AVENUE

Autonomous Vehicles to Evolve to a New Urban Experience

D2.4 First Passenger needs analysis and specifications

Markus Dubielzig, Siemens AG,
Michel Reisch, SLA,
Mary Panou CERTH

Deliverable Due Date : Month 5

Status: [On going, Draft, Under Review, Accepted]

Dissemination Level: [Public, Confidential, Restricted, …]

Revision History

Author	Entity	Date	Comments
Markus Dubielzig	SAG	28-08-2018	Draft Version
	SAG	04-09-2018	2nd Draft Version
Michel Reisch	SALES-Lentz		
Mary Panou	CERTH	11-09-2018	3rd Draft Version
	SAG	18.9.2018	5th Draft Version
Dimitri Konstantas	UniGe	28.9.2018	Final review

Co-funded by the Horizon 2020 programme of the European Union

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 769033

Index

Executive Summary

User experience and accessibility e.g. for Persons with Reduced Mobility (PRM) play a major role when trying to develop and establish innovative and disruptive urban public transport services. Moreover access of PRMs to public transport is a human right and mandatory in Europe (and member states). To ensure that the Avenue Vehicles and the services around them are not only usable but also well accepted by all users including PRM (elderly, people with disabilities and in general potentially vulnerable users) we are following the human centred design process for interactive systems (ISO 9241-210). Following this standard we ensure that all relevant stakeholders play an important role in the requirement phase and throughout the project.

Emphasis must also be put on the cultural and organisational differences within the user group, and member countries. This included explorative, qualitative studies at the beginning of the project as well as the creation of personas to establish a common understanding among the project participants about the scope and basic ideas behind the user needs and expectations. Therefore this Deliverable, as part of Task T2.2 aims to deepen our understanding of the end users and the context in which the users operate. The passenger needs are derived from the interviews and are grouped in minimum, baseline and ambitious expectations. These results will be communicated to the designers, developers, providers and contributes to the other WPs and Deliverables.

D2.4 is the first deliverable of Task 2.2 and summarizes the results of the initial user studies made by the involved WP2 partners in the different countries. To ensure an actual, positive user experience for all, users will be involved in all relevant phases of the project (conception of services (WP4), security options (WP6), operation validation (WP7) etc.) to guarantee that the users opinion and needs are taken into account as early and thoroughly as possible. D2.5 and D2.6 will therefore update this deliverable and summarize the results, collected in the progress of the project at the respective time.

Chapter 2 gives an overview on the initial user studies and summarizes already some main results from the different interview sites.

Chapter 3 is about the analysis of the gathered answers.

Chapter 4 summarizes the requirements derived from the user study.

Chapter 5 gives the conclusions

Chapter 6 includes Personas developed based on the interviews and the requirements.

Annex A gives an overview of the most important and related legal requirements.

Annex B contains the used interview guideline.

1 Introduction

The target of the AVENUE project is to demonstrate and pilot the adaptability and efficiency of the deployment of small and medium autonomous vehicles (AV's) in Lyon, Luxembourg, Geneva, Copenhagen and 2-3 replicator cities as of the 3d year of the project. The AVENUE vision for future public transport in urban and suburban areas, is that autonomous vehicles will ensure safe, rapid, economic, sustainable[1] and personalised transport of passengers, while minimising vehicle changes. The goal is to provide door to door autonomous transport allowing commuters to benefit from autonomous vehicles.

At the end of the AVENUE project - 4 year period - the mission is to have demonstrated that autonomous vehicles will become the future solution for public transport. The AVENUE project will demonstrate the economic, environmental and social potential of autonomous vehicles - for both companies and public commuters - while assessing the vehicle road behavior safety.

Workpackage 2 *Requirements and Use Cases* paves the foundation for developing and establishing innovative and disruptive urban public transport services.

Task 2.2 *Passenger needs (including PRM) and requirements specification* takes care of all users and their needs. To ensure that all needs are considered, AVENUE aims to continuously involve users throughout the project. "D2.4 - *First Passenger needs analysis and specifications"* is the first of a series of three deliverables. It gives an overview of the user consultations carried out in the different partner countries, the resulting analysis and the definition of the user requirements. These requirements have been derived from the conducted interviews with users and user organizations and from relevant normative and legal documents.

1.1 Motivation and context

Public transport has changed a lot in the last 30 years. In many cases the whole infrastructure provides tailor-made services like e.g. mobile tickets or comfortable door-to-door schedules for the wide range of people who frequently use the different transport systems. In particular the requirements of people with disabilities and older persons are now considered during all development stages of new vehicles, bus stops or ticket machines to really fit the special needs of the different target groups. New service solutions include the support of smart devices like e.g. mobile phones to allow people to use their preferred method to purchase tickets, to schedule their transport as well as to get a lot of useful information while they are on the go. Upcoming services[2] even realize a Bluetooth connection to the board computers of buses and trams allowing users to get additional information on the route or allow passengers to remotely control the vehicle by transmitting signals to trigger stop and other service requests using their Smartphone. Being used to these services the expectations of future mobility services is rather high.

[1] Within urban transportation sustainable most often refers to electric vehicles.
[2] ivantoCore https://www.ivanto.de/home_en/

Therefore, to set up a new model of public transportation targeting also elderly people, people with disabilities and vulnerable users - a user centred design approach is essential. Such an innovative model will only be successful when the needs of the users (passengers) are considered sincerely in the specifications and functionalities. Therefore AVENUE aims to include and consult users' right from the beginning of the project and throughout the project. It is important to identify these requirements as a first step of the project. Therefore a survey acquiring these needs has been conducted right at the beginning. The goal of these interviews was to gather all requirements, problems and identify strategies that passengers have developed to overcome barriers. As problems and solutions might vary between local areas and between nationalities, interviews have been conducted by all involved partners and in all participating countries.

Besides users, also regulations in Europe and in the different countries play a major role. The following directives and laws have direct influence on our developments (an extract of the most important ones can be found in Annex A Legal Overview":

- Bus & Coach Directive 2001/85 ECE (Repealed 2014): Accessibility of the vehicle (ramps, kneeling systems, lifts) & wheelchair & occupant restraint systems (WTORS) for wheelchair occupant & bus passenger safety
- REGULATION (EC) No 661/2009[1] *(successor of Bus & Coach directive) Article 7* 4. Vehicles of Class I shall be accessible for people with reduced mobility, including wheelchair users
- Regulation No 107[2] of the Economic Commission for Europe of the United Nations (UNECE) — Uniform provisions concerning the approval of category M2 or M3 vehicles with regard to their general construction
- In Switzerland Section 3 of the Directive on the technical requirements for the accessibility of public transport defines the Special requirements for bus and trolleybus services.

Indirect influence:

- COMMISSION REGULATION (EU) No 1300/2014 [3]

When applying today's regulation to our project, there are many things that need to be clarified.

E.g.: Regulation No 107 Annex A 3.3.4: *If a vehicle is fitted with a ramp or lift, a means of communication with the driver shall be fitted outside, adjacent to the door, and at a height between 850 mm and 1 300 mm from the ground. This requirement shall not apply to a door situated in the direct field of vision of the driver*.

How can operators follow this rule in a driverless vehicle?

2 Initial user studies

When deriving new services it is very important to fully understand the base service.

AVENUE aims to introduce a new model of public transportation with autonomous mini-buses. Therefore it is important to understand the needs, the issues, the problems and which personal strategies users of public transport use for coping with the public transportation restrictions and functioning. Therefore Task 2.2 developed an interview guideline which was used in all participating countries to question users of public transportation.

