



Automated Vehicles to Evolve to a New Urban Experience

DELIVERABLE 8.7

D8.7 Second iteration social impact assessment



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Acronyms

CATI	Computer Assisted Telephone Interview
EC	European Commission
SUMP	Sustainable Urban Mobility Plan
PRM	People with Reduced Mobility
PTO	Public Transport Operators
WP	Work Package
AV	Automated Vehicle

Executive Summary

An important aspect of the AVENUE project, is the socio-economic and environmental evaluation (WP8) It consists of an Environmental Impact Assessment (T8.1), an Economic Impact Assessment (T8.2), a Social Impact Assessment (T8.3) and a Sustainability Assessment (T8.4). In this deliverable, we will report on the social impact assessment. The aim of the social impact assessment is to study user experience, user acceptance and potential changes in mobility behaviour in the use of public transport systems. Questions are: are the mobility needs of users met; are users afraid to take a bus without driver; are there gender, age or disability specificities? Furthermore, we aim to assess what potential users in general think, and what attitudes, expectations, fears, hesitations they have regarding automated minibuses.

In this second iteration of the social impact assessment, we provide an overview of the empirical work realised during the period of August 2019 – January 2021. The first iteration study, which was realised to cover the previous period (October 2018 - July 2019) has been reported in Deliverable 8.8.

In the AVENUE social impact assessment, we focus on the social impact of the deployment of automated minibuses in the four official AVENUE cities, Luxembourg, Copenhagen, Geneva and Lyon. In addition, the needs and expectations in a town without automated minibuses (Singen) were investigated. The primary aim is to understand whether the introduction of automated minibuses in the public transport system will result in a changed mobility behaviour

Five studies have been conducted and reported upon in this deliverable. A first study focused on the mobility needs, mobility gaps and the question whether automated minibuses can fulfil these mobility gaps. A second study focused on the social acceptance of automated minibuses in the four AVENUE cities. This study investigated expectations, attitudes and acceptance of automated minibuses among potential users. The third study focused on the user experiences of passengers of the automated minibus service in Nordhavn, Copenhagen. A fourth study took the perspective of the safety drivers. Their own experiences with the automated minibus, their observations and interaction with the users provided input on the AVENUE user experiences. The fifth study conducted takes a different perspective; not the (potential) users are the object of study, but the social media content about automated minibuses. This should also contribute to understand the social acceptance of automated minibuses.

Based on these studies, we can draw some preliminary conclusions. A first general insight, based on the results of all included studies, is that there is no acute need for a complete substitution of current public transport offers in the perception of citizens. Secondly, the on-demand system, as a key aspect of the AVENUE project. First results show that willingness to use the automated minibuses increases if an on-demand service is provided (see chapter 2 and chapter 3) and that people are only interested in changing their mobility behaviour if it provides additional temporal and spatial flexibility. Hence, the results so far point to the significance of an on-demand service for the success of the automated minibus service.

1 Introduction

AVENUE aims to design and carry out full-scale demonstrations of urban transport automation by deploying, for the first time worldwide, fleets of automated minibuses in low to medium demand areas of 4 European demonstrator cities (Geneva, Lyon, Copenhagen and Luxembourg) and 2 to 3 replicator cities. The AVENUE vision for future public transport in urban and suburban areas, is that automated vehicles will ensure safe, rapid, economic, sustainable and personalised transport of passengers. AVENUE introduces disruptive public transportation paradigms on the basis of on-demand, door-to-door services, aiming to set up a new model of public transportation, by revisiting the offered public transportation services, and aiming to suppress prescheduled fixed bus itineraries.

Vehicle services that substantially enhance the passenger experience as well as the overall quality and value of the service will be introduced, also targeting elderly people, people with disabilities and vulnerable users. Road behaviour, security of the automated vehicles and passengers' safety are central points of the AVENUE project.

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

1.1 On-demand Mobility

Public transportation is a key element of a region's economic development and the quality of life of its citizens. Governments around the world are defining strategies for the development of efficient public transport based on different criteria of importance to their regions, such as topography, citizens' needs, social and economic barriers, environmental concerns and historical development. However, new technologies, modes of transport and services are appearing, which seem very promising to the support of regional strategies for the development of public transport.

On-demand transport is a public transport service that only works when a reservation has been recorded and will be a relevant solution where the demand for transport is diffuse and regular transport is inefficient. On-demand transport differs from other public transport services in that vehicles do not follow a fixed route and do not use a predefined timetable. Unlike taxis, on-demand public transport is usually also not individual. An operator or an automated system takes care of the booking, planning and organization.

It is recognized that the use and integration of on-demand automated vehicles has the potential to significantly improve services and provide solutions to many of the problems encountered today in the development of sustainable and efficient public transport.

1.2 Automated Vehicles

A self-driving car, referred in the AVENUE project as an **Automated Vehicle (AV)** is a vehicle that is capable of sensing its environment and moving safely with no human input. The choice of Automated vs Automated was made in AVENUE since, in the current literature, most of the vehicle concepts have a person in the driver's seat, utilize a communication connection to the Cloud or other vehicles, and do not independently select either destinations or routes for reaching them, thus being "automated". The automated vehicles are considered to provide assistance (at various levels) to the driver. In AVENUE there will be no driver (so no assistance will be needed), while the route and destinations will be defined automatically (by the fleet management system). The target is to reach a system comprising of vehicles and services that independently select and optimize their destination and routes, based on the passenger demands.

In relation to the SAE levels, the AVENUE project will operate SAE Level 4 vehicles.



SAE J3016™ LEVELS OF DRIVING AUTOMATION

	SAE LEVEL 0	SAE LEVEL 1	SAE LEVEL 2	SAE LEVEL 3	SAE LEVEL 4	SAE LEVEL 5
What does the human in the driver's seat have to do?	You are driving whenever these driver support features are engaged – even if your feet are off the pedals and you are not steering			You are not driving when these automated driving features are engaged – even if you are seated in “the driver’s seat”		
	You must constantly supervise these support features; you must steer, brake or accelerate as needed to maintain safety			When the feature requests, you must drive	These automated driving features will not require you to take over driving	
	These are driver support features			These are automated driving features		
What do these features do?	These features are limited to providing warnings and momentary assistance	These features provide steering OR brake/acceleration support to the driver	These features provide steering AND brake/acceleration support to the driver	These features can drive the vehicle under limited conditions and will not operate unless all required conditions are met		This feature can drive the vehicle under all conditions
Example Features	<ul style="list-style-type: none">• automatic emergency braking• blind spot warning• lane departure warning	<ul style="list-style-type: none">• lane centering OR• adaptive cruise control	<ul style="list-style-type: none">• lane centering AND• adaptive cruise control at the same time	<ul style="list-style-type: none">• traffic jam chauffeur	<ul style="list-style-type: none">• local driverless taxi• pedals/steering wheel may or may not be installed	<ul style="list-style-type: none">• same as level 4, but feature can drive everywhere in all conditions

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Figure 1.1 Levels of driving automation

1.2.1 Automated vehicle operation overview

We distinguish in AVENUE two levels of control of the AV: micro-navigation and macro-navigation. Micro navigation is fully integrated in the vehicle and implements the road behaviour of the vehicle, while macro-navigation is controlled by the operator running the vehicle and defines the destination and path of the vehicle, as defined the higher view of the overall fleet management.

For micro-navigation Automated Vehicles combine a variety of sensors to perceive their surroundings, such as 3D video, lidar, sonar, GNSS, odometry and other types sensors. Control software and systems, integrated in the vehicle, fusion and interpret the sensor information to identify the current position of the vehicle, detecting obstacles in the surround environment, and choosing the most appropriate reaction of the vehicle, ranging from stopping to bypassing the obstacle, reducing its speed, making a turn etc.

For the Macro-navigation, that is the destination to reach, the Automated Vehicle receives the information from either the in-vehicle operator (in the current configuration with a fixed path route), or from the remote-control service via a dedicated 4/5G communication channel, for a fleet-managed operation. The fleet management system considers all available vehicles in the services area, the passenger request, the operator policies, the street conditions (closed streets) and send route and stop information to the vehicle (route to follow and destination to reach).

1.2.2 Automated vehicle capabilities in AVENUE

The automated minibuses employed in AVENUE fully and automatically manage the above defined, micro-navigation and road behaviour, in an open street environment. The vehicles are automatically capable to recognise obstacles (and identify some of them), identify moving and stationary objects, and automatically decide to bypass them or wait behind them, based on the defined policies. For example, with small changes in its route the AVENUE shuttle is able to bypass a parked car, while it will slow down and follow behind a slowly moving car. The AVENUE vehicles are able to handle different complex road situations, like entering and exiting round-about in the presence of other fast running cars, stop in zebra crossings, communicate with infrastructure via V2I interfaces (ex. red light control).

The automated minibuses used in the AVENUE project technically can achieve speeds of more than 60Km/h. However, this speed cannot be used in the project demonstrators for several reasons, ranging from regulatory to safety. Under current regulations the maximum authorised speed is 25 or 30 Km/h (depending on the site). In the current demonstrators the speed does not exceed 23 Km/h, with an operational speed of 14 to 18 Km/h. Another, more important reason for limiting the vehicle speed is safety for passengers and pedestrians. Due to the fact that the current LIDAR has a range of 100m and the obstacle identification is done for objects no further than 40 meters, and considering that the vehicle must safely stop in case of an obstacle on the road (which will be “seen” at less than 40 meters distance) we cannot guarantee a safe braking if the speed is more than 25 Km/h. Note that technically the vehicle can make harsh break and stop with 40 meters in high speeds (40 -50 Km/h) but then the break would too harsh putting in risk the vehicle passengers. The project is working in finding an optimal point between passenger and pedestrian safety.

1.3 Scope and aim of the social impact assessment study

In this deliverable, we will report on the AVENUE social impact assessment. The aim of the social impact assessment is to study user experience, user acceptance and potential changes in mobility behaviour in the use of public transport systems. Questions are: are the mobility needs of users met; are users afraid to take a bus without driver; are there gender, age or disability specificities? Furthermore, we aim

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to assess what potential users in general think, and what attitudes, expectations, fears, hesitations they have regarding automated minibuses.

In this second iteration of the social impact assessment, we provide an overview of the empirical work realised during the period of August 2019 – January 2021. The first iteration study, which was realised to cover the previous period (October 2018 - July 2019) has been reported in Deliverable 8.8. In the first deliverable, we primarily reported on the preparation of the studies to be conducted within the AVENUE project. Due to changes in the project process itself – e.g. timing of introduction of the on-demand service - as well as the COVID-19 pandemic, some alteration had to be made in the planning as laid down in this first deliverable. This includes changes in the planned surveys – in terms of timing, methodologies as well as target groups. In the current deliverable we will address both these changes and show the results from the empirical work already done.

2 AVENUE social impact assessment

In this chapter we will introduce the AVENUE social impact assessment, starting with an introduction of the main themes guiding this assessment. Hereafter, we will introduce the studies that have been conducted and will be presented in the remaining of this deliverable.

2.1 Introduction

Public support is of crucial importance for a successful implementation of the AVENUE automated minibus service system. Elements that are important for the creation of public support are: safety, comfort, technology trustworthiness, effectiveness, accessibility and price (Kyriakidis et al. 2015; Nordhoff et al. 2018b; Bernauer and Wicki 2018; Litman 2019). A recent study shows that potential users are supportive of this new technology (Nordhoff et al. 2018a). To increase its acceptance, the new technology should be introduced to the public as soon as possible, while simultaneously being further advanced and pushed to high-quality level (Salonen and Haavisto 2019). Furthermore, visual assessments (e.g. lights, signals) and government support increase acceptance (Wicki and Bernauer 2018).

