoed in the questionnaires from ITS European congress visitors were very serious concerns about safety were found.

- **The role of IoT**: In most user tests the role of IoT was opaque; participants were usually not elaborately briefed on where information was coming from and how the architecture was arranged. Users were also not explicitly asked about the role of IoT. However, in discussions with participants, the idea of CAV vehicles becoming a “thing” in IoT was received well and was seen as a logical step in future developments. ITS congress visitors were asked explicitly about this. As they are mostly people who are experts in the intelligent transport field, they had a better understanding of the possible role of IoT. A large majority agreed that the role was (very) important, especially for the enhancement of automated driving.

- **The usefulness of services:** In the user tests only a limited version of the envisaged services was experienced or observed. However, these services should be seen as part of a wider development, either in terms of wide-spread availability of CAV or of services in which the encountered use case was only a small part. Specifically, car sharing can be seen as a service that contains many of the use cases. In addition, the tested services are part of a wider traffic system, in which the infrastructure and other road users will play their role. Participants seemed quite willing to engage in looking at the bigger picture, and answers about future use were in general positive. Also, in focus groups, people felt comfortable to discuss a world in which such services would be widely available.

- **Public awareness:** many participants mentioned the need for awareness-raising amongst the general public about all these new developments. The participants were usually people already interested, but many of them learned new things and were of the opinion that information and debated would be both interesting but also very necessary. Demonstrations and providing opportunities for people to engage with CAD should be an important step in future development. Our user tests provided valuable experience for evaluators and pilot sites on how to organise this.

Further developments of the technology and new user tests are possible and necessary once system functionalities are fully functioning. These tests can then provide a better understanding of the user requirements, concerns and expectations related to automated driving progressed by IoT. Despite the fact that the results could not directly be used to quantify user acceptance of the use cases (due to limited testing and user types), they are very useful for further development of automated driving and IoT. The distance between the technologies existing today (e.g. ADAS) and what automation will bring in the next decades is worth exploring to further understand the usefulness, penetration trends and acceptance.

Overall, the results indicate important aspects that should be taken into account when designing different automated driving use cases and IoT services. Besides the results of the user evaluation, the measurement instruments, as well as the developed and applied methodology in AUTOPILOT, are an important basis/ tools for further evaluation tasks on CAVs. Therefore, this deliverable with the provided scales, protocols, questions etc. can be used in future research and innovation projects on a national or European level.

9 Literature

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Appendix 1: Questionnaires

Livorno – HP (English translation)

Part 1: Evaluation of the system

1) **V1 -**Please state briefly what your motivation for taking part in this demonstration is:

____

2) **V2 -** What is your first impression of the service after the demonstration?
(Free association)

____

3) **V46-V58 -** I think that the system is …

			Neutral				don't know
Useful	[ ]	[ ]	[ ]	[ ]	[ ]	Useless	[ ]
A positive experience	[ ]	[ ]	[ ]	[ ]	[ ]	A negative experience	[ ]
Exciting	[ ]	[ ]	[ ]	[ ]	[ ]	Boring	[ ]
Undesirable	[ ]	[ ]	[ ]	[ ]	[ ]	Desirable	[ ]

Part 2: Future use

In the following part, please imagine the system is already on the market and works reliably.

4) **V18 -** Would you be interested in using the system regularly if it were available to you (in full operation, as this was a limited trial)?
   - Yes/No/Don't know
     - **V19.1 -** If Yes – why yes?
       ____
     - **V20.2 -** If No –why no?
       ____

5) **V21-V40 -** Compared with my usual travels, I believe that using the system regularly would …

			don't know
increase the number of trips I make	|__|__|__|__|__|__|__|__|__|	decrease the number of trips I make	[ ]
increase my car use	|__|__|__|__|__|__|__|__|__|	decrease my car use	[ ]
increase my car use during peak hours	|__|__|__|__|__|__|__|__|__|	decrease my car use during peak hours	[ ]
increase my safety in traffic	|__|__|__|__|__|__|__|__|__|	decrease my safety in traffic	[ ]
increase the safety of pedestrians and bicyclists	|__|__|__|__|__|__|__|__|__|	decrease the safety of pedestrians and bicyclists	[ ]
increase my travel comfort	|__|__|__|__|__|__|__|__|__|	decrease my travel comfort	[ ]
increase my stress while driving	|__|__|__|__|__|__|__|__|__|	decrease my stress while driving	

6) **V85.C12 - V92.C12 -** If the service was available, how do you think it would affect your choice of travel mode?