To be noted that although in this draft report we present and giving special focus to people with disabilities, the methodology, questionnaires, and replies collected are generic, targeting all types of population.

2.1 Development of an interview guideline

Due to the fact that people with disabilities have special requirements, they play an important role in gathering user requirements. Taking into account that every human will have some type of disability in his/her life or can be situational induced disabled (e.g. wearing a headset), the requirements derived from people with disabilities will be useful for all and could serve a worst case scenarios.

The aim was to develop a common questionnaire which would be used by all face-to-face or phone interviews, to collect data from the users that could be effectively analysed and provide a dependable and consistent set of user requirements which could be used in AVENUE. We utilised a mixture of closed and open questions. While the closed questions can easily be analysed, the open questions give users the opportunity to explain their way of handling things, but also to raise issues, which had not been thought of by the experts. For privacy reasons, and because of the fact that the requirements are similar, we did not distinguish between blind and different levels of low vision/partial sight. To ensure the best phraseology the questionnaire was developed together with Physiologists, disability experts and colleagues with disabilities. Finally partners translated the interview guideline, which was prepared in German and English and translated to French, Danish and Greek.

We wanted to have interviewees with the widest range of backgrounds, thus to compile the broadest possible user needs. Therefore the interviewees where chosen randomly with slightly different strategies in the different countries.

Participation in the interviews was voluntary. The interviewees were informed that they are able to withdraw at any time and without any given reason. Furthermore all participants were informed that all data collected during the interviews would be provided anonymously to assure the protection of their privacy. Medical data was neither asked nor recorded. To enhance privacy the interview does only distinguish between four different age groups, gender and three kinds of disability: visually, hearing or mobility impaired. Persons with reduced cognitive abilities, e.g.

reading, understanding, were not considered explicitly and will maybe analysed in more detail in the follow-up evaluations.

The interview was divided into three parts:

- Requirements for public transport due to the well-known use of “classic” public transport

  The aim of this part was to identify the status-quo and current issues.

- Evaluation of experience with autonomous buses (if existent), especially in comparison to conventional public transport (which is better, which is worse)

  This part of the questionnaire aimed at figuring out the experience passengers already have with autonomous public transport.

- Wishes and expectations for future autonomous buses

  In this part all passengers were asked to imagine how future autonomous busses could change and improve public transport.

The complete questionnaire can be found in Annex B.

	Denmark	France	Germany	Greece	Luxembourg	Overall
<24		**2**	**3**			**5**
female		1	2			3
male		1	1			2
25-39		**3**	**7**		**1**	**11**
female			5			5
male		3	2		1	6
40-59	**3**	**2**	**8**		**4**	**17**
female	2	1	2		3	8
male	1	1	6		1	9
60<	**2**		**8**	**15**		**25**
female	2		1	6		9
male			7	9		16
Overall	**5**	**7**	**26**	**15**	**5**	**58**

Table 1: Participants age groups and sex

Overall 58 Persons participated in the Interviews. 33 of them had some kind of disability:

	hard of hearing	reduced mobility	visually impaired	Overall
<24			**1**	**1**
female			1	1
25-39			**5**	**5**
female			3	3
male			2	2
40-59		**1**	**10**	**11**

female		1	3	4
male			7	7
60<	**3**	**1**	**12**	**16**
female	1		3	4
male	2	1	9	12
Overall	**3**	**2**	**28**	**33**

Table 2: Participants with disabilities

To identify possible differences and requirements in the different countries, the interviews were conducted in Denmark, France, Greece, Luxembourg and Germany. The following chapter gives a short impression on the interviews in each country.

2.1.1 Interviews in Germany

Siemens had its main focus on interviews with people with disabilities.

Siemens colleagues with disabilities involved in the AVENUE project used the corresponding newsletter and association magazines to call for volunteers for interviews. In this case data confidentiality was already clarified in the call for volunteers and it was described that answers will only be used in anonymous form and that they will not be stored with names together. It was further written that the data will only be considered in an aggregated form by the partners of the project.

Although the agreement of the user could be seen in the fact that they called us voluntarily all participants were asked again if they agree to the privacy rules of the project.

These calls resulted in more than 20 users calling back volunteering for an interview either face to face or on the phone. Therefore the selection of the participants were random and nearly equally distribute in terms of gender. We had participants younger than 24 but also ones older than 60 years of age.

It turned out that there is a clear difference between rural areas and capital cities when it comes to the interaction with the driver: While in rural areas nearly 80% of the passengers' contact the driver to ask for certain services or even to engage in conversation, this is not the fact in cities. However this was not the case in a few cities: The reason for these differences is that the drivers in the respective cities received an annual training for supporting PRM.

Furthermore it turned out, that smart phones play a major role: Regarding the fact that state of the art assistive technology is already part of these smart devices, people with disabilities also enjoy accomplishing their travel tasks in a comfortable manner, and with less required 3rd party assistance then before. E.g. wheelchair users are now able to schedule their transport with several changeovers by using a mobile app that lists all possible connections with the required low floor busses, which are equipped with appropriate ramps. Blind people welcome the friendly, synthetic voice prompts of the next bus stops which reminds them just in time to leave the bus at the intended location. Quite a lot of the interviewees have seen what is possible today during

demonstrations in the City of Soest. They are now demanding from their local public transport operators to install similar solutions.

Anyway, human assistance is in most cases still the preferred choice for many people with disabilities in terms of problems when using public transport systems.

2.1.2 Interviews in Luxembourg

The participants were mainly between 40 and 59 years old and 60% use public transport less than once a week. 20% say they would use public transport on a daily basis to get to work and 60% use their cars often (in general). 80% use their smart phone to get traveller information while using public transport and 60% say they would carry a laptop while using public transport. 80% live more than 500 m away from the closest public transport station. 60% don not talk to the driver while using public transport. 80% feel more secure when there are surveillance cameras and emergency call buttons installations. The top 3 wishes for public transport are: closer stations to home/work, more frequent stops in industrial zones, Wi-Fi + traveller information systems.

80% have never used a driverless bus before but are aware that they exist. 80% are willing to take such a bus but only 60% would send their child to school in a driverless bus. 80% say that it does not make a difference if there is an operator in the driverless bus or not. When it comes to the question if driverless buses are more secure than conventional buses, the opinions are very different. Top 3 concerns of autonomous buses: autonomous buses are slowing down normal traffic, safety and punctuality of autonomous buses. Top 3 wishes for future autonomous buses: digital seat reservation, acclimatisation and higher frequency of service.

2.1.3 Interviews in Denmark

The Danish partner Amobility conducted 5 interviews with older passengers. The interviewees were chosen randomly and based on their willingness to participate. Besides the general age related abilities three of the five participants are visually impaired and one has a reduced mobility and is wheelchair dependent.

2.1.4 Interviews in Greece

In CERTH-HIT, the Greek partner interviewed 15 older travellers > 60 years of age (9 male and 6 female), who reside in Thessaloniki city, Greece and frequently use public transport. The participants are parents or family members of CERTH/HIT employees. They were asked in advance by their family members if they consent to participate in the interview and if they accept to be contacted by a CERTH employee. Interviews were pre-scheduled with the participants and took place on the phone. All data were anonymously and confidentially collected, to be used by the project partners only (this was explicitly explained to the participants).