In the AVENUE social impact assessment, we focus on the social impact of the deployment of automated minibuses in the four official AVENUE cities, Luxembourg, Copenhagen, Geneva and Lyon. In addition, the needs and expectations in a town without automated minibuses (Singen) were investigated. The primary aim is to understand whether the introduction of automated minibuses in the public transport system will result in a changed mobility behaviour, which corresponds to the following research question:

What is the social impact of automated public transport systems, and how does this contribute to a changed mobility behaviour?

To change mobility behaviour of citizens in the four AVENUE cities by introducing automated minibuses requires a need for new mobility services, social acceptance of automated mobility services by the society as well as a positive user experience. These aspects are interrelated, but nevertheless should be distinguished, as citizens might be accepting the new technology in general but might not be willing to use it due to unsatisfactory or even negative user experiences. Or, people that are reluctant to the new technology will start using it due to positive user experiences (Shackel 2009; Tullis, T. & Albert, A. 2013). These three concepts correspond to the first three research questions that guide the social impact study:

1. What are the mobility needs of citizens, and can an automated minibus service provide in this need?
2. What is the social acceptance of automated public transport systems in the four AVENUE test cities?
3. What is the user experience of automated shuttles in the four AVENUE test cities?

Of specific interest in the AVENUE project, is the target group of people with reduced mobility (PRM). To stipulate its importance, we defined the following research question:

4. What is the accessibility of automated public transport systems for people with reduced mobility (PRM)?

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These questions will be answered via a combination of observation and interview techniques. These techniques will be adapted from classic methods used in user experience design and evaluation such as usability testing or contextual enquiry. Each chapter will discuss the methodological considerations and methods applied in the study.

In addition to the classic methods used to answer research questions 1 to 4, we aim to gain insights in the role of social media in the acceptance of automated public transport, by answering the following question;

5. How are automated vehicles discussed in social media, and what lessons can we learn for AVENUE?

Gaining insights from the contents of social media, could provide other indicators about the social acceptance of automated minibuses.

2.2 Research approach

To answer the research questions, we designed and conducted 6 studies (see **Fehler! Verweisquelle konnte nicht gefunden werden.**): quantitative survey among potential users; a quantitative survey among actual users, a qualitative, longitudinal survey among residents of the pilot sites, a qualitative study among safety drivers and a social media analysis. The study on the experiences of PRM has been conducted as part as AVENUE WP2, its results do however also feed into this deliverable. Table 2.1 provides an overview of the details of the studies, and their current status.

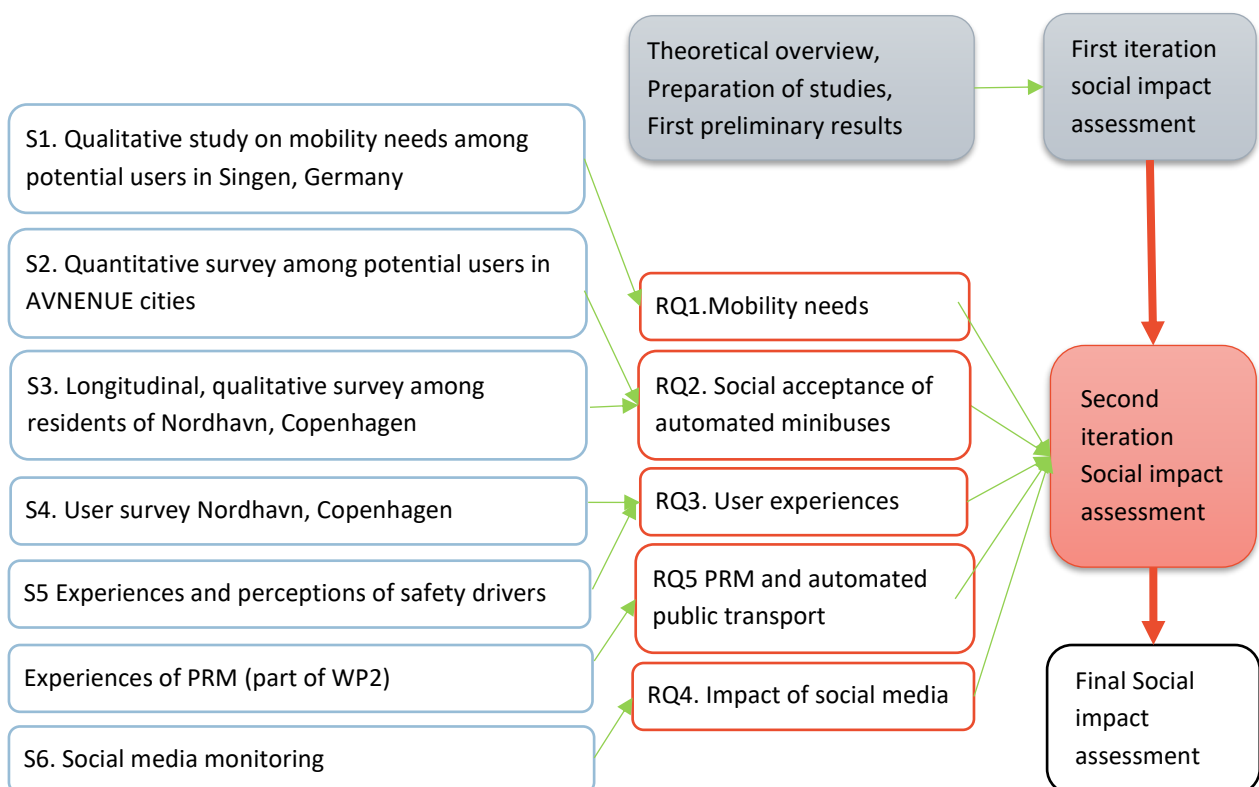


Figure 2.1 Methodological approach to social impact assessment

Table 2.1 Overview studies conducted for the social impact assessment

OBJECTIVE	MOBILITY NEEDS, MOBILITY GAPS	SOCIAL ACCEPTANCE		USER EXPERIENCES			SOCIAL MEDIA
STUDY	Mobility needs, mobility gaps and expectations of automated minibuses	Expectations, attitudes and acceptance of automated minibuses	Mobility behaviour at pilot site level	User experience of actual users	Experiences of safety drivers	Accessibility of automated public transport for PRM	Social media monitoring
TARGET GROUP	Citizens	Potential users, households	Residents of pilot site	Users of the automated minibuses	Safety drivers	People with Reduced Mobility	Comments of social media users
METHOD	Qualitative interviews	Quantitative, online survey	Qualitative, longitudinal study interviews	Quantitative, online questionnaires	Qualitative interviews	Qualitative interviews	Media analysis
SAMPLE SIZE	n=7	n= 981	n=8	n = 68	n=6	N=58 (part of WP2)	n=781
STATUS	Completed	Analysis completed	Data collection completed for Nordhavn, Copenhagen	Analysis completed for Nordhavn Copenhagen	Completed	Completed (part of WP2)	Completed
NEXT STEPS	x	Conduct control measurement in spring 2021 If possible under COVID situation; conduct survey at pilot site level	Finalise data analysis. Conduct study at other sites	Conduct user surveys in Luxembourg, Geneva and Lyon	x	X	x
CHAPTER IN DELIVERABLE	3	4	-	5	6	7	8

2.3 Specific themes in this deliverable

This deliverable is structured around the studies that provide insights on the three central topics for the social impact assessment (mobility needs, social acceptance of automated minibuses and user experiences). There are, however, some themes that cross-cut these studies. Three important themes require a word of introduction; the effect of the COVID 19 pandemic, the on-demand services and the relation to the sustainable urban mobility plans.

Firstly, the effect on of the COVID-19 pandemic on public transport in general and automated minibuses in particular. The COVID-19 pandemic has direct consequences on the AVENUE project, as the majority of the operations endured a halting of the operations. Some pilots were able to restart their operations as of October 2020 with restrictions (such as a limitation of the number of passengers and requirement of protection masks), while others were not able to restart. For the social impact assessment, this meant that there was no opportunity to study user experiences or to conduct face-to-face interviews with residents of the pilot project areas. This has resulted in delays, and might even result in cancellation of some studies, such as user surveys. The COVID-19 pandemic will, however, also result in indirect influences; mobility demand is decreasing, due to lock-downs and home-office requirements. Furthermore, the demand for public transport is decreasing even more, as people rather opt for corona-safe mobility systems, such as a private car, or cycling. In the user survey conducted in Copenhagen (presented in chapter 5), we included questions on the effects of COVID-19; these questions will be included in all relevant upcoming AVENUE studies. A first indicator based on the study in Copenhagen shows is that COVID-19 influences the mobility patterns of about 50% of the users. The study also shows that that trust in automated minibuses is at a comparable level to trust in other public transportation systems.

Secondly, the on-demand system, as a key aspect of the AVENUE project, is a topic that is included in all studies. First results show that willingness to use the automated minibuses increases if an on-demand service is provided (see chapter 4 and chapter 5) and that people are only interested in changing their mobility system if it provides additional temporal and spatial flexibility (see chapter 2). Hence, the results so far point to the significance of an on-demand service for the success of the automated minibus services operation.

The European Commission (EC) introduced the concept of Sustainable Urban Mobility Plan (SUMP) aiming a 'new planning paradigm' in mobility, which comprehends a shift from planning for motorised roads and infrastructure to planning for people (Arsenio et al. 2016). Since 2013 the SUMP's approach has been widely recognised, targeting sustainable and integrative planning processes to deal with the complexity and dynamicity of urban mobility (Eltis 2020). Hence, it embraces new modes of transport, e.g. micro-mobility, automated and connected vehicles, and new concepts as Mobility as a Service (MaaS), shared mobility and so on. The concept of SUMP comprehends the integration of all modes of transport, public and private, motorised and non-motorised and a long-term planning vision. It targets to improve the mobility accessibility, sustainability and citizens' well-being (European Commission 2013). Automated minibuses are expected impact to urban mobility, and could therefore become an important mode of transport to be considered in SUMP strategies and long-term vision. The results of this social impact study could feed into recommendations to improve or update the relevant SUMPs, for instance through integrating insights on the mobility needs and gaps (Chapter 3), through defining the potential of the

integrating automated minibuses in the public transport through the expectations and attitudes of potential users (Chapter 4) and through the experiences of actual users, and their willingness to change modes of transport (Chapter 5).

2.4 Structure of this deliverable

The structure of this deliverable follows the logic of the research questions. Hence, we will start with mobility needs in Chapter 3. This chapter presents the results of a qualitative study into the mobility needs and mobility gaps of citizens in Singen (Germany) and discusses the possibility of introducing an automated minibus service to reduce the mobility gaps. Hereafter we will discuss the expectations, attitudes and acceptance of automated minibuses in the four AVENUE cities in Chapter 4. This chapter presents the results of a quantitative survey among potential users. Hereafter we will continue with the user experiences, divided into three target groups; users of the automated minibus, safety drivers in the automated minibus, and people with reduced mobility (PRM). In chapter 5, we will present the results of a quantitative survey among actual users in the Nordhavn line in Copenhagen. In chapter 6, we will present the results of a qualitative study conducted about the experiences of safety drivers in the AVENUE pilot sites. In chapter 7 we will discuss the social impact of automated minibuses in public transport for the third target group, PRM. In chapter 8, presents a social media analysis on the acceptance of automated minibuses. We finalize with conclusions in chapter 9.

3 Mobility needs

3.1 Introduction

Automated minibuses are expected to contribute in fulfilling gaps of mobility in different cities or villages. In order to select suitable cities for new pilot projects, it is relevant to have a citizen centric approach. This means that the focus is primarily on understanding the needs of citizens and their attitudes towards the current mobility situation and towards new mobility solutions like the automated minibuses. To roll out a system of automated minibuses, additional sites have to be investigated. A possible location to extend to is the town of Singen in Germany.