	… less often	… as often as today	don't know
I would use public transport ….	[ ]	[ ]	[ ]
I would use a private conventional car ….	[ ]	[ ]	[ ]
I would walk or use a bicycle ….	[ ]	[ ]	[ ]
I would use a taxi service ….	[ ]	[ ]	[ ]

7) **V4 - V30 -** How important or unimportant is it for you to receive the following information from the service?

	1 Very important	2	3 Neutral	4	5 Very unimportant	Don't know
information on detected hazards	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
information on what the car will do about the hazards (change lane, slow down, stop, …)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Information on upcoming driving manoeuvres (turns etc)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Information on (personal) data needed for using the service	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Service fees	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
What assistance is available during service (eg in case of failure)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Other information *(please specify)*: ______________________________	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

8) **V60 – V63 -** How important is it for you to be able to:

	1 Very important	2	3 Neutral	4	5 Very unimportant	Don't know
drive the vehicle yourself whenever you want to	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
control speed of vehicle	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
control headway to car in front	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Other information *(please specify)*: ______________________________	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

9) **V88 – V95 -** On which type of your regular/daily trips do you think the service would benefit you?

	1 Very beneficial	2	3 Neutral	4	5 Not at all beneficial	Don't know
Commuting trips	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Business travel	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Errands (incl. school runs, grocery shopping)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Leisure, visits	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

10) **V96 -** Would you be willing to pay extra for this system when buying a new car?
[ ] yes
[ ] no
[ ] don't know

11) **V97- V101 -** When thinking about the service you tested, how do you feel about the following topics?

	1 Not at all concerned	2	3 Neutral	4	5 Very concerned	Don't know
Privacy of my data (who is following where I drive and why, e.g. GPS tracking)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Security of the self-driving vehicle (e.g. against hacking)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Security of my data (how safe is my data e.g. from outside hackers)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Liability in case of accident or malfunction	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Other, please specify: ______________________________	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

12) **V102-** What would you tell the designers of the system to change to make the system more useful to you?

[ ] ____
____

Background
At the end of the survey, we would like to ask you few general questions about yourself.

13) **V8-** Do you currently have a car available for your use?
[ ] yes, (nearly) always
[ ] yes, sometimes
[ ] no or hardly ever

14) **V13.C1 – V16.C1 -** Which mode of transport do you typically use for the following trip types?
Choose 1-3 often used modes. Exclude trips made by airplane.

	Passenger car	Public transport	Taxi	Motorbike or scooter	Bicycle or walking	I don´t make such trips
Commuting	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Business travel	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Leisure / hobbies / visits	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Errands (incl. grocery shopping)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

15) **V31.C2– V34.C2 -** Please state how often do you ...

	(Almost) daily	Several times a week	Weekly	Monthly	Rarely or never
drive on a motorway or other 2-carriageway road	[ ]	[ ]	[ ]	[ ]	[ ]
drive on a rural 2-lane road road	[ ]	[ ]	[ ]	[ ]	[ ]
drive on urban street network	[ ]	[ ]	[ ]	[ ]	[ ]
need to find a parking space for your car at the end of the trip (no fixed spot available)	[ ]	[ ]	[ ]	[ ]	[ ]

16) **V17.C3 – V23.C3** - Please state how often you use the following systems:

	(Almost) daily	Several times a week	Weekly	Monthly	Less often or never	I do not know this	I do not have this system
Adaptive Cruise Control (ACC)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Navigation system or route planning	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Other (please specify): ______________________	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

17) **V9-** How familiar are you with Internet of Things (IoT)?
[ ] I know a lot about it.
[ ] I have heard about it.
[ ] I work in the field
[ ] I have never heard about it.