It turned out that half of interviewees are willing to use driverless /autonomous public busses. But they would only do so under certain conditions. First of all, they would feel safer if an employee would always be on board (for 14 out of 15 respondents) or the service was operated for many years and they trust it. The other half of the users is opposed towards autonomous buses without even considering to use them in the future. Regarding the safety level of an autonomous bus, 6 users believe that it is less safe than a conventional bus, another five that it will be the same, while only three responded that it would be safer. In terms of reliability of autonomous buses, the majority of the respondents (8 people) believe that it will be higher and only two users give a negative reply. The respondents reply hypothetically in the above issues, as they have never used an autonomous bus so far (but about half of them were aware of their existence), apart from 2 people that have used and autonomous metro before.

2.1.5 Interviews in France

CEESAR conducted 7 Interviews with mostly younger persons. Most of them have high expectations on autonomous vehicles. In many urban domains in France e.g. Paris or Lyon, public transport is often overcrowded, even during the off-peak hours. Therefore, a communication between drivers and travellers is difficult to establish and passengers often manage in transit situations e.g. transport of baby carriages, either on their own or with the friendly assistance of other passengers. This circumstance seems likely to be one of the reasons for the higher acceptance of autonomous vehicles in these urban areas.

2.1.6 Interviews in Geneva

<to be done>

3 Analysis of the results

In the first step, all interviews were read to allow a summary review and evaluation of the results and to examine whether there are shortcomings in the survey or in the answers that should be addressed.

The results of all interviews were recorded into an Excel sheet. Each respondent was given a unique ID and the individual answers were checked to ensure the data was correct and complete. The questions were assessed and where possible – recorded in a quantifiable format.

There were three types of questions which were recorded as follows:

- YES/No answers were counted and percentages used to determine the general trend
- Ranked answers, 1 to 4 with one never and 4 often
- Qualitative answers were searched for expected key topics and the number of times mentioned extracted to a numerical recording.

3.1 Analysis of answers

24 women took part in the interview, which is 43% of all interviewees.

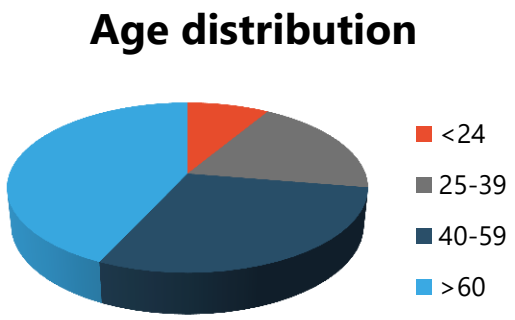

Figure 1: Age distribution

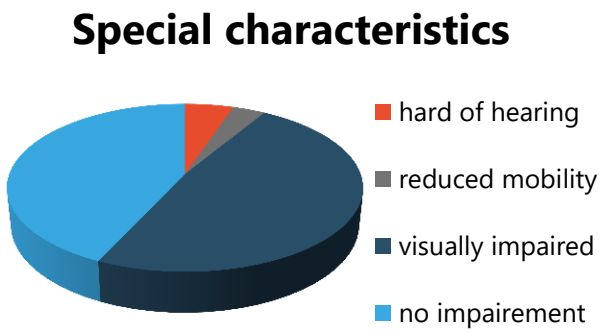

Figure 2: Special characteristics

33 interview partners are users with some kind of impairment, which is 57% of all interviewees.

None of the participants with hearing impairment would use an autonomous bus, while 57% of the visual impaired would use it. However there might not to be a correlation between hearing impaired and acceptance of autonomous vehicles, because all of them are over 60 years of age. In the age group of over 60 only 44% (15 Interviewees) would use an autonomous bus, while 10 would not do it.

Number of Answers to "Would you take a driverless bus?" sorted by Agegroup

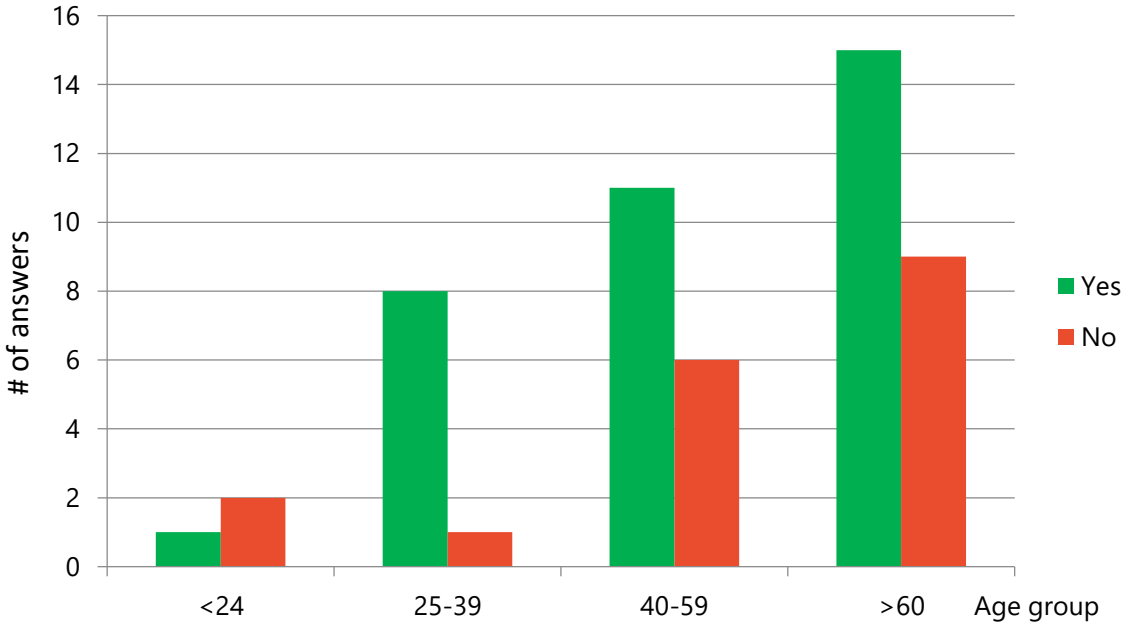

Figure 3: Would you take a driverless bus?

In the group of users without any impairment only 32 % would not use autonomous vehicles (50% of those would us them under some circumstances)

The majority of the 58 interviewed persons are frequent PT users. 18 Persons mention that they use it daily and 30 several times a week. 16 travel to work (12 of them on a daily basis) 28 use it for leisure and again 12 of them are daily users.

Nearly 60% of the participants talk with the driver with half of them for conversation. (Age does not play a role)

Only nine participants mention that they prefer to drive their own car and that they use PT less than once a week (three from France and Luxembourg, two from Germany and one from Denmark). All of them say that the connections are weak or the public transport is too rare at their places and that the distance to the next and from the nearest bus stop at their destination is too far (70% more than 500 m). The average time of their trips is more than 30 minutes.

Based on these numbers it is obvious, that the acceptance and expectation from these interviewees with regard to autonomous vehicles is very high! Eight persons would take the driverless bus with seven that would even send their children to school with it. At the same time even six do not see any advantage if an employee of the transport company would be in the vehicle.

Looking at the same answers of persons with a distance of less than 100 m to the next public transport stop the answers look different as roughly 50% would not take a driverless bus.