This study was therefore conducted to get an initial understanding about the current situation, problems and needs regarding the mobility of the citizens of Singen. Additionally, the study aimed to analyze their expectations and concerns on future mobility solutions like the automated minibus, which was evaluated more detailed. The village Singen is located in Germany, between the cities Karlsruhe and Pforzheim. It has a population about 3.800 inhabitants and is about 10 square kilometers big. In terms of topography, Singen has a big height difference. Due to this topography, the village is divided into “Unterdorf” (lower part) and “Oberdorf” (higher part). The majority of the shops as well as the train station are at the edge of the village in the “Unterdorf”. The village is connected to major roads, such as the B 10, providing a direct link to the German highway A8. Additionally, there is the train station for the railway line (Interregio-Express Train) to Karlsruhe/Aalen and the tramway (S5) to Pforzheim/Karlsruhe, as well as one bus stop, which connects different villages in the local community Remchingen and surroundings.

The results of this study are not only relevant for gaining detailed insight in the potentials for Singen, but provide general lessons for attitudes towards and demand for the deployment of automated minibus services.

3.2 Study Design

A qualitative research approach was selected to gain insights on the current mobility situation and expectations towards automated minibus services.

3.2.1 Data collection

Qualitative, semi-structured interviews were conducted with citizens of Singen. The interviews were structured by a guideline, that is included in appendix A. The target group of the study were the citizens and regular visitors of Singen. An equal distribution of women and men, different age groups and public transport users versus non-public transport users was required. A requirement set by the AVENUE project, is the inclusion of people with reduced mobility (PRM), this could be people with travelling with baby carriage, wheelchair, walking aids) (Brosius et al. 2012).

3.2.2 Recruiting respondents

Recruiting of respondents was conducted via distributing the request on several social media platforms, community websites of Wilferdingen-Singen and Remchingen or invitation by mail to known contact persons. In order to collect the right sample, an online screening questionnaire was conducted. This questionnaire covered the following issues: gender, age, PRM, place of residence, mobility behavior, mobility gaps, satisfaction about the public transport and current traffic situation. 46 respondents answered these screening questions. 12 persons fulfilled the quota criteria and were willing to take part in the survey (see Table 3.1 Sample structure **Fehler! Verweisquelle konnte nicht gefunden werden.**) . For qualitative studies it is usual to have smaller samples but to select the sample consciously by theoretically based criteria (Brosius et al. 2012).

Table 3.1 Sample structure

Gender	<ul style="list-style-type: none"> • Women: n=7 • Men: n=5
Age	<ul style="list-style-type: none"> • Between 16-29 years: n=1 • Between 30-60 years: n=8 • 61 years or older: n=3
PRM	<ul style="list-style-type: none"> • Baby carriages and stroller: n=1
Place of Residence	<ul style="list-style-type: none"> • Singen: n=10 • Wilferdingen: n=2 (but regularly/very often in Singen due to work)

3.3 Current Mobility Situation in Singen

The screener questionnaire provided first insights on the mobility situation. About two thirds (62%, based on the total sample of n=46) are not satisfied with the offer of public transportation in Singen and about every second is not satisfied with the current traffic situation (Figure 3.1). Obviously, especially the current offer of bus services is not satisfying. Cars are the most used transportation means (see), train and bus are used less, rarely or only occasionally.

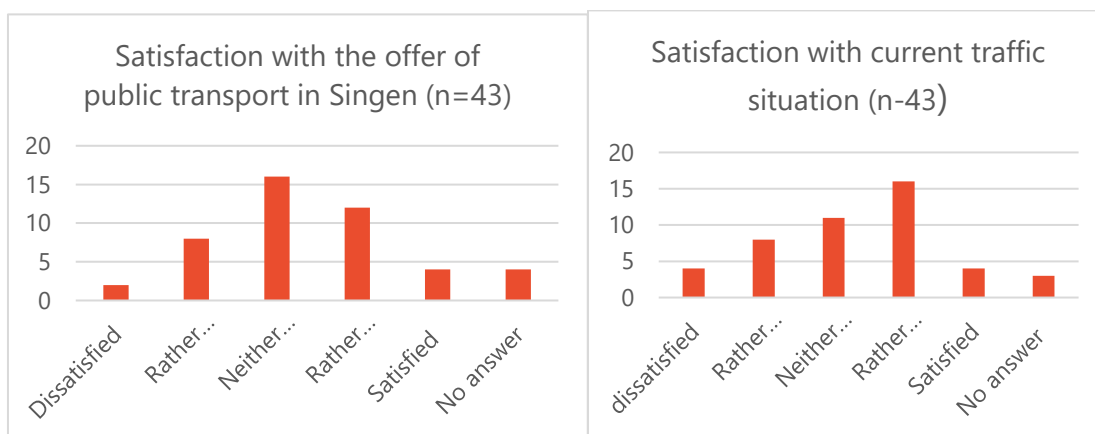


Figure 3.1 Satisfaction with public transport (left) and traffic situation (right) in Singen

Use of car

The car is the main mode of transport; each of the 12 participants was in possession of a car. Cars are used for many occasions: to go shopping, to reach the train station in order to leave Singen by train and for leisure activities like visiting friends, family members or cultural offers.

Our respondents report on functional motives for using the car; it provides a flexibility, both locational flexibility and time flexibility that the bus apparently does not offer. The flexibility of the car results in a cognitive relief. As they are able to use their car at any time to any destination, it is not necessary to plan anything – they can just go out of the house to their car, get in and drive off. Due to the topography in Singen, the car also offers a physical relief. By car, the steep hilly roads can be easily overcome. The car also allows transports of groceries and provides a feeling of protection and security. This was reported in relation to returning home from the train station in Singen at night. The area around the train station (including the underpass) was described as particularly dangerous. Using a car is therefore seen as a means to avoid stress, and adds to a certain status of well-being. Only minor barriers for using the car were identified by the interviewees; the lack of good and secure parking spots at the train station (an additional barrier to use the train) and the consumption of alcohol during leisure activities.

Use of bus

If the bus is used (rarely or only occasionally) occasions to use the bus are; to go shopping; to reach the train station from home; leisure activities and; for students to go to university. The motive structure of the respondents for riding a bus is limited to the functional motives:

- not having to find a parking spot at destination (cognitive relief as a motive for using the bus);
- physical relief when using the bus because they do not have to walk uphill, for example from the supermarket or from the train station to their home
- opportunity for other activities in the time of using a bus (such as sending a text message to a friend or read a short article)

The interviewees mention many problems in the bus system of Singen, see also Table 3.2. A barrier mentioned by all respondents is the impractical stops position, i.e. the nearest bus stop is too far away. Other problems mentioned are inappropriate departure times; bad conditions inside the bus; the bus does not offer air conditioning, has only little space for shopping bags and is mostly dirty due to missing responsibility of the individual to keep the bus clean. Interviewees state that ticket prices are too high for the services offered. Once these problems decrease, the likeliness of interviewees using the bus (again) will raise.

Table 3.2 Identified problems in the current bus system in Singen

<i>Event</i>	First- and-last mile	Shopping	Leisure activities	School (<18 Years)
<i>Identified problems</i>	Nearest bus stops too far away			
	Impractical departure times and bad timing			
	No cleanliness, air condition			
	High ticket price			

	Little space for shopping bags		
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Use of bicycle

The bicycle is used to go shopping; to reach the train station from home; for leisure activities like visiting friends/family or cultural offers and exclusively the students to come to university. Using the bicycle offers especially local and time flexibility, which results in time saving and cognitive relief. Next to the functional motives, also fun and to have a positive environmental impact when using the bicycle motivates to use this mode of transport. Some problems of using the bicycle are reported. The topography and the bad road conditions (few bicycle paths, lot of parked cars) conditions in Singen hamper the use of the bicycle. These conditions make the shopping (returning home with purchases) exhausting and unfavourable. In using the bicycle to reach the train station, bicycle thefts are a problem. Hence, Singen does not currently offer optimal conditions for using the bicycle as the main means of transport.

In a first conclusion, it can be stated that for all the mentioned occasions, the car is the most popular mode of transport to move within Singen. Most of the residents own a car due to the fact that it offers better mobility than public transport systems as the bus. The only noticeable barrier when using the car, are a shortage of good parking spots in some areas within Singen. Experiences with the bus and the bus system are mostly negative and deficient.

3.3.1 Mobility needs

The basic need for mobility and also in life in general is avoiding stress, which results in further different needs. The objective while moving from one place to another is to satisfy the different needs in order to achieve a maximum of stress avoidance. Four primary needs were identified (see also Figure 3.2): Freedom and independence; Comfort and well-being; Trust and; Fun and experience.

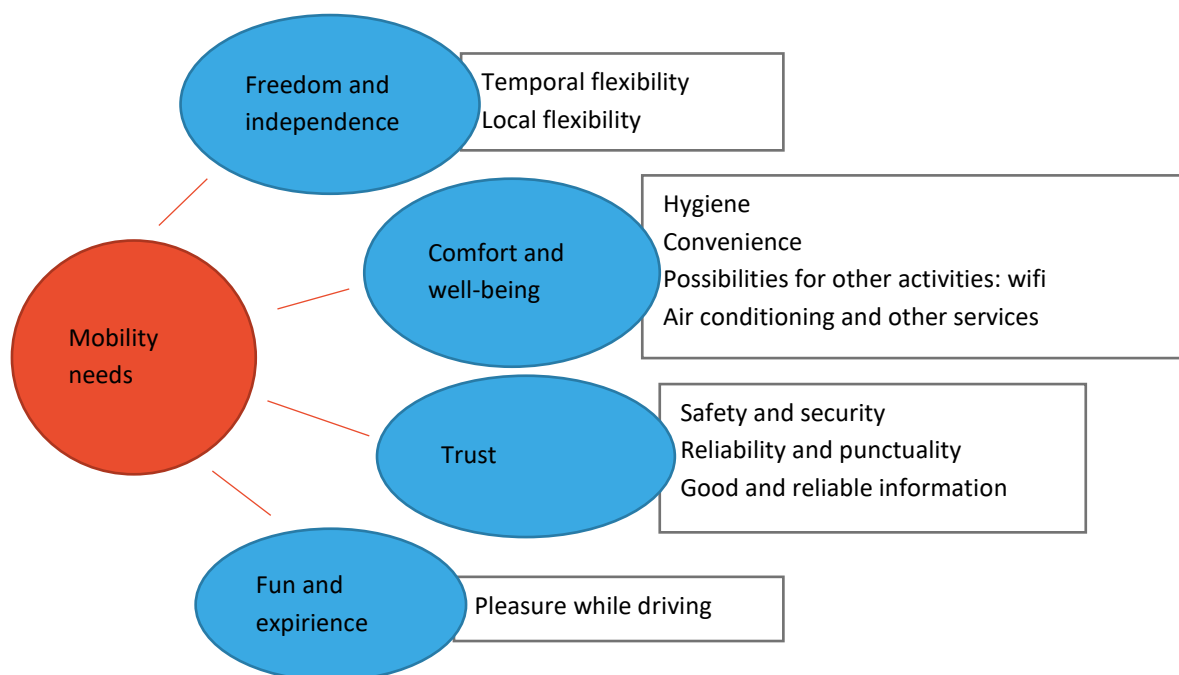


Figure 3.2 Mobility needs

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The mobility need “freedom and independence” can be fulfilled by a certain degree of temporal and local flexibility. In Singen, only a limited amount of trains arrives and departs to reach destinations like the work place. Interviewees express a need for the possibility to arrive at and depart from the station at any time to catch the planned train, and to leave from the train station. An additional need is local flexibility, meaning the opportunity to reach the station from any point and come back from the train station to any point within Singen. These needs should be fulfilled to overcome the first-and-last-mile gap. Hence, there is a need for a mode of transport, that provides a high level of flexibility.