18) **V11 -** How much do you drive annually on average? ______ km

- less than 5.000 km a year
- 5.000 up to 20.000 km
- more than 20.000 km
- don´t know
- no answer

19) **V12 -** What year were you born?

    ____

20) **V24-** Please specify your gender

    [ ] Male
    [ ] Female
    [ ] Other
    [ ] Prefer not to say

21) **V25-** Where do you live? (city)

    ____

Thank you for participating at the survey!

AUTOPILOT

Appendix 2: Reports on the user tests

Brainport Highway Pilot (Hazard Detection)

1 Background

The Highway Pilot Public Testing took place the 12th – 14th March 2019 at the Automotive Campus, Helmond, NL. Thirty Eight (38) participants took part, recruited through online and social media advertisements[1]. These took place across eleven sessions over the three days in groups of between 2 and 5 participants.

2 Test Protocol

Introductory presentations were given in Dutch, as were most discussions. Description of the technology and test conditions were carried out in English (due to nationality of the engineers involved). A Dutch speaker was present at all stages to provide translation and facilitate discussions in Dutch. Questionnaires were in Dutch and carried out on an ipad by the participants, through the online survey tool, 'Limesurvey'. The questionnaire had been refined following the December pilot tests, in both content and userbility.

3 Technical problems

There were some minor issues with the technologies during the testing, and not all of the obstacles were detected on every run, as set out in the table below.

	Tour 1	**Tour 2**
Tuesday 12th March	No lane change pictogram. Just a warning sign	
Demo 1	First spb took too much time to deactivate. As a result, second spb was not active. I faked the second spb by controlling the acc speed manually.	Good. Speed reduction too late for the pothole
Demo 2	Had to restart the car	
Demo 3	Good	Had to restart the car
Wednesday 13th March	To be provided	
Thursday 14th March	To be provided	

4 Results

4.1 Pre-Test Expectations

Participants were asked to rate their expectations of the test in four areas and the usefulness of the service on a 5 point scale. This was rated 2 to -2 (eg Positive = 2, Negative = -2).

1 Web: https://www.helmond.nl/1/nieuws/2019/Februari/Oproep-testers-voor-automatisch-rijden-gezocht
FB: https://www.facebook.com/123325024386589/posts/2320923817960021?sfns=mo

Appendix 3: Detailed survey summaries

User Acceptance – Requirements

	Hazard Detection	Platooning	Urban Driving	AVP
Brain-port	- <u>Importance of Information during the Service</u> ○ Almost every participant rated information on detected hazards (36 out of 38) and on what the car will do about the hazards (35 out of 38) as (very) important ○ No participants thought that either the information on detected hazards or what the car would do were unimportant ○ 2 participants were neutral about the information on detected hazards ○ 3 participants were neutral bout what the car would do ○ Other information that participants would like to see: ▪ Acoustic/tactile signal ▪ Information on traffic jams, unexpected road lane changing users, moving objects, alternative routes, speed cameras, police, fire brigade, ambulance ▪ Hazards like ghost riders, slow riders, unreliable road	- <u>Importance of Information during the Service *(as a Leader)*</u> ○ No participants thought that the information in all aspects were very unimportant as a leader ○ No participants thought that the information in aspects of route guidance, estimated waiting time to form platoon, estimated time to final location, and what assistance is available during service were unimportant ○ All participants thought that the information about estimated waiting time to form platoon was important or very important ○ 8 participants were neutral about the information on (personal) data needed for using the service ○ Information on road guidance was ranked as (very) important by all 20 participants (15 “very important”, 5 “important”) ○ Information on headway kept to car behind is (very) important for 16 participants, but there are 3 respondents who perceive this information as unimportant - <u>Importance of Information during the Service *(as a Follower)*</u> ○ No participants thought that the information in all aspects were very unimportant as a follower ○ No participants thought that the information in aspects of estimated waiting time to form platoon, (personal) data needed for using the service, estimated time to final location, what assistance is available during service, and receive pre-warning about manual driving were	- <u>Usefulness of Information during the Service</u> ○ 70% of participants thought that the information on crowds of pedestrians that could affect the route of the car was useful or very useful ○ Around half of participants thought that the information on crowds of pedestrians for other reasons and having access to the information would be useful ○ Nearly half of participants did not think that crowd information for other reasons was useful. - <u>Other information that participants would like to see are:</u> ○ Information about weather conditions ○ Information about time (waiting time, time the ride will take, time of arrival) ○ Information on what the car does and why ○ The app could be more user friendly (more colors, more clear images) ○ Information about the route	