“Would you take a driverless bus?” in relation to the distance to the next busstop

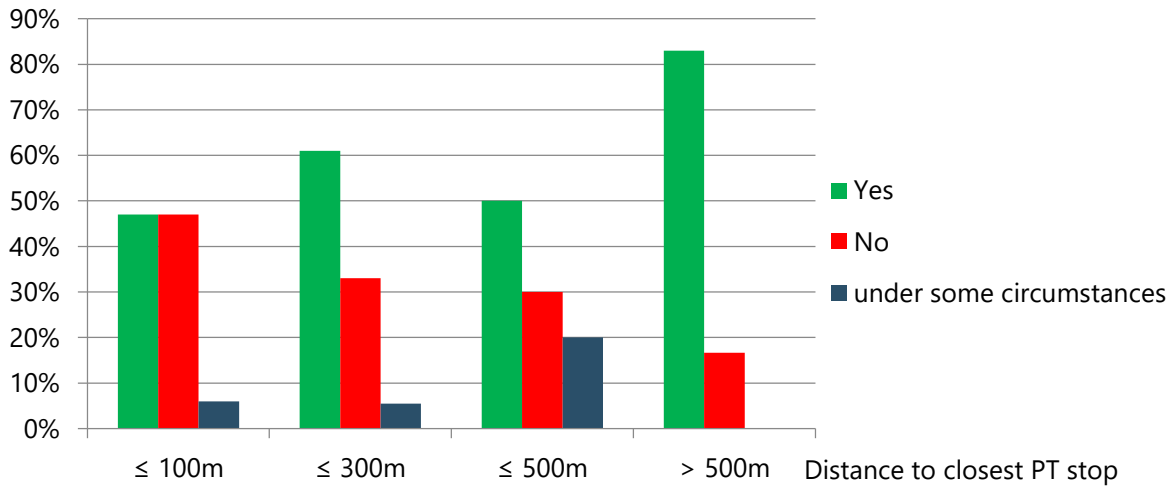

Figure 4: Would take AV depending on the distance to the next stop

Autonomous public transport will be accepted more easily in areas with a poor coverage of public transport and low frequency of service.

3.2 About public transport in general

What the interviewees in general dislike about public transport are delays, frequency of service (and thus long waiting times), overcrowded wagons/no seat, dirty and littered vehicles, missing information and rude staff.

Of course, they want public transport to be on time, with fairly priced tickets, a high frequency of service and more destinations, clean vehicles as well as available and comfortable seats, even guaranteed seats for people with special needs. It would be nice to have more flexibility regarding the stops. For some interviewees, to be picked up from their home and being dropped off at their destination and thus not having to walk far to a stop, is a real benefit that allows them to live a more mobile and independent life.

Despite all criticism, users are glad they have public transport and say that it is reliable most of the time. They often enjoy the spare time in the daily routine and they do appreciate it if public transport vehicles are not stuck in traffic. This is one disadvantage of busses unless they have a separate lane.

What all public transport passengers want is **information**: More, accurate and accessible information, e.g.

- Acoustically understandable announcements
- Correct announcement of the upcoming stop (not time-delayed!)
- Information when the bus will actually arrive – not when it is supposed to arrive according to the time table
- Information where the bus is, at every moment

When users talk about positive experiences in public transport, it usually involves other people: receiving help from the driver or other passengers, having a conversation, a funny bus driver (or even a singing one!) or amusing passengers. This is an indication of how important **interpersonal communication** and interaction is for humans. The driver has an outstanding role in this context

3.3 The attitude towards autonomous public transport

Many interview partners are quite sceptical and are not convinced that the technology is already mature enough to be trusted. Some say that they would never use an autonomous bus (7 persons). A maturity needs to gain more trust in this technology before they are ready to get in. Only four interviewees are ready to hop on an autonomous bus today.

Safety is an important topic for the interviewees. Most of them have heard of accidents by autonomous vehicles, and they stress that this technology needs extensive testing before it can be put into operation. They would use autonomous vehicles only if they are convinced that they are safe.

While they think that technology like sensors etc. provides advantages, many users nevertheless fear accidents. Some believe that other drivers will crash into the bus as they will not be able to anticipate its behaviour. Others believe that the technology is not fail-safe and/or advanced enough to handle complex traffic situations, and the autonomous bus will have accidents without a driver. Only a minority of interviewees is of the opinion that safety will be increased.

Many interview partners are afraid that the use of autonomous busses in the field will lead to more delays and failures due to unstable technology and because traffic situations are too complex to be handled by technology in general ("Sometimes you have to act boldly and just go, otherwise you are forever stuck at a crossroads.")

Some are even worried about cyber attacks against an autonomous bus: if there is no driver to interfere, hackers could make the bus go faster or drive off a bridge or into oncoming traffic.

The overall attitude/scepticism towards autonomous vehicles made clear to us **that trust** has to be gained first, and even little incidents or accidents are likely to destroy that trust.

Interview partners state that they would use autonomous busses "only if they were in service for a long time without accidents". Reports about other passengers using the bus, recommendations of authentic testimonials, and statistics like "57 passengers have travelled on this bus today" or "this bus has driven 1408 km" could have a confidence-building effect.

However, for most interviewees, a "**security driver**" who can interfere or take over and acts as an authority figure is essential. Passengers also want someone in the bus who can answer questions, provide information and help them getting on or off the bus when necessary. They are afraid of vandalism or even robberies or assaults could be a problem if there is no supervisor in the bus.

What passengers fear if there is no bus driver:

- No one in the bus to perform first aid if required.
- Feeling uncomfortable all alone in the bus at night, especially in certain neighbourhoods.
- No authority figure present to keep passengers calm (→ school kids)
- Vandalism
- No information if there are any problems
- No communication (chatting with the driver is quite common in some areas)
- No support during the trip/ on board and especially no support to get on and off. Users are worried that they will not have enough time to get on and off.
- No support to reach the connection
- Compromised safety: a driver can flexibly react to all unforeseen situations and interfere if necessary

Nonetheless, there are a few interview partners who can think of advantages if the bus is not operated by a human driver:

- A smooth driving style as there is no impatient driver
- Gentle braking
- Clear announcements, no more mumbling
- No cursing

However, they want security personnel to be present in the vehicle.

Many interview partners are worried that bus drivers will lose their jobs.

Of course, autonomous public transport has to meet the users' requirements for a "normal" public transport. However, there are some expectations that go beyond this, as well as wishes that are due to the special nature of autonomous public transport.

Expected advantages of autonomous busses:

- Bus connections where there are none today (because it is not profitable today)
- A smoother ride, no more sudden braking manoeuvres (no driver who loses his patience)
- Technology should allow for a smarter and more comfortable and efficient travel experience.
- No cancelled busses due to a lack of available drivers
- Cheaper tickets

Expressed requirements:

- Bus on demand: no rigid timetable but being able to call the bus whenever needed.
- Door to door service: no fixed stops but being able to call the bus to any position
- The information where the bus is right now and where it is going (considering flexible routes)

4 Use cases and requirements

The analysis of the responses to the questionnaire revealed a significant amount of data that had to be converted into user requirements. Use cases were generated to better understand user requirements and help develop AVENUE user requirements. These use cases were first enumerated using one of the standard templates.