Another mobility need is “comfort and a state of wellbeing”. This includes air conditioning, hygiene and cleanliness inside the mode of transport, special conveniences, as well as the possibility for other activities such as checking mails (Wifi). Especially in cases of leisure activities like visiting friends or going to restaurants within Singen the mode of transport should be clean. For people on their way back from shopping, the mode of transport should offer an easy storage and transport of those items.

A third identified mobility need is “trust”; the mode of transport should offer a high degree of safety and security. Reliability, punctuality, as well as a good and reliable information policy regarding traffic jams, delays or waiting times have been given as well. Trust should be fulfilled in any occasion when moving around within Singen. Due to the limited train services in Singen (not all trains make a stop here, esp. a problem at night) a reliable, punctual and secure mode of transport for the first-and-last-mile is needed.

A final mobility need is the need of ‘fun and experience while driving’. This need is required for long distances and is not relevant for the short distances and occasions within Singen.

Summing up, the mobility need “freedom and independence” is a priority for mobility within Singen. It has to be fulfilled in the main occasions, especially regarding the temporal and local flexibility. But also, the mobility needs ‘comfort and well-being’ and ‘trust’, have to be fulfilled with corresponding requirements.

3.3.2 Mobility gaps in Singen

Mobility gaps are given when the citizens of Singen consider the offered or available means of transport as insufficient to fully satisfy their mobility needs under given conditions and in the certain mobility situation. Two major mobility gaps have become apparent, once the first/last mile to/from the train station and further going shopping especially without the availability of a car.

First and last mile (esp. from home to train station)

Specific mobility needs are to be fulfilled for the first and last mile, see **Fehler! Verweisquelle konnte nicht gefunden werden..** Currently, there are three options to reach the train station: by car, by bus or by bike. Reaching the train station by car, on the one hand, offers greater flexibility in terms of time than the bus, but time is lost again looking for a parking space. For reaching the train station by bus, you will have to overcome some problems, such as a lack of good and well-located bus stops, and inappropriate departure times for certain train connections. This results in an unsatisfied state of freedom and independence. Reaching the station by bike has certain disadvantages as well. At the train station there is a high risk of thefts, which hampers the residents to use their bicycles and put it there on the stands. Another

disadvantage stated by the interviewees, is the difference in elevation between the station and “Oberdorf”. In case of bad weather people like to switch to another mode of transport.

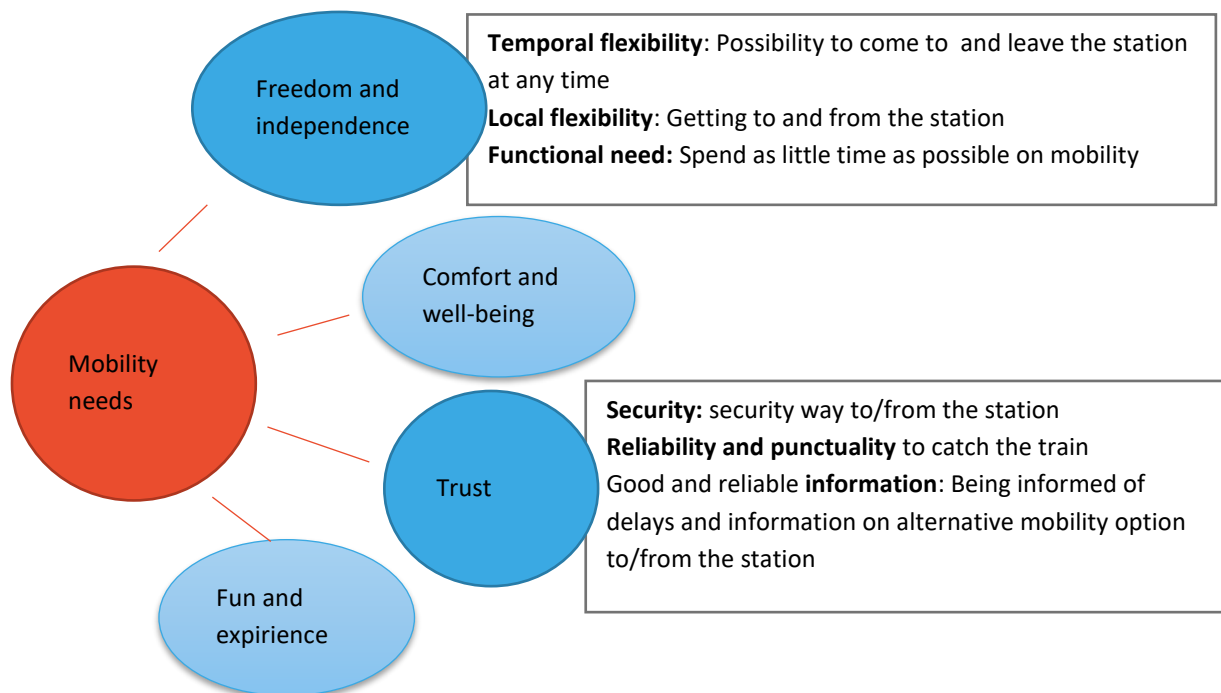


Figure 3.3 Mobility needs in the situation of the first-and-last-mile

Shopping without the availability of a car

Alternative transportation means to go shopping are using the bicycle and the bus. Both the bus and the bicycle are not satisfying the mobility needs in the situation of going shopping. Transporting larger purchases by bike is a problem especially when people live in the "Oberdorf". Also, in case of bad weather use of bicycle is not satisfying. In using the bus for shopping, problems occur by a lack of flexibility and a lack of storage space.

As a conclusion the mobility situation is not satisfying at all in Singen. There is an acute need for improvement by offers of public transport being more flexible and solving esp. the problem of bridging the last mile from home to train station.

3.4 Expectations towards Automated minibus

In this study, we aimed to assess whether an automated minibus service could provide a solution for the mobility gaps within Singen. In order to give the respondents a first impression about automated minibuses, a videoclip was shown. The reactions show that the automated shuttle service is perceived as a promising solution. It is expected to offer higher flexibility, to increase sustainability, to be an advanced model of transportation. In general, it is seen to be an attracting “additional” solution but cannot completely replace other means of transport. These issues will be illustrated more detailed in the following paragraphs.

3.4.1 Expectations of Flexibility

Spontaneous reactions show esp. high expectations towards improved flexibility. Due to its small and compact appearance, the respondents assume that the automated minibus is able to come to many, even winding places within Singen. They therefore expect a better network of bus stops, resulting in higher local flexibility. Additionally, the automated minibus seems to have a modern technology and agile locomotion, which offers fast processes like the start and stop or the door opening. This results again in a fast mobility from A to B and finally in more temporal flexibility. Furthermore, the respondents associate the automated minibus as being modern, digital and innovative. Hence, they assume a connection to an app on their smartphones to have a fast order processing from anywhere. Having such a possibility to order the automated minibus from anywhere at any time again results in a local and temporal flexibility. For many, linking to an app is a suitable solution to realize an on-demand service, but also allows a good information policy including the waiting time forecasts, delays and the planned route.

Nevertheless, respondents also worried about some obstacles. For instance, a high demand of the automated minibus could cause a loss of punctuality. Especially in case of buying chilled goods this is even more important. Additionally, it is remarkable that the temporal flexibility was prioritized over the local flexibility. The respondents accept more to walk some meters than waiting too long for the bus. Summing up (see also Table 3.3), the shuttle is expected to be very suitable to satisfy the need for more freedom and flexibility.

Table 3.3 Perceived requirements, opportunities and obstacles for the automated minibus service

REQUIREMENTS	OPPORTUNITIES	OBSTACLES
LINK TO AN APP:	Pick-up service with flexible start and destination	Unreliable information in the app
	Can be booked anywhere and at any time	Reliability and punctuality when demand is high
	Fast order processing	Loss of independence and freedom; switch to another mode of transport
	Easy and quick payment	
	Good information policy	
MODERN TECHNOLOGY	Create an efficient route, to get to your destination quickly	No access to older people
	Research all possible locations in Singen	No access for people without a smartphone
	Fast mobility from A to B	
	PRM can get in quickly and easily	

3.4.2 Safety & Security

The respondents associate the automated minibus with a low probability of accidents due to the preprogrammed routes and its sensors. The most respondents assume human errors like the lack of concentration, stress or distraction as more likely than any technical errors of the software. Nevertheless, the test subjects are suspicious to them since the technology can also make wrong decisions. Especially one respondent, working in the IT branch, reflected on programming errors, which hampers the trust in

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the safety of the automated minibus. Additionally, respondents expressed a concern as the reaction of the automated minibus is unpredictable for them.

Regarding the security there are some perceived expectations like a better protection against attacks on the street especially on the way home in the night. So, the automated minibus could offer a more secure last mile from the train station to their home. In contrast, it has turned out that some fears attack within the buses, especially when the automated minibus is driving without any human component. Furthermore, there are some concerns regarding the help for older people or people with reduced mobility when there is no human component available. So, the lack of personal component in an automated minibus is seen as an obstacle for a secure feeling when using the bus. Therefore, a human component, like the supervisor inside the bus, could alleviate security concerns.

Summing up, the perception of safety and security is ambivalent. On the one hand KI may be less vulnerable than human being due to a lack of concentration. On the other hand human beings in the bus increase a more general feeling of security.

3.4.3 Environmental effects

In addition to the positive expectations towards flexibility positive environmental effects are expected. Some respondents mentioned the CO₂ savings, no fossil fuels as well as the noise emission due to the electric drive of the automated minibus. But there are also some critical statements, regarding the use of really green electricity, inefficient passenger transportation due to the small size of the automated minibus and better alternatives such as hydrogen cells. However, environmental friendliness itself is not considered as a primary need for mobility.

3.4.4 Economical Aspect/Pricing

The respondents state that they are willing to pay a higher price compared to currently used means of transportation, under the condition that the automated minibus service is a real improvement in terms of temporal and local flexibility, connection to an app for fast ordering and efficient routing (see Figure 3.4). Additionally, a certain standard of hygiene through cleanliness and tidiness, as well as some seats and room to stand should also be given as basic requirements. Finally, to fully trust the automated minibus, a certain security through an operator inside the vehicle should be given as a basic requirement. Above the basic requirements there were mentioned some additional requirements, even some which could be categorized as luxury requirements. For example, room for bags, Wi-Fi inside the bus or an electric outlet are illustrating additional requirements. Are those given, it would satisfy the mobility need comfort and well-being even more. This results in a willingness to pay an even higher price than for the basic services.

In conclusion, the aspect of pricing is considered important. The fact that respondents have a clear idea of what should be given for which price, it illustrates that the price itself has a relevant and decisive impact on deciding the mode of transport. In the case of the automated minibus a higher price than conventional means of transport is accepted, as long as the mentioned basic requirements, especially regarding flexibility, are more satisfying in comparison to current public transport offers.