	users, large water ponds, upcoming emergency services, unusual crowds on fixed routes ▪ → From the above, participants would like to see a join between this service and existing traffic systems, and would like audio signals	unimportant ○ Half of participants were neutral about the information on (personal) data needed for using the service ○ The majority of participants (over 50%) thought that the information in all aspects were important or very important as a follower ○ Nearly everyone (95%) thought that the information about estimated waiting time to form platoon and receive pre-warning about manual driving were important or very important ○ Route guidance seems to be slightly less important as a follower than as a leader - <u>Other information that participants would like to see:</u> ○ Information about traffic and about the chances of platooning not working out ○ How many followers you have behind you. And a notification when someone quits on their own initiative ○ As a follower, be warned in time for unexpected events on the road which the leader can see ○ Information on other users - <u>Importance of Features of the Service *(as a Leader)*</u> ○ No participants thought that the features of adjust/choose the distance between cars and stop the platooning anytime were very unimportant as a leader, on the contrary, those information were assessed as (very) important by 17 and 19 out of 20 respondents. ○ 2 participants thought that communicate with other drivers were unimportant or very unimportant ○ 8 participants were neutral about feature of communicate with other drivers as a leader during service ○ Nearly everyone (95%) thought that the feature of stop the platooning anytime was important or very important, and no one thought it was		

		unimportant. - <u>Importance of Features of the Service *(as a Follower)*</u> ○ No participants thought that the features in all aspects were very unimportant as a follower ○ 4 participants thought that adjust/choose the distance between cars was unimportant ○ 8 participants were neutral about feature of communicate with other drivers as a follower during service ○ All participants thought that the feature of stop the platooning anytime was important or very important ○ Nearly everyone (95%) thought that the feature of drive the vehicle yourself whenever you want to was important or very important and no one thought it was unimportant. ○ Communicating with the driver of the lead vehicle was (very) important for 15 out of 20		
Li-vorno	- <u>Importance of Information during the Service</u> ○ No participants thought that any type of information were unimportant, except of one person who stated that information on personal data would be very unimportant ○ All 12 participants found one of the main feature of the system – providing information on detected hazards – as very important ○ 7 to 9 participants found also information about what the car will do about the hazards as well as personal data needed for using the service as very important ○ Information about service			

	fees and what assistance is available during service use were both rated only by 4 to 5 participants as very important one - <u>Importance of Features during the Service</u> ○ All participants rated the option to drive the vehicle by oneself whenever one want to as (very) important ○ The option to control speed of the vehicle was found to be (very) important by 9 out of the 12 participants; 3 were neutral about it ○ The option to control headway to car in front was rated only by 3 participants as very important; 5 found it (somehow) important, and 3 chose "neutral"			
Tam-pere			- <u>Importance of Information during the Service</u> ○ A majority (23 to 26) of participants found it important to get the following information: route monitoring, estimated arrival time, information on detected pedestrians and cyclists and information on traffic light status ○ 17 participants found it important to get information on upcoming driving maneuvers, but 9 participants felt neutral about this information ○ 11 to 12 participants found it important to get information on points of interest or sights near the route and information about restaurants, hotels, cafes etc. near	- <u>Importance of Information during the Service</u> ○ A majority (25 to 28) of participants found it important to get the following information: route guidance to parking place, estimated waiting time, confirmation that the car is successfully parked, wait time to retrieve car on return and parking fees ○ 12 to 15 participants found it important to get information on points of interest or sights near the parking place and information about restaurants, hotels, cafes etc. near the parking place while 8 to 9 participants rated those information as (very) unimportant