4.1 General requirements for safe passenger exchange

4.1.1 Outside the vehicle

Bus station /Bus stop			
ID/Number	Requirement	Expectation	Source
1	The infrastructure at each station shall be identical.	Should have	Userreq.
2	The infrastructure at each station shall offer shelter.	Must have	
3	The infrastructure at each station shall offer tactile paving.	?	
4	The infrastructure at each station shall offer sufficient lighting.	Must have	Userreq
5	Incoming busses shall be announced (audio) at the station (like at train stations): bus line and destination		Userreq
6	There shall be audio and visual information at the bus stop that indicates the direction of all bus lines departing from this stop.		Userreq

Line indicator / Identification of the line / Vehicle			
ID/Number	Requirement	Expectation	Source
7	The line shall be displayed on the vehicle (visual)	Must have	Userreq.
8	The bus shall announce itself at the bus station (audio) (route, branch letter, direction and destinations)	Should have	Userreq.
9	It shall be visually and acoustically recognizable when the vehicle has come to a standstill (very quiet vehicle).	Should have	Userreq.
	Acoustic Vehicle Alerting System (AVAS) Manufacturers shall install AVAS meeting the requirements set out in Annex VIII in new types of hybrid electric and pure electric vehicles by 1 July 2019. Manufacturers shall install AVAS in all new hybrid electric and pure electric vehicles by 1 July 2021.		EU 540/2014 Article 8

Doors and entrances			
ID/Number	Requirement	Expectation	Source
10	Doors shall be reliably and safely detectable (visually and tactilely) outside of the vehicle.	Must have	Userreq.
	Doors or the outline of doors operated by passengers shall be detectable by the visually impaired on the outside of the vehicle.		Switzerland: VAböV Art. 15
	When a door is automatically or remotely opened by the driver or other member of the train crew a signal shall be given: • that is clearly audible to persons inside the train • that is clearly audible to persons outside the train • that is clearly visible to persons inside & outside the train • This signal shall last for a minimum of 3 s from the moment that the door starts to open		FprEN 16584-2:2015 5.3.3.2 ff
11	Doors shall recognize objects of ≤ 1.5 cm diameter over the entire height (white cane or dog leash).	Should have	Userreq
12	Doors shall open long enough for passengers to safely get in and out	Must have	Userreq
13	Doors shall indicate before they close	Must have	Userreq
14	Doors shall be prevented from closing on a passenger	Must have	Userreq
	Automatic and semi-automatic, doors shall incorporate devices that detect if they close on a passenger where a passenger is detected the doors shall automatically stop and remain free for a limited period of time.		TSI/PRM (2008) 4.2.2.4.2.1.
	If the passenger enters or leaves the vehicle while the door is closing, the closing process shall be interrupted automatically and the door shall return to the open position. The reversal may be actuated by one of the safety devices referred to in paragraph 7.6.6.3.1 above or by any other device.		UNECE R107 7.6.6.3.2
Interface of door control device			
15	There shall be an acoustic detection signal for door button (outside)	Should have	Userreq
	Door controls, whether manual, pushbuttons or other devices, shall contrast with the surface on which they are mounted.		TSI/PRM 4.2.2.3.1
	(1) A door control device shall have visual indication, on or around it when enabled and shall be operable by the palm of the hand exerting a force not greater than 15 N. (2) It shall be identifiable by touch (for example: tactile markings); this identification shall indicate the functionality.		TSI/PRM 5.3.2.1.

4.1.2 In the vehicle

Passenger Information system			
ID/Number	Requirement	Expectation	Source
16	The next stop shall be announced optically and acoustically (2-channel principle).	Must have	Userreq.
17	The announcements in the bus shall include information about available connections.	Should have	Userreq.
Displays			
	Displays shall be sized to show individual station names or words of messages. Each station name, or words of messages, shall be displayed for a minimum of 2 seconds.		TSI/PRM 5.3.1.1.
	If a scrolling display is used (either horizontal or vertical), each complete word shall be displayed for a minimum of 2 seconds and the horizontal scrolling speed shall not exceed 6 characters per second.		TSI/PRM 5.3.1.1.
	Displays shall be designed and assessed for an area of use defined by the maximum viewing distance according to the following formula: Reading distance in mm divided by 250 = font size (for example: 10 000 mm/250 = 40 mm).		TSI/PRM 5.3.1.1.
Acoustical announcements			
18	Volume of acoustical announcements shall adjust automatically depending on the noise level in the vehicle.	Must have	Userreq
	The spoken information shall have a minimum STI-PA level of 0,45, in accordance with the specification referenced in Appendix A, index 5.		TSI/PRM 4.1.2.11
	The spoken information shall have a minimum RASTI level of 0,5, in accordance with IEC 60268-16 part 16, in all areas. Where provided, spoken information shall be consistent with essential visual information that is being displayed. Where spoken information is not provided automatically, an audible communication system shall be provided to allow users to get information upon request.		TSI/PRM (2008) 4.1.2.11
	Acoustic passenger information must be easily understandable for the hearing impaired, and in particular appropriate acoustic announcements in passenger compartments must be provided. If necessary, they must be repeated or be repeatable on demand		Switzerland VAböV Art 5

Light			
ID/Number	Requirement	Expectation	Source
19	The lights in Busses shall be improved, lights shall not be dazzling.	Should have	Userreq

20	The lighting in the vehicle must be bright enough to enable unobstructed movement in the vehicle.	Must have	Userreq
21	Shadows shall be avoided in the vehicle	Should have	Userreq
22	Indirect lighting shall be provided to avoid glare and reflections (e.g. on glass surfaces).	Should have	Userreq
23	The door areas, step edges and danger areas shall be adequately illuminated	Must have	Userreq
	Internal electrical lighting shall be provided for the illumination of: All passenger compartments, crew compartments, toilet compartments and the articulated section of an articulated vehicle; Any step or steps; The access to any exits and the area immediately around the service door(s) including, when in use, any boarding device fitted; The internal markings and internal controls of all exits; All places where there are obstacles;		Regulation No 107 7.8. Artificial lighting

Vehicle			
ID/Number	Requirement	Expectation	Source
24	The floor shall be totally low with no steps.	Must have	Userreq.
25	The doors shall be reliably and safely detectable inside the vehicle.	Must have	Userreq.

Passenger Interaction			
ID/Number	Requirement	Expectation	Source
26	The interior of the vehicle shall be designed to enhance passenger interaction.	Nice to have	Userreq

5 Conclusions

In summary it can be said that the requirements, identified in the survey, are similar across Europe. Most requirements can already be found in the relevant regulations and standards and therefore have to be considered anyway.

It is interesting that especially in rural areas passengers receive a better support by the drivers than in urban areas. The same effect is recognized in cities where the local associations of the disabled work closely together with the public transport operators. Especially people who have experienced such a service express concerns regarding driverless vehicles. And thus a general sceptical attitude against autonomous vehicles seems to be present. On the one hand this scepticism is due to empathy (drivers become unemployed) on the other hand interviewees fear the missing “supervising element” in the vehicle. Even those interviewees that have a very positive attitude towards autonomous vehicles would welcome some sort of “security driver” inside the vehicle.

To overcome the scepticism and to convince passengers to use autonomous public transport, trust-building measures will be necessary.

6 Personas

This chapter summarizes the requirements and users expectations by means of personas. The personas were created following the Alan Cooper and Kim Goodwin methodology [4][5]

Carlo

The daily chat with the driver makes the bus ride quite enjoyable

Age: 60 years and older

Gender: male

Special characteristics: visually impaired

Scenario: Carlo lives in a medium sized town, and is *partially sighted*. Although he still can see enough to find his way he is using a *white cane* thus the other road traffic participants can recognize his disability. He is riding the *bus daily* in order to go *to his workplace in all weather conditions* and mostly at the same time. He prefers the *early connection* thus avoiding the bus filled with crazy kids playing strange music from their smart phones. Although he likes soccer he prefers to leave work earlier or later if the local soccer team has a home game. He does not like drunk fans singing loudly in the bus.

Due to his *daily rides* he is already well known by most bus drivers in the city. Therefore he tries to get a *seat near the driver* to talk about the latest news in the city. At this time of the year he has to *switch the bus* once to get to his work, during winter he has a direct connection. Carlo likes to use his smart phone to keep an eye on the travel time because he does not want to miss the connecting bus. *Some drivers* know him so well, that they tend to call his connecting bus on their own, telling them to wait, as they will arrive soon. "*Some of these guys even open the window and tell me where to go thus I do not have to search the right bus with my monocular*".