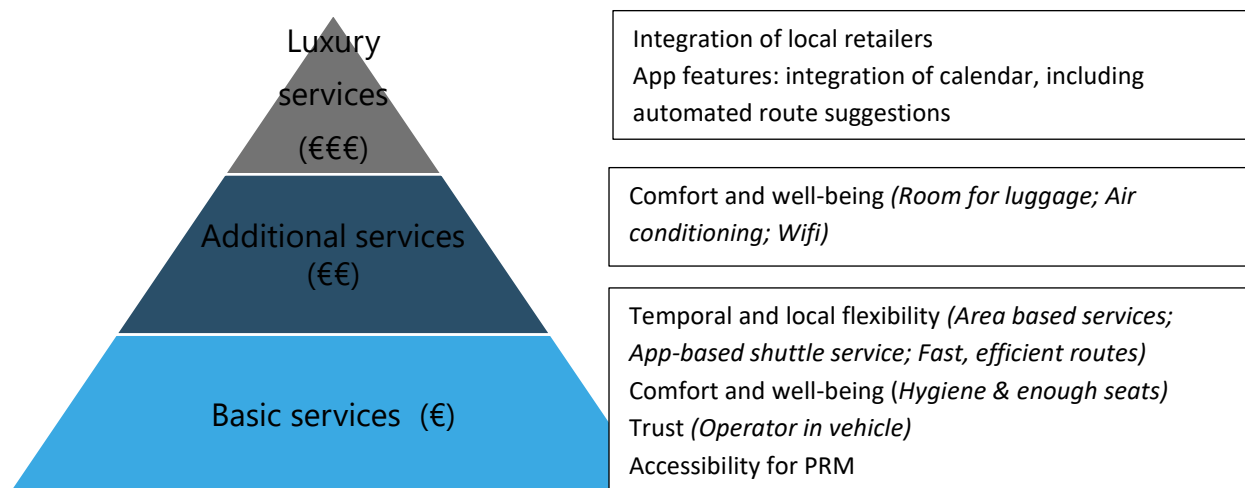


Figure 3.4 Willingness to pay is dependent on the offered services

3.4.5 Opportunities and Risks in the Competitive Environment

The automated minibus as a future mode of transport was mainly compared with the own car, the bicycle and the current bus system within Singen. In the comparison to the own car, stress avoidance due to cognitive relief is a big opportunity for the automated minibus in the view of the respondents. Additionally, you do not have to search for any parking spot in public places, which avoids stress as well. Regarding the economical aspect and the pricing, the automated minibus brings another opportunity in terms of no fixed costs. You can use the automated minibus only when it is needed and pay only in the moment of use, while there are always fixed costs with the own car. Besides the opportunities there are some concerns about the punctuality and reliability, especially in situations of high demand.

In comparison to the bicycle, the automated minibus offers the opportunity of protection in case of bad weather. Additionally, it gives a higher protection from attacks in critical situations, particularly when going home from the train station in the night. Furthermore, and most relevant for the use of the automated minibus instead of the bicycle, is the physical relief since it is easier to overcome the slope within Singen with the automated minibus, especially after going shopping. So, the transport of the groceries is less exhaustive.

The automated minibus offers tremendous advantages over the existing bus system in Singen. When using the automated minibus, a higher temporal flexibility is expected due to expected higher transportation frequencies. Furthermore, there is a local flexibility and physical relief since of the area-based service from anywhere. Additionally, the respondents expect a higher standard of hygiene, more room for groceries and bags, air conditioning and Wi-Fi, which result in a big advantage against the current bus system within Singen. The automated minibus was evaluated with a high potential for partial substitution of every mode of transport. Particularly it is convincing regarding the cognitive and physical relief. In competition with the car, which is defined as the main mode of transport, it seems to be unlikely to replace this in the short term with the automated minibus. A complete substitution of the bicycle is also not possible, as the motives enjoyment and exercise are not fulfilled with the automated minibus. But in comparison to the

bus system within Singen the automated minibus has tremendous potential for fully substitution. Consequently, and in conclusion, the residents assessed the automated minibus as a valuable addition.

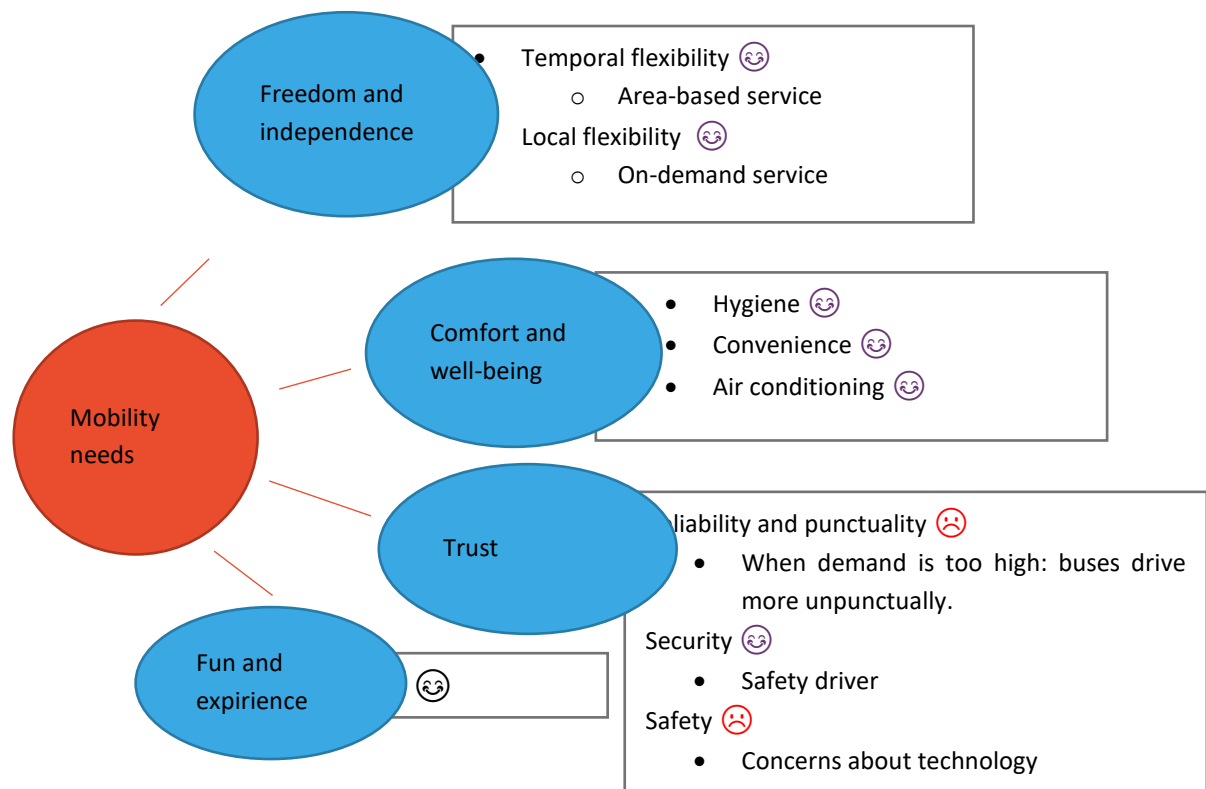


Figure 3.5 Automated minibus and mobility needs

3.5 Key Learnings

The study shows that the current offer of public transportation in Singen is not satisfactory, and that walking or cycling not an optimal solution to replace public transport or the car. This results in mobility gaps, such as the first-and-last mile to/from the train station. The automated minibus service is perceived as a solution for the current mobility gaps in public transport offers, as it is perceived to an increased degree of temporal and local flexibility. However, it is primarily perceived as an attractive “additional” solution, but cannot replace existing means of transport.

The study shows that temporal flexibility is prioritized over the local flexibility. This means that respondents are accepting an additional distance to the nearest bus stop (in walking distance) over waiting time. This result asks for a more detailed analysis of the requirements for an on-demand service; what is an acceptable distance between home and the pick-point (physical or virtual bus stop); and what is an acceptable waiting time?

An automated minibus service could be a mobility solution in locations comparable to Singen, where there is an acute need for improved public transport. It can be expected that the willingness to test the new service will be high. The study shows that an automated minibus service will not be a complete substitution of all mobility options, it is not to be expected that a private own car or bicycle is fully

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replaced, however, there is potential for the automated minibus service to replace the current bus system. Under the condition that the service will bring additional services, is of higher quality than the current service and is a real improvement in terms of temporal and local flexibility, respondents are willing to pay a higher price for the service.

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4 Expectations, Attitudes and Acceptance of automated minibuses

For the social impact assessment, we have designed a survey focused on potential users of automated minibuses. This survey focuses on mobility behaviour in general and views on automated minibuses as public transport options in particular. The objectives of the representative survey are to gain insights into the individual needs and lifestyles, mobility behaviour, social and psychological well-being, experienced life-quality at test site, and perception and attractiveness of the concepts offered by the automated minibus.

The preparation of the survey and its first results have been reported on in Deliverable 8.8 “First Iteration Social Impact Assessment” (Korbee et al. 2019). Please consult that document for a more detailed account of the survey preparation. A full version of the questionnaire is included in Appendix B of this deliverable as well. In this chapter, we will focus on presenting the full data-collection procedure (Section 4.1), present the descriptive results (Section 4.2), present the analysis and results of the target group (Section 4.3) and providing an outlook for next steps (Section 4.4).

4.1 Data collection

Two methods were applied for data collection. Online surveys were conducted in Copenhagen, Geneva and Luxembourg, and a computer assisted telephone interview (CATI) was conducted in Lyon. The CATI survey conducted in Lyon was part of a larger, regular "barometer" study commissioned by Keolis. The relevant raw data from the CATI survey were provided by Keolis for evaluation. A small excerpt of the questions from the "barometer" study was included in our online survey. The central questions for the surveys were questions which are directly connected to the automated minibuses, such as awareness, knowledge, attitudes, acceptance and willingness to use the offer. These questions lasted about 5 to 10 minutes. In order to better understand the needs and satisfaction of potential users with the current traffic situation and the offers of public transport and to examine the current mobility behaviour, corresponding questions were asked in addition. With the inclusion of the AVENUE questions, the interviews lasted about 15 to 20 minutes. As the barometer already consists of a large amount of questions being only relevant for Keolis, but not for Avenue, only the questions focussing directly on the automated minibuses, were included. An overview of the included questions can be found in Appendix B.

4.1.1 Copenhagen

In Copenhagen, the survey was distributed online through different media-channels of the local transport operator and AVENUE partner, letsHolo, including their homepage, access via (<https://www.letsholo.com/nordhavn>) and their facebook page (Figure 4.1). In addition, flyers were publicly distributed in the city of Nordhavn. **Fehler! Verweisquelle konnte nicht gefunden werden.** As prime potential users of the shuttle service, the residents of Nordhavn (including families, children, and elderly), commuters working in Nordhavn, and visitors to the area, are considered. Hence, these different types of potential users were also targeted in the representative survey.

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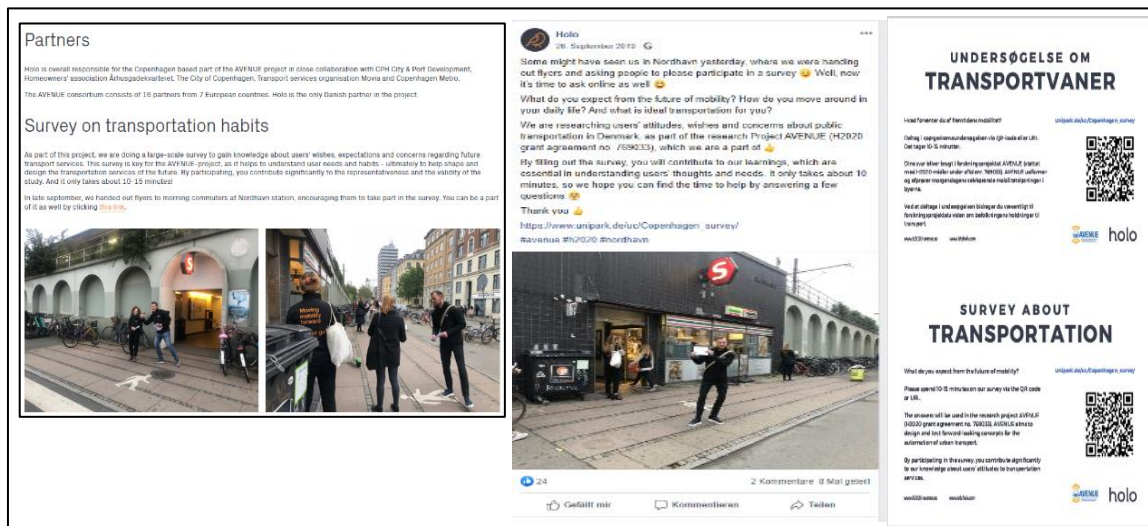


Figure 4.1 Distribution of flyer and link in Copenhagen

The personal recruitment in Nordhavn rendered the highest results. The response rate increased sharply after the first distribution of flyers in the end of September 2019 as well as in the beginning of November and December.