			the route while 8 participants rated those information as (very) unimportant - <u>Other information</u> ○ Information about congestions, accidents, alternative routes, (free) parking spots, weather, animals ○ Target speed for driving in green wave in consecutive traffic lights - <u>Importance of Functions of the Service</u> ○ 19 participants found it important to get information in their own language ○ 15 participants found it important to personalize the information they receive ○ 23 participants found it important to drive the vehicle themselves whenever they want to ○ 24 participants found it important to control the speed of the vehicle ○ 23 participants found it important to control the distance to car in front - <u>Other functions</u> ○ Autonomous parking ○ View nearby objects ○ Speed adjustment	- <u>Other information</u> ○ Information on the parking situation and parking space ○ Waiting time for car to return from parking ○ Pictures or videos while/ where the car drives - <u>Importance of Functions of the Service</u> ○ 23 participants found it important to get information in their own language ○ For the aspect “choose where the car should park”, 12 participants found it important and 10 participants found it unimportant ○ 22 participants found it important to be able to stop the process and park themselves - <u>Other functions</u> ○ Customer service, payment in the same app ○ Information on weather ○ Remote control of heating during parking ○ Complete trip planning ○ Choose from multiple drop-off/pick-up points, even if they differ from the original drop-off point
Ver-sailles			- <u>Importance of Information</u> ○ Most important information (*M* > 4,5): information about parking space availability and location, route guidance to station, information an detected hazards, information about restaurants, hotels, cafes etc. near the vehicle’s location, estimated time left in self-	

			driving mode, estimated waiting time ○ Less important (*M* < 4): tourist information (point of interest/ sights neat the vehicle's location), duration of the tour - <u>Other information</u> ○ Maximum time use of service, number of people waiting for service, info on charging points ○ Info on other touristic circuits in auto mode ○ Time or mileage of electric autonomy ○ Comparison of carbon cost of this trip to diesel tour bus trip - <u>Importance of Functions</u> ○ On average, all functions (receive information in your own language, personalize the information you receive, drive the vehicle yourself whenever you want, stop the ride anytime)are assessed as relevant - <u>Other functions</u> ○ Voice interaction	
Vigo			- <u>Importance of Information</u> ○ Around 86% of participants thought that the information on detected pedestrians or cyclist is (very) important. ○ Around 87% of participants believed that information on upcoming driving manouvres was very important or important. 5 respondents were neutral about this kind of information. ○ Over half of sample in this test though that the information on traffic light status is very important.	- <u>Importance of Information</u> ○ Around 45% of participants thought that the information regarding route guidance to parking is very important. Only 2 persons considered that it is not significant. ○ Three quarters of participants believed that it was essential to have information about the estimated waiting time for parking in case no parking space available. ○ About three quarters half of participants thought that the feedback that the car is

			○ Eighteen persons were neutral about information on (personal) data needed for using the service. ○ For 68% of them is very important to receive information in their own language and 31% of them considered it as important. ○ Most of the sample considered that drive the vehicle by their self whenever they want to be very important. ○ 70% of participants believed that is very important to control de speed of vehicle. ○ Around 70% of respondents considered that control headway to car in front is, at least, important (for 19 persons it was considered as very important). - <u>Other information/functions</u> ○ Traffic status, road status, accidents ○ Estimated arrival time ○ Function that informs about other vehicles on other lanes ○ Weather conditions ○ Sound alert coming closer to roadworks or traffic lights ○ Information on energy savings ○ State of the vehicle ○ Information on what the car "sees" (e.g. signs)	successfully parked would be useful. ○ 65% of participants thought it would be advantageous to have information about wait time to retrieve car on return. ○ Most of drivers did not considered useful provide information about personal data necessary to use the service. ○ Around 60% of participants were neutral about the idea of having points of interest near the parking place. 7 drivers did not know if it was important. ○ Three quarters of respondents considered as neutral to have information about restaurants, hotels, cafes, etc., near the parking place. - <u>Other information</u> ○ Waiting time ○ Photo when car has been parked ○ Information on parking space ○ Information on service error rate of the previous month ○ Up to date info about costs