Carlo has been in trouble once: While driving home the passenger information system in the bus crashed thus there were no announcements of the stops anymore. Being tired from work he forgot to count the stops and the bus was crowded so he had no way to talk to the driver. Using the live traffic app from the local operator and the help of some other passengers he finally managed to leave the bus at the right stop.

Carlo has never used an autonomous bus, but has used an autonomous tram at an airport. He is not really convinced of it, as he is afraid that his friends, the bus drivers, might lose their jobs.

[3] https://pixabay.com/photo-1054311/

[4]

Mary

Bus travel is super easy now that I use the new mobility app

Age: 25 to 39

Gender: female

Special characteristics: blind

Scenario:

Mary became blind after an accident. After this serious change in her life her parents always patronized her, which made her aggressive. Today she wants to be as independent as possible thus she does not accept unsolicited help by others. While she is able to walk to her office she takes the bus at least twice a week to go shopping or for meeting friends in the pub. Shopping is always a bit difficult, as the next bus stop is far more than 500m away from her home. Especially carrying the shopping bags and using the white cane for this distance is not very comfortable. At the shopping mall she likes to get assistance offered by some of the stores (some even carry her shopping bags to and even on the bus).

Mary does not really care about the passenger information system. She is using the new onboard feature which has been introduced last month to all busses in her hometown. Using the accessible app, her phone connects to the bus and helps her to find the correct line and the respective entrance. Inside the bus she receives notifications about next stops, connections at the next stops, and information about the next stops, e.g. roadwork. Besides getting information she could also request a stop, which she often uses at night, or triggering an emergency call.

Mary never has tried autonomous vehicles, but is very interested in this development. "*Especially for us blind passengers I am expecting a huge improvement in mobility*".

[4] https://pixabay.com/photo-2564026/

[5]

Ned

The lousy connection and the distance to the bus stop make bus travel a pain

Age: 40 to 59

Gender: male

Special characteristics: motorically impaired

Scenario:

Ned lives together with his wife in a small village. His office is in the near town, which is roughly a 30 km drive. When he was younger he enjoyed driving with his own car, but after his accident he cannot fully move his leg anymore. This has turned him into a user of public transport, because somehow he has to get to his office.

The next and only bus stop of the village is in the center, using his walking aids it takes him about 15 minutes to go there.

Due to his legs he needs a bit more time than the younger generations to enter the bus. Ned prefers to get a seat, if possible with a cane holder, where he can fixate his walking aids. For the ride to his office he needs to switch once. While the 1st bus leaves only every hour, the connection is far better. However, when it is cold and snowy he asks the driver to contact the connecting bus to wait for him if possible.

If everything goes well, the trip is about one hour and 15 minutes. "*The main problem is the bad connection from my home village, if you miss the bus you have to wait one hour*. *On the other hand I can understand that this connection does not pay off for the operator.*" Ned is technology affine thus he dreams of a Bus on demand service. "*This would definitely make living in a village more attractive to young families. This would allow an on demand connection to the city center, and there could be much more "bus stops" in our small village.*" The only thing that he is afraid of is, that hackers might highjack the vehicle.

[5] https://pixabay.com/photo-2642030/

[6]

Katie

I only use public transport to avoid traffic jams and the hunt for a parking lot

Age: 25 to 39

Gender: female

Special characteristics: --

Scenario: Katie lives in a big city. She drives her car to work. But for going to the city center she takes public transportation to avoid traffic jams and the annoying hunt for a parking lot. So once or twice a week, when she wants to go shopping or meet up for a drink with friends, she takes the subway. If there is a soccer game, a concert or any other major event, she reschedules her appointments. Overcrowded subway cars are an absolute horror to her. "With so many people on the move I avoid public transport like the plague."

Her trip takes about 20 minutes. Katie checks the time table on her mobile phone and picks her route thus she does not have to change trains or to the bus. Changing is inconvenient; being stuck in traffic while on the bus is a pain; she rather walks a bit longer. *"If I take the bus, I'm just as stuck in traffic."*

She does not use public wifi on the train. *"I have my data plan, I don't register and submit my data just to use a public wifi"*.

Katie hates it when the subway station or the subway car is dirty and littered. She feels a bit insecure in the late evenings when there are only few other passengers and when some passengers are drunk. *"I don't mind surveillance cameras in the subway at all. In fact, they make me feel safer."*

Katie has heard of autonomous cars being developed but had no idea that there were already autonomous buses in service. She finds the thought a bit unsettling, but believes that once technology is more advanced, using autonomous vehicles will be quite normal. She does expect a safety driver to be on the bus. "*I'd feel a lot safer with a safety driver on board. He could control the system and is simply someone who is there when needed*".

[6] https://pixabay.com/photo-3457638/

Annex A Legal Overview

Annex A gives a brief overview on the related legal requirements for public transport.

Although TSI PRM has its focus on rails vehicles some requirements can easily be mapped to other means of public transport. Therefore this Annex also has a focus on related rules of the TSI PRM.

The following section is an extract of the TSI PRM[3] Chapter 5:

5. INTEROPERABILITY CONSTITUENTS

5.1. Definition

According to Article 2(f) of Directive 2008/57/EC, 'interoperability constituents' means any elementary component, group of components, subassembly or complete assembly of equipment incorporated or intended to be incorporated into a subsystem, upon which the interoperability of the rail system depends directly or indirectly. The concept of a 'constituent' covers both tangible objects and intangible objects such as software.

5.2. Innovative solutions

As stated in point 4.1 of this TSI, innovative solutions may require new specifications and/or new assessment methods. These specifications and assessment methods shall be developed by the process described in article 6 of the Regulation.

5.3. List and characteristics of constituents

The interoperability constituents are covered by the relevant provisions of Directive 2008/57/EC and are listed below.

5.3.1. Infrastructure

The following items are identified as being interoperability constituents for infrastructure:

5.3.1.1. Displays

(1) Displays shall be sized to show individual station names or words of messages. Each station name, or words of messages, shall be displayed for a minimum of 2 seconds.

(2) If a scrolling display is used (either horizontal or vertical), each complete word shall be displayed for a minimum of 2 seconds and the horizontal scrolling speed shall not exceed 6 characters per second.

(3) Displays shall be designed and assessed for an area of use defined by the maximum viewing distance according to the following formula: Reading distance in mm divided by 250 = font size (for example: 10 000 mm/250 = 40 mm).

5.3.2.1. Interface of the door control device

(1) A door control device shall have visual indication, on or around it when enabled and shall be operable by the palm of the hand exerting a force not greater than 15 N.

(2)It shall be identifiable by touch (for example: tactile markings); this identification shall indicate the functionality.

5.3.2.6. Interface of the call for aid device

A call for aid device shall:

(1) be indicated by a sign having a green or yellow background (according to the specification referenced in appendix A, index 10) and a white symbol, representing a bell or a telephone; the sign can be on the button or bezel or on a separate pictogram;

(2) include tactile symbols;

(3) emit a visual and audible indication to the user that it has been operated;

(4) provide additional operating information if necessary;

(5) be operable by the palm of a person's hand and not require a force exceeding 30 N to operate.

5.3.2.7. Internal and External Displays

(1) Each station name (which may be abbreviated), or words of messages, shall be displayed for a minimum of 2 seconds.

(2) If a scrolling display is used (either horizontal or vertical), each complete word shall be displayed for a minimum of 2 seconds and the horizontal scrolling speed shall not exceed an average of 6 characters per second.

(3) The typeface used for texts shall be easily readable.