4.1.2 Luxembourg

In Luxembourg, the representative survey was supposed to be distributed through the media channels of Sales Lentz and the city of Luxembourg. The cooperation with the city could not be realized, thus the link to the survey was only published on the Facebook page of Marc Sales, **Fehler! Verweisquelle konnte nicht gefunden werden**.owner of Sales Lentz and the mobility pioneer site¹ of Sales Lentz (see Figure 4.2**Fehler! Verweisquelle konnte nicht gefunden werden**.). The expected target groups for the representative survey for Luxembourg were commuters going to and coming from work (especially at Contern), as well as tourists, local residents and passers-by's

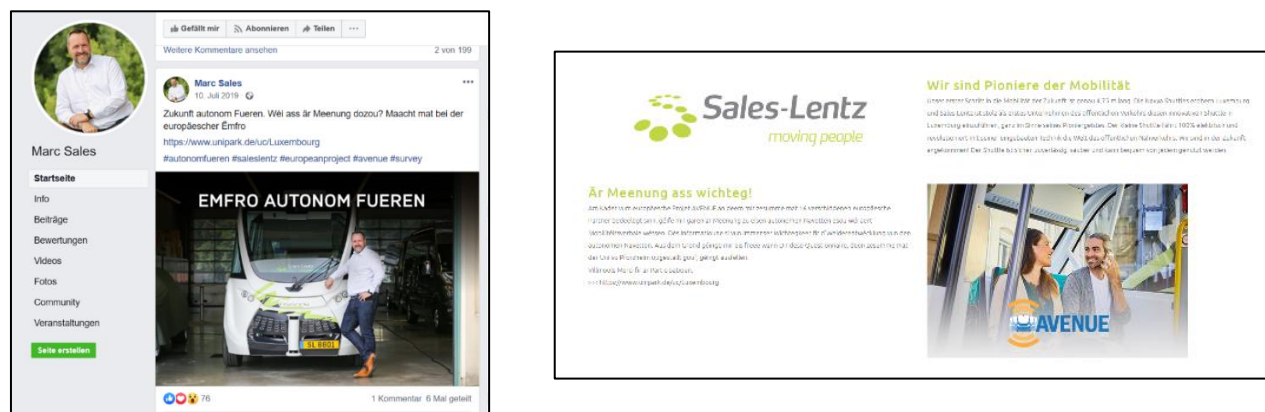


Figure 4.2 Announcements survey Luxembourg

¹ Link: <https://www.mobilitypioneers.lu/?lang=de>

The reactions to these promotions were quite small, consequently a re-launch with a new link started in the end of October 2019, now including also an internal app only for Sales Lentz employees. Nevertheless, the response rate did not grow. Reason was a presentation of the old link on the pioneer side, which should be replaced soon by the new one. Current sample is now $n=27$, the major part completed in the beginning of November 2019, with the distribution of the new link in the employees app.

4.1.3 Geneva

In Geneva, the survey was planned to be distributed by different media channels of TPG (homepage and facebook). Finally, the link to the survey was presented only on the Facebook (Figure 4.3 Distribution of survey Geneva on TPG Facebook page). The campaign on the social media ran from August 28th to September 8th, sending publicity to Facebook users. Due to high costs of running such a Facebook campaign, it was not possible to continue with this action over a longer time. The distribution was quite successful at the very beginning. From August 26th till September 6th the major part of the current sample of $n=243$ completed the survey.



Figure 4.3 Distribution of survey Geneva on TPG Facebook page

4.1.4 Lyon

There was no need to distribute the representative survey via different media channels in Lyon, due to the integration of some of the questions in the "Barometre Usages et Profils 2019 – Questionnaire de l'enquete". Lyon is the only city that thus had no problems in reaching the aimed quota of 600 respondents but is due to the small number of questions not comparable with regard to all questions to the other cities.

4.1.5 Data cleaning and sample structure

Records from respondents completed the survey by clicking through the questions in less than 200 seconds, or did not answer any of the questions were removed. As a result, 21 surveys from Geneva and 5 from Copenhagen were removed. Respondents who started the survey but did not finish it completely are included in the analysis, as well as respondents who did not answer continuously to all the questions. This is explained by the wish to achieve as much data as possible. Finally, 978 records remained, divided over the four cities. The structure of the sample is diverse; we reached all age groups, female and male potential users, employees as well as students, households with or without children (see Table 4.1 Fehler! Verweisquelle konnte nicht gefunden werden.).

Table 4.1 Sample characterization

<i>Total respondents</i>	978
<i>City</i>	Lyon: 654 Copenhagen: 127 Geneva: 170 Luxembourg: 27
<i>Age</i>	40% younger than 36 years 60% older than 36 years
<i>Sex</i>	52% Male 48% Female
<i>Occupation</i>	62% employee 18% Student 9% self-employed 11% other
<i>Education</i>	57% Tertiary 38% Secondary 5% primary
<i>Household composition</i>	40% have children in household 57 % do not have children in household 3% refused to answer
<i>Own private car</i>	30 % none 44% one car 26% more than one car
<i>Most frequently used transport system</i>	24% own car 10% bus 14% train etc. 32% Bike 5% Walking 15% Other means of transport

4.2 Results

The results are presented in two steps. In a first step, we will present the results on a descriptive level, detailing the differences between the surveyed cities (sections 4.2.1, 4.2.2 and 4.2.3).. The second part of this result section, we will present the outcomes of the cluster analysis (4.3).

4.2.1 General Situation

These questions were not asked in the CATI survey in Lyon. The results are based on the respondents in Copenhagen, Luxembourg and Geneva (n=321). The representative survey has reached city dwellers, not so much the inhabitants of the surrounding area with the exception of Luxembourg: Overall 52 % living in city or city suburb, 22% living in medium to large town.

In general, satisfaction with life situation seems to be high in the pilot cities, see Table 4.2. Our respondents present a high quality of life in general (7.6 in comparison to Eurostat 2019 7,3), with slight differences between the cities: Copenhagen (8.0) and Luxembourg (7.8), score higher than Geneva (7.3). The satisfaction with life has also been divided into separate items: Respondents report on a high quality of standard of living (4.0) and a high satisfaction with accommodation (4.0), and a high satisfaction with local area as a place to live (4.0). The results therefore show that respondents are satisfied with the general aspects of life. Focusing on specific elements provides a different picture; there is a general dissatisfaction with the local traffic situation (2.6), the public transportation offer (3.4) and the local environmental situation (3.2). The satisfaction with the local traffic situation is slightly lower compared to 3.6 as predicted by Pederson and colleagues (2011)². There are slight differences between the three cities, but the overall trend is comparable throughout the three cities.

Table 4.2 Satisfaction general items

		Copenhagen	Geneva	Luxembourg	Overall
Satisfaction with life	Mean value ¹	8.0	7.3	7.8	7.6
Satisfaction with life EUROSTAT²	Mean value ¹	7.8	8.0	7.6	7.4
Satisfaction with present standard of living	Mean value ³	4.2	3.8	3.9	4.0
Satisfaction with accommodation	Mean value ³	3.9	3.9	4.3	4.0
Satisfaction with family life	Mean value ³	4.3	4.0	4.3	4.1
Satisfaction with your local area as place to live	Mean value ³	4.2	3.9	3.8	4.0
Satisfaction with current traffic situation in and around your city	Mean value ³	3.1	2.2	2.2	2.6
Satisfaction with public transportation offer	Mean value ³	3.4	3.4	3.2	3.4

² <https://onlinelibrary.wiley.com/doi/full/10.1111/j.1559-1816.2011.00789.x>

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		Copenhagen	Geneva	Luxembourg	Overall
Satisfaction with environmental situation in your city	Mean value ³	3.4	3.0	3.3	3.2

¹Mean values on factor variables (higher values mean higher satisfaction, where 1= lowest, 10=highest)

²Eurostat news release: Quality of life in 2018: How satisfied are people with their lives; 11.07.2019

³Mean values on factor variables (higher values mean higher satisfaction, where 1= lowest, 5=highest)

⁴No value available for satisfaction as an overall number for the three cities.

* These questions were not included in the CATI survey in Lyon

The respondents are asked to reflect upon possible problems in their direct neighbourhood (Figure 4.4). Heavy traffic is perceived as the most problematic in all three cities, followed by noise (3,1); air quality (3,4) and public transport (3,4). Similar to the general satisfaction of life; there are slight differences between the three cities, but the overall trend is comparable throughout the three cities.

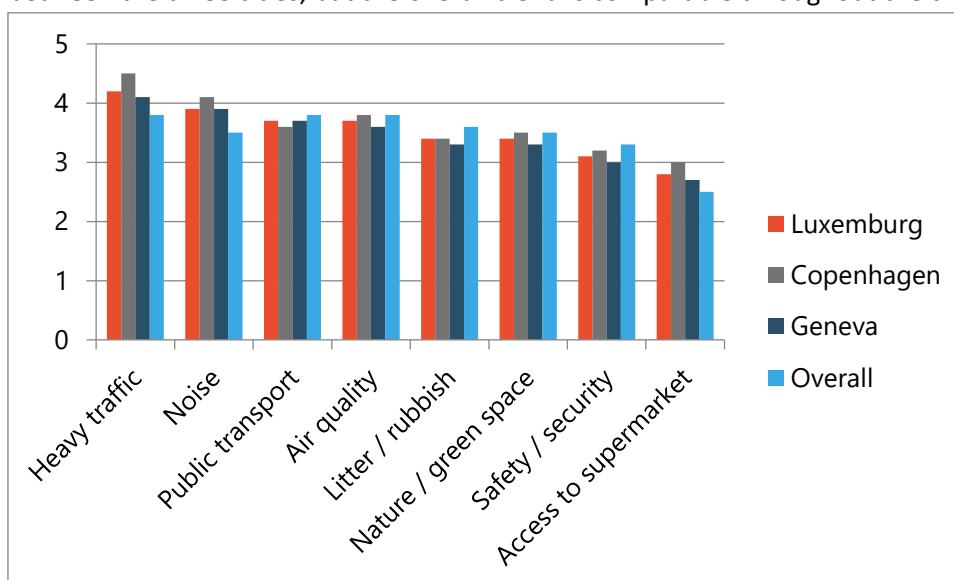


Figure 4.4 Major problems in the direct neighbourhood

4.2.2 Mobility Behaviour

The bike is the most preferred transport system in general (32%, Table 4.3). However, this is primarily due to the popularity of cycling in Copenhagen, and the disproportioned size of the Copenhagen sample compared to the Luxembourg sample. The own car is by far the most preferred transport system in Luxembourg, with 67%, and ranks second in both Copenhagen (23%) and Geneva (19%). The bus ranks relatively high in both Geneva and Luxembourg (both 15%), whereas it is not popular in Copenhagen (2%).