(4) Upper Case Letters and numbers used in external displays shall have a minimum height of 70 mm on front displays and 35 mm on side displays.

(5) Internal displays shall be designed and assessed for an area of use defined by the maximum viewing distance according to the following formula:

Area of use of the internal displays for rolling stock

Reading distance	Height of upper case letters and numbers
< 8 750 mm	(reading distance/250) mm
8 750 to 10 000 mm	35 mm
> 10 000 mm	(reading distance/285) mm

The following section is an extract of the Regulation No 107 [2]:

Regulation No 107 [2] of the Economic Commission for Europe of the United Nations (UNECE) — Uniform provisions concerning the approval of category M2 or M3 vehicles with regard to their general construction [2015/922]

R 107 defines PRM as:

> "'*Passenger with reduced mobility' means all passengers who have a difficulty when using public transport, such as disabled people (including people with sensory and intellectual impairments, and wheelchair users, people with limb impairments, people of small stature, people with heavy luggage, elderly people, pregnant women, people with shopping trolleys, and people with children (including children seated in pushchairs).*"

The following section contains an extract of relevant Requirements for persons with reduced mobility:

5. REQUIREMENTS

5.2. Vehicles of Class I shall be accessible for people with reduced mobility, including at least one wheelchair user and one unfolded pram or pushchair according to the technical provisions laid down in Annex 8. In rigid vehicles of Class I the area for the accommodation of a wheelchair may be combined with the area for the accommodation of an unfolded pushchair or pram. In such a case, the area shall have signs fixed on or adjacent to the area with the following text, equivalent text or pictogram: 'Please give up this space for a wheelchair user'.

7.6.6.4. Inhibition of the automatic closing process on doors marked for special service, e.g. for passengers with prams, passengers with reduced mobility, etc.

> 7.6.6.4.1. The driver shall be able to inhibit the automatic closing process by actuation of a special control. A passenger shall also be able to inhibit the automatic closing process directly by pressing a special push-button.

7.6.6.4.2. The inhibition of the automatic closing process shall be indicated to the driver, e.g. by a visual tell-tale.

7.6.6.4.3. Re-establishment of the automatic closing process shall in any case be capable of being done by the driver.

7.6.6.4.4. Paragraph 7.6.6.3 above shall apply to the subsequent closing of the door.

Annex 8 ACCOMMODATION AND ACCESSIBILITY FOR PASSENGERS WITH REDUCED MOBILITY

3.2. Priority seats and space for passengers with reduced mobility

3.2.1. Seats shall be either forward or rearward facing and shall be situated in a position near to a service door(s) suitable for boarding and alighting and compliant with paragraph 3.1 above. 3.2.2. There shall be adequate space for a guide dog under, or adjacent to, at least one of the priority seats. This space shall not form a part of the gangway

3.2.8. Vehicles fitted with a priority seat shall have pictogram(s) in accordance with Annex 4, Figure 23B visible from the outside, both on the front nearside of the vehicle and adjacent to the relevant service door(s). A pictogram shall be placed internally adjacent to the priority seat.

3.3. Communication devices

3.3.1. Communication devices shall be placed adjacent to any priority seat and within any wheelchair area and shall be at a height between 700 mm and 1 200 mm above the floor.

3.3.2. Communication devices situated in the low floor area shall be at a height between 800 mm and 1 500 mm where there are no seats.

7 Annex B The Interview guideline

Interview Guideline Passengers

Document:	WP2 Interview Guideline Passengers
Version:	1.2
Language:	English
Date:	2018-07-26

Authors:	Linda Mathé, Siemens AG
	Markus Dubielzig, Siemens AG
	Philipp Quaet-Faslem, Siemens AG

Besides a brief introduction and collection of demographic data, the interview is divided into three parts:

1. requirements for public transport due to the well-known use of “classic” public transport
2. evaluation of experience with autonomous buses (if existent), especially in comparison to conventional public transport (which is better, which is worse)
3. wishes and expectations for future autonomous buses

Optional questions are marked in **green** and the addendum **[optional]**. If enough time is available, the optional questions should also be asked.

Questions about passengers with **special needs** are marked in **orange** and the addendum **[ACC]**. They are only used in the corresponding interviews.

Part 0: Introduction and demographic data

- Hello, do you have a few minutes?
- We are from the EU project AVENUE and are conducting a survey on the future of public transport in Europe.
- You can rely on us to treat your data confidentially. Under no circumstances will your name be disclosed. Your answers will only be used in anonymous form and will not be stored together with your name.
- After the survey, the data are only considered in aggregated form – i.e. together with all other surveys. They are used by the project partners for the further development of future offers in public transport.

1. Agreed to consent:

☐ yes ☐ no

2. Which age group do you belong to:

☐ 24 years and younger
☐ 25 to 39 years
☐ 40 to 59 years
☐ 60 and older

3. Sex (observed)

☐ female ☐ male ☐ other/unknown

4. Special characteristics (observed)

☐ VIP (visually impaired)
☐ hard of hearing
☐ reduced mobility, e.g.
  ☐ wheelchair ☐ stroller
  ☐ walker ☐ large/heavy luggage
  ☐ walking stick, walking aid ☐ bicycle
  ☐ guide dog ☐ _____

Part 1: Usage patterns and wishes (basis: classic public transport)

5. How often do you use public transport (bus, tram, underground, suburban and regional trains)?

☐ less than once a week ☐ several times per week ☐ daily

6. What are you using public transport for? [optional]

Travel to work	☐	never	☐	rarely	☐	occasionally	☐ often
Leisure	☐	never	☐	rarely	☐	occasionally	☐ often
Vacation	☐	never	☐	rarely	☐	occasionally	☐ often
Business trips	☐	never	☐	rarely	☐	occasionally	☐ often

7. How often do you use the following means of transport? [optional]

bus	☐	never	☐	rarely	☐	occasionally	☐ often
tram	☐	never	☐	rarely	☐	occasionally	☐ often
subway	☐	never	☐	rarely	☐	occasionally	☐ often
regional train	☐	never	☐	rarely	☐	occasionally	☐ often
train	☐	never	☐	rarely	☐	occasionally	☐ often
plane	☐	never	☐	rarely	☐	occasionally	☐ often
taxi/shared taxi	☐	never	☐	rarely	☐	occasionally	☐ often
Own car	☐	never	☐	rarely	☐	occasionally	☐ often
Bicycle/E-Bike	☐	never	☐	rarely	☐	occasionally	☐ often

8. What influences the likelihood of you using public transport?

Note 1: Taxi does not count as public transport!
Note 2: State probability of use (increased - unchanged - reduced)

Storm, rain, snow, coldness, fog etc.	☐	increased	☐	unchanged	☐	reduced
Darkness, night	☐	increased	☐	unchanged	☐	reduced
Rush Hour	☐	increased	☐	unchanged	☐	reduced
Major events, trade fairs	☐	increased	☐	unchanged	☐	reduced
_____	☐	increased	☐	unchanged	☐	reduced

9. Which assistive devices do you use before, during and after the trip?

☐	magnifying glass	☐	suitcase
☐	white cane	☐	GPS
☐	wheelchair	☐	walker
☐	walking stick	☐	_____
☐	_____	☐	_____

10. Do you use a smart phone in relation to public transport for:

☐	ticket purchase	☐	other services in and on the vehicle
☐	time table/connection info	☐	public WIFI (in vehicle)
☐	delay alarm	☐	_____

11. If onboard WIFI is available, what do you use it for: [optional]

☐	what is in the surroundings	☐	tourist information
☐	stop request	☐	entertainment
☐	next stop	☐	_____
☐	delay alarm/connection	☐	_____