Table 4.3 Preferred transport system

		Copenhagen	Geneva	Luxembourg	Overall
Car	respondents	23%	19%	67%	24%
Train	respondents	22%	8%	11%	14%
Bus	respondents	2%	15%	15%	10%
Bike/ e-bike	respondents	44%	27%	0%	32%
Walking	respondents	1%	9%	4%	5%
Other means of transport	respondents	8%	22%	3%	15%

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In selecting a preferred transport system speed, travel time (mean 2,1) and punctuality (3) are most important, followed by price (3.8). In addition to asking for the preferred transport system, we asked the respondents about the actual use of different transport systems. Five questions were asked to make sure we got full insight in the actual use. In the first question regarding this topic we asked for the frequency of use specific means of transport. The results hereof are presented in Table 4.4. We see that the walking and use of bike are most prominent modes of transport used on a daily basis. More interesting to see, is that in Geneva, 25% state that they use the car on a daily basis, whereas only 19% depict the car as preferred means of transport. This means that people are using the car, whereas they would prefer to use another transport system. In Copenhagen, we see the opposite, 23% of the respondents' state that the car is the preferred means of transport, whereas only 16% use it on a daily basis. Furthermore, we see that on general, bus and train are used more frequent (overall 23% and 23%) but are not being seen as the preferred mean of transport (only 10% for both).

Table 4.4 Current use of transport

		Copenhagen	Geneva	Luxembourg	Overall
Car	daily users	16%	25%	67%	25%
Train	daily users	45%	22%	0%	23%
Bus	daily users	10%	33%	15%	23%
Bike	daily users	60%	30%	4%	40%
Walking	daily users	75%	70%	56%	71%

As a follow-up question, we asked the respondents whether there are differences in using a transport system, depending on bad weather. About half of our respondents (56%) indicated that this is true. Bad weather conditions increase the preference of using the own car (48% in Geneva, 64% in Luxembourg, and 28% in Copenhagen). Respondents also report that the use of the bus is increased in cases of bad weather (overall 50%, Geneva 62%, Copenhagen 34% and Luxembourg 33%). The increase in the use of buses is primarily caused by people using a bike.

To gain more precise information, we asked the respondents to indicate which means of transport is used for different goals; commuting to/from work, going to the supermarket, and visiting family and friends (see Table 4.5). Walking is the most used means of transport for going to the supermarket (57%), followed by the car (30%) and bike (23%). The bus is hardly used for going to the supermarket (only 8%). This is also confirmed by our qualitative study in Singen³.

Table 4.5 Occasions per transportation system

		Commuting to/from work	Going to supermarket	Visiting family and friends
Car	overall respondents	25%	30%	36%
Train	overall respondents	29%	0%	14%
Bus	overall respondents	29%	8%	20%
Bike	overall respondents	41%	23%	33%
Walking	overall respondents	26%	57%	31%

³ Please see chapter 2 of this deliverable that is presenting the results of our qualitative study into the mobility needs, wishes and gaps in Singen.

4.2.3 Acceptance of automated minibuses

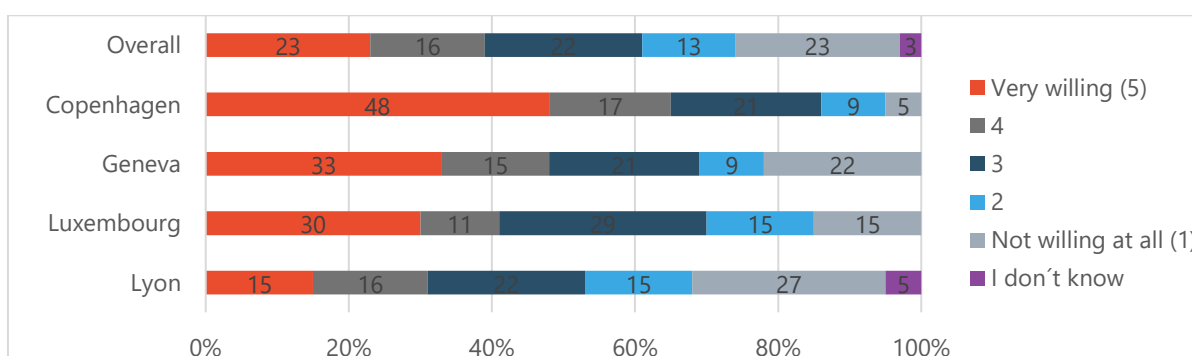
The following questions were included in the CATI survey in Lyon, so the results from Lyon are included in the presentation of results. A small majority of our respondents (58%) was aware (in 2019) of the existence of automated minibuses Table 4.6.

Table 4.6 Awareness of automated shuttles

		Copenhagen	Geneva	Luxembourg	Lyon	Overall
Awareness of Automated shuttles	Yes	57%	66%	100%	55%	58%
Awareness of pilots in city	No tests are planned in my city	2%	14%	19%	0%	5%
	Tests are planned, but are not yet in operation	17%	9%	7%	7%	12%
	Tests are in operation in my city	9%	40%	70%	46%	38%
	I don't know	72%	37%	4%	43%	45%
Experience with automated shuttles	Yes	7%	20%	63%	10%	14%

There is a wide range of information sources: newspaper (32%), radio (34%), internet (31%), social media (20%) or seen on the test site (22%). Only a small portion of those respondents who know automated minibuses (58%, n=571) are also experienced with them (14% of n=571 with knowledge). Awareness of pilots in the respective cities is high. Every second respondent is already well acquainted with planned (12%) or already taking tests (38%). The knowledge was lowest for Copenhagen, with 72% did not know about planned tests in 2019). Again, there is a wide range of information sources: newspaper (32%), radio (26%), internet (28%), social media (12%) or seen on the test site (19%).

The willingness to use automated minibuses ranges from very willing (23%) to not willing at all (also 23%), as is visualized in Figure 4.5. The willingness to use is highest in Copenhagen (3.9) and lowest in Lyon (2.9). This may be interpreted as a risk: Expectations are highly positive if experience is still low or not existing, the longer experiences may exist the more people may also know about dissatisfying aspects as low speed (see recognized advantages and disadvantages). But as well the openness for new technologies may also be higher in Copenhagen.


Figure 4.5 Willingness to use automated minibus per city

The willingness to use is comparable between younger (16 to 35 years old) and elder (>36) people. It is somewhat higher among male (3.2) than for female (3.0) persons. There is no difference among car owners (3.6) and those having no car in their household (3.5).

4.2.4 Advantages and concerns

Important questions in the survey are the question related to perceived advantages (Figure 4.7) and perceived concerns (**Fehler! Verweisquelle konnte nicht gefunden werden.**) regarding the use of automated minibus. A general impression is that the respondents have a positive perception on the benefits of automated minibuses. All items asked for have a minimum agreement of 48%, going up to an agreement of 69% for the perceived benefit that automated minibuses can enhance freedom for PRM. On the perceived concerns we see a slightly more differentiated picture. Respondents show a high agreement with concerns regarding the functioning of the automated minibus (this includes the interaction with motorized and non-motorized traffic, its reaction to unforeseen situations and issues of liability in the case of an accident). Respondents are less concerned over issues such as having to learn how to use the automated minibus.