12. What do take with you when travelling by public transport?

☐	baby carriage/stroller	☐	_____
☐	luggage	☐	_____
☐	shopping trolley	☐	_____

13. Dou you mainly ride alone or with others? [optional]

☐	alone	☐	in a group (how many persons?)
☐	with others		_____

14. How do you normally get to the starting point? [ACC]

☐	on my own	☐	being brought

15. How far is the closest public transport stop (typically)?

☐ ≤ 100 m ☐ ≤ 300 m ☐ ≤ 500 m ☐ > 500 m

16. Do you find the bus line, bus stop and the entrance independently? [ACC]

☐ yes ☐ no

17. Do you need assistance when changing (not when exiting)? [ACC]

☐ yes ☐ only in special cases: _____
☐ no

18. When changing buses, do you walk in front or behind the Bus? [optional]

☐ in front ☐ behind

19. How do you mainly get from the bus stop to your destination? [ACC]

☐ on my own ☐ being picked up

20. How far is the closest public transport stop to your destination (typically)?

☐ ≤ 100 m ☐ ≤ 300 m ☐ ≤ 500 m ☐ > 500 m

21. Do you talk to/contact the driver?

☐ not applicable (doesn't use public transport where contact to driver is possible)
☐ no
☐ yes, for:
- ☐ ticket purchase ☐ ensuring connection
- ☐ call a taxi ☐ _____
- ☐ conversation ☐ _____

22. Are you usually looking for a seat?

☐ yes ☐ no

23. Which demands do you have on a seat:

☐ in driving direction ☐ close to the driver
☐ close to the exit ☐ with space for luggage
☐ with stop request button ☐ with handle
☐ with emergency intercom ☐ _____
☐ with cane holder ☐ _____

24. How long is your average trip/average distance [optional]

Note: to better understand the use of seats

in minutes: _____ # of changes: _____

25. Which information do you expect from the passenger information system (PIS)? [optional]

☐ connection information ☐ ETA
☐ closures ☐ _____

26. Which senses do you prefer? [optional]

☐ visual ☐ _____
☐ acoustic

27. Would you like to get more information about the current stop? [optional]

☐ closure ☐ construction work
☐ snow not removed ☐ _____
☐ substitute stop ☐ _____

28. What is your experience with boarding and disembarking assistance? [ACC]

☐ manual ramp ☐ automatic ramp
☐ lowering of the vehicle ☐ _____

_____

29. Are you preparing yourself to use public transport?

☐ No, I do this spontaneously ☐ _____
☐ Yes, I prepare myself in advance

30. Which information might help you when using PT?

_____

31. Do you use PT also in also in less familiar cities?

☐ yes ☐ no

32. If so, how do you prepare yourself (finding, changing, …)?

---

33. Have you ever had a bus accident or an emergency stop? [optional]

☐ yes ☐ no

34. Would you like to buckle up on the bus for safety reasons? [optional]

☐ yes ☐ no ☐ occasionally

Part 1 B: Vehicle equipment

Remark: Skip this part if (not) applicable

35. How do you find handholds, handrails and controls (color, contrast, tactile markings)? [ACC]

---

36. Do you think grooved handle bars are particularly useful? [optional]

☐ yes ☐ no

37. How do you like the lights in the vehicle, especially in the entrance area or at steps? [ACC]

---

38. Which experiences have you made with automatic doors (opening and closing)? [ACC]

---

39. What is your experiences with displays/messages outside the vehicle? [ACC]

---

40. Do camera surveillance and emergency call stations make you feel more secure?

☐ yes ☐ no

Part 1 C: Assessment of PT

41. What do you like about PT, what do you dislike?

42. If you had three wishes for public transport …

1.
2.
3.

43. Tell me about a positive experience in bus travel/public transport use that you experienced lately!

(What happened? Where did that happen? Who was involved? How did that feel?)
Remark: in order to design a positive user experience, we need to identify the experience categories relevant for AVENUE.

Part 2: Experiences with autonomous transportation

44. Have you ever used a driverless vehicle before?

☐ no → *continue with buses*

☐ yes, with:

☐	skytrain	☐	autonomous car
☐	driverless subway	☐	_____
☐	autonomous bus		

45. If yes: Where and when was that in each case?

_____

_____

46. Please tell us about your experience with the autonomous transportation. What did you like about it?

Note: Focus on buses if several different experiences are available

_____

_____

_____

_____

47. What did you dislike?

_____

_____

_____

_____

48. What differences do you notice between autonomous and conventional driver-controlled buses? How do you rate these?

☐ no experience with autonomous buses

_____

_____

_____

_____

49. How do you assess the maturity of the current autonomous buses?

Note: Based on the vehicles and services you have actually experienced, not the idea of future usage

- ☐ not yet operational
- ☐ suitable for everyday use, but with restrictions
- ☐ equivalent to other public transport
- ☐ better than conventional buses
- ☐ no experience with autonomous buses

Part 3: Wishes and expectations for future autonomous buses

50. Have you heard that there are buses that drive independently?

☐ yes ☐ no

51. Would you take a driverless bus? If no, why not?

☐ yes ☐ no

---

52. What would be prerequisites for you to get in?

---

53. Does it make a difference to you whether a driver/employee of the transport company is in the vehicle? Which or what would you expect from this person?

☐ yes ☐ no

---

54. Would you send your child to school on a driverless bus? If no, what would be the prerequisites for you to let your child ride along?

☐ yes ☐ no

---

55. How do you assess the safety (e.g. accidents) of an autonomous bus compared to conventional buses?

☐ less secure than conventional buses
☐ no difference
☐ more secure than conventional buses

---

56. How do you assess the reliability (e.g. punctuality) of an autonomous bus compared to conventional buses?

☐ higher/better than conventional buses
☐ no difference
☐ lower/worse than conventional buses

---

57. How do you assess the comfort of an autonomous bus compared to conventional buses?

☐ higher/better than conventional buses
☐ no difference
☐ lower/worse than conventional buses

---

58. Do these assessments (last three questions) apply to all situations? What differences do you see?

*Note: Cf. question **Error! Reference source not found.**: storm, rain, snow, cold, fog etc. – darkness, night – rush hour – major events, trade fairs*

---

59. What are your concerns when autonomous buses are used regularly? Name the three most important ones!

1. _____
2. _____
3. _____

60. What are your wishes and expectations concerning autonomous buses of the future? Name the three most important ones!

4. _____
5. _____
6. _____

61. Do you have any further comments or thoughts on future autonomous buses?

Thank you very much for this interview!

8 References

[1] European Parliament and the Council, “Regulation (EC) No 661/2009,” 13 7 2009. [Online]. Available: http://data.europa.eu/eli/reg/2009/661/oj. [Accessed 26 09 2018].

[2] Economic Commission for Europe of the United Nations (UNECE), “Regulation No 107 of the Economic Commission for Europe of the United Nations (UNECE),” 18 6 2015. [Online]. Available: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:42015X0618(01). [Accessed 12 9 2018].

[3] E. COMMISSION, “COMMISSION REGULATION (EU) No 1300/2014,” 18 11 2014. [Online]. Available: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014R1300. [Accessed 11. September 2018].

[4] K. Goodwin, “Perfecting Your Personas,” May 2008. [Online]. Available: http://www.cooper.com/newsletters/2001_07/perfecting_your_personas.htm.

[5] J. A. T. Pruitt, The Persona Lifecycle: Keeping People in Mind Throughout Product Design (Interactive Technologies), M. Kaufmann, Ed., 2006.