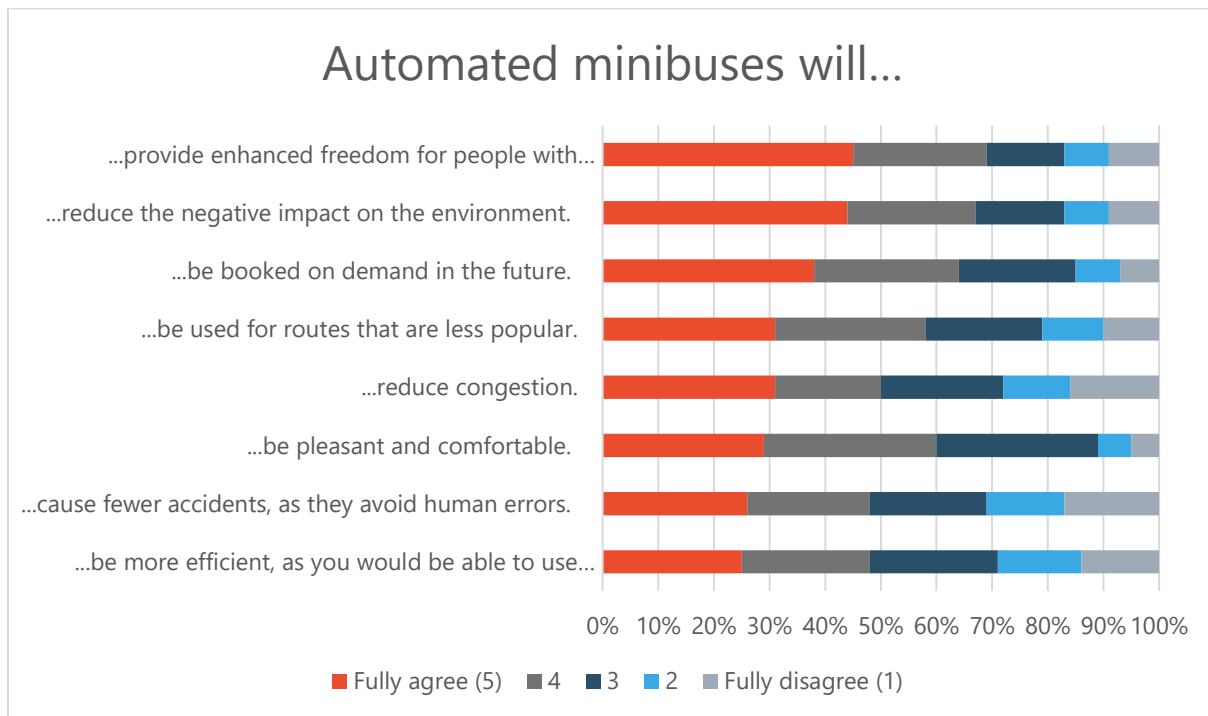


Figure 4.6 Perceived advantages of automated minibuses

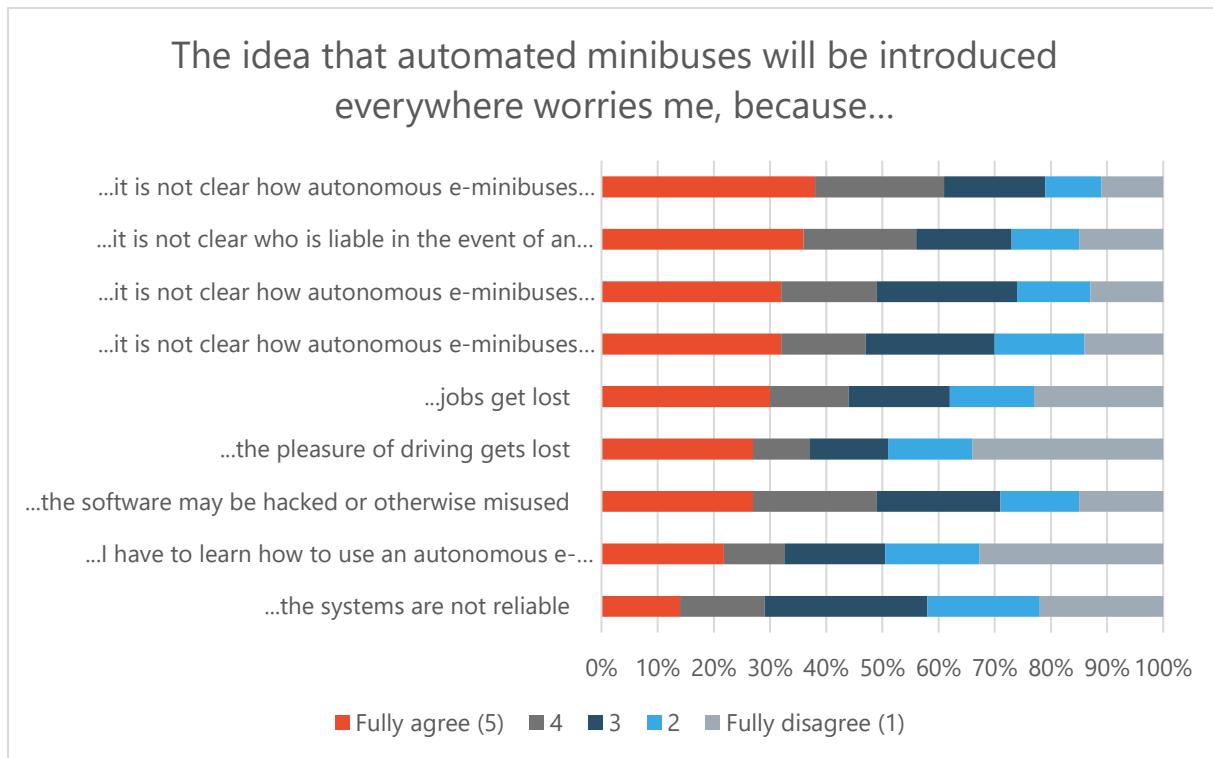


Figure 4.7 Perceived concerns over automated minibuses

4.2.5 Willingness to pay

To assess the willingness to pay, two questions were asked. A first question asked for preferences between a cheaper automated minibus (44%), a conventional private car (21%) or a more expensive automated private car (7%). A group of 13% would not use any of these options, and the remaining 15% does not know. The majority of the respondents is willing to pay the equivalent or more of what they pay for current, conventional public transport (65%). However, there is also a group that is not willing to pay at all (14% or less than the equivalent of what they pay for current conventional public transport (21%). These numbers are rather stable across the cities, age groups and gender groups.

4.3 Target groups

4.3.1 Data analysis methodology

The statistical program SPSS was used for data analysis. After an initial descriptive analysis, a factor analysis was carried out to reduce the number of perceived advantages and disadvantages of automated minibuses. This was followed by a hierarchical cluster analysis to identify different typologies of respondents according to these perceived advantages and disadvantages. As a next step a multiple linear regression was used to analyse the influence of the calculated factors on the willingness to use the automated minibuses.

Factor analysis

A factor analysis, with the variables for the expected advantages and disadvantages of the automated electric minibuses, was carried out to compress the data and identify correlations in the data. The item battery of 19 variables was used to ask for these advantages and disadvantages. The Scale leads from (1)

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meaning “do not agree at all” to (5) meaning “agree completely”. The additional scale point (6) “I can’t judge” was set on missing for the factor analysis. 17 of the items got included into the analysis. Two items have been excluded because one was only asked in Lyon but not in the other cities and the other one was not asked in Lyon but in the other cities. (Using them would have led to erroneous results.) Additionally, a filter was set, excluding those respondents from Lyon who stated, that they did not hear of the automated minibuses before the survey, as they got only a small amount of the items presented. In total 761 cases were then included in the factor analysis. The principal component method (PCA) was used to extract the factors. The Kaiser-Meyer-Olkin measure of sampling adequacy was ,889 representing a relatively good factor analysis. The Bartlett’s test of Sphericity was significant (Chi-Quadrat (136) = 2495.231, $p < .001$) indicating that correlations between items were sufficiently large for performing a PCA (Tabachnick and Fidell 2014; Cleff 2015).

Four factors are extracted to explain the expected advantages and disadvantages of the automated minibuses. The VARIMAX method is used to rotate the factors and yield orthogonal, interpretable factors. The decision for four factors is based on contextual interpretability (not on the Eigenvalues) (Field 2013). The factors can explain 60.41 percent of the total variance. All factor loadings are higher than 0.4, indicating high construct validity (**Fehler! Verweisquelle konnte nicht gefunden werden.**Table 4.7).

Table 4.7 Items and factor loading

	Loading
Optimizing Public Transport	
... be more efficient, as you would be able to use your time better than in a car, walking or cycling	,770
... reduce congestion	,754
... be booked on demand in the future	,747
... provide enhanced freedom for people with mobility issues	,746
... cause fewer accidents, as they avoid human errors	,700
... be pleasant and comfortable	,684
... reduce the negative impact on the environment	,661
... be used for routes that are less popular	,629
Safety Issues	
... It is not clear how automated minibuses interact with motorized road users	,868
... It is not clear how automated minibuses interact with non-motorized road users	,858
... it is not clear who is liable in the event of an accident	,728
Fears and Security	
... privacy is not protected	,746
... the software may be hacked or otherwise misused	,607
... the systems are not reliable	,515
... jobs get lost	,504
Practical driving issues	
... the pleasure of driving gets lost	,718
... I have to learn how to use an automated minibus	,705

As a next step, a check was made whether factor values or the mean values can be calculated for the factors. For this purpose, a reliability analysis is performed for each group of variables of the

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corresponding factor, whereby the Cronbach α is calculated in each case. This indicates how well the variables measure the same, i.e. whether the factor value variables can be formed or not. For all factors except the “practical driving issues” Cronbach’s Alpha was higher than 0.6, which is acceptable. Since only the variables of the last factor “practical driving issues” show a Cronbach α of under 0.5 (unacceptable) but nevertheless the factors were classified as reasonable on the basis of theoretical considerations, the factor values were formed anyway (Blanz 2015).

Cluster analysis

As a next step, the factor values were calculated, saved as new variables and used to carry out a hierarchical cluster analysis in order to identify different target groups. The squared Euclidean distance was set as distance measure and the ward method as a fusion algorithm. As all variables have the same measurement and scale level, a z-standardisation was not necessary. To find the right number of clusters, the agglomeration schedule and the dendrogram were examined indicating for a 4 cluster-solution. Nevertheless, cluster-solutions 3 to 7 were saved in order to conduct several one-way analyses of variance. The analysis of variance is a useful tool to find differences between groups and thus helps to interpret the clusters. The independent variable is the respective Cluster-solution (from 3 to 7), the dependent variables are the calculated factor variables. A comparison of the mean values between the clusters and their attitude on the perceived advantages and disadvantages of automated minibuses is now possible. The best interpretable result was found in the 5-cluster solution. According to the degree of accordance/approval and rejection to the perceived advantages and disadvantages of automated minibuses the clusters were named.

4.3.2 Results

In this section, we will present the target groups of potential users that are distinguished based on the analysis of this survey. In defining target groups, a two-step approach was applied as detailed in the methodology section (234.3.1). The factor analysis, conducted to compress the measured items, was based on a question depicting on concerns and benefits of automated minibuses. Four factors measure the attitudes towards automated minibuses (see Table 4.8). The first factor correlates to statements that address positive effects of the shuttles in terms of optimizing public transport: greater flexibility, also for people with reduced mobility, on demand, reduced traffic and environmental problems. The second factor, safety issues, summarizes statements that address that it is unclear how the shuttles interact with other traffic members. The third factor combines statements addressing fears such as job loss or security risks such as software hacking. Finally, there is a factor that summarizes that people don't want to give up driving pleasure or are unwilling to learn new systems.

Table 4.8 Factors measuring attitudes towards automated minibuses

Factor 1: Optimizing Public Transport	Factor 2: Safety Issues	Factor 3: Fears and Security	Factor 4: Practical Driving Issues
Be more efficient	Interaction with motorized road users	Privacy is not protected	The pleasure of driving gets lost
Reduce congestion	Interaction with non-motorized road users	Software may be hacked	I have to learn how to use the minibus
Be booked on demand	Liability in case of an accident	The systems are not reliable	
Provide enhanced freedom for PRMs		Jobs get lost	
Cause fewer accidents			
Be pleasant and comfortable			
Reduce the negative impact on the environment			
Be used for routes that are less popular			

Five target groups of potential users can be discerned based on these four factors (see Table 4.9). The identified clusters differ on the four factors measuring expected benefits and concerns. There are two small target groups who already take a clear position towards the shuttles: either enthusiastic (7%) or refusing (8%). The group of enthusiasts highly values the optimizing effects for public transport (with an average mean value of 4,52 out of 5) and has no problems with safety, security and practical driving issues (mean values respectively 1,79; 1,69 and; 1,65). The refusers focus on risks and do not yet see the benefits.

Three clusters represent the majority of potential users see benefits as well risks and do not yet know if benefits or risks prevail; the uncritical goodwill (29%); the indifferent (15%) and; the sceptical goodwill (13%)⁴. The uncritical goodwill sees the benefits higher than average (with an index of 112) and slightly lower perception on risks (with indices of 98, 91 and 95). The group 'indifferent' does not distinguish clearly between the perceived advantages and disadvantages (with indices between 83 – 89). The sceptical goodwill rates both the advantages and the disadvantages higher than average. In the remainder of this result section, we will discuss differences between the target groups based on mobility behaviour, mobility needs and attitudes.

⁴ 28% of the sample was not included in the cluster analysis

Table 4.9 Cluster description

		Enthus-iasts	Uncritical goodwill	Indifferent	Sceptical goodwill	Refusers	Overall ³
		n=76	n=304	n=157	n=140	n=84	N=981
		7%	29%	15%	13%	8%	100%
Optimizing public transport	Mean value ¹	4.52	3.88	3.14	3.82	2.32	3,61
	Index ²	127	112	86	107	61	100
Safety Issues	Mean value ¹	1.79	3.39	2.88	4.26	4.68	3,42
	Index ²	51	98	83	125	139	100
Fears and security	Mean value ¹	1.69	2.75	2.57	3.67	3.94	2,91
	Index ²	57	91	87	129	137	100
Practical driving issues	Mean value ¹	1.65	2.65	2.44	3.67	3.25	2,76
	Index ²	60	95	89	136	120	100

¹Mean values on factor variables (higher values mean higher consent, where 1= lowest, 5=highest)

²Indices ((index: The proportion of a characteristic in a cluster compared to the proportion of the characteristic in the total sample Index>100=positive relation, index <100=negative relation)

³Missing respondents: People that had not heard of automated minibus, where only asked part of the item battery in questions 24 & 25. These respondents were excluded from the cluster analysis

The five clusters appear to differ by gender but not by age (see Table 4.10). Male seem to be better informed and therefore mention clearer opinions: they either represent the majority of both the enthusiasts (64%) and the refusers (64%) but also those who clearly recognize advantages as well as disadvantages (indifferent). Women represent the majority of those having no clear opinion: the sceptical goodwill with 58%. The division of age groups between the five clusters follows roughly the general division of these age groups.

Table 4.10 Demographic characterization of the clusters

		Enthusiasts	Uncritical goodwill	Indifferent	Sceptical goodwill	Refusers	Overall
		n=76	n=304	n=157	n=140	n=84	N=981
Gender	Female	36%	48%	31%	58%	36%	48%
	Male	64%	52%	68%	42%	64%	51%
	Other	0%	0%	1%	0%	0%	1%
Age	16-35 years old	46%	37%	44%	39%	41%	40%
	36 years and older	54%	63%	56%	61%	59%	60%

4.3.3 Characterization of the potential target groups

Cross cluster, the car (24%) and the bike (32%) are most preferred transport options, followed by train (14%), bus (10%) and walking (5%). The five target groups differ in their current mobility behaviour, see Table 4.11. The groups of enthusiasts and uncritical goodwill are primarily train and bike users, the groups of sceptical goodwill and refusers are more often car users. In the group of refusers, 47% uses their car on a daily bases, compared to 24% overall. Frequent car users are thus more likely to refuse to use the shuttles, and are not ready to give up their own car. This outcome confirms earlier research of Dittmar (Dittmar 2011) and Salonen and Haavisto (Salonen and Haavisto 2019) that claim that cars are used to express one's social position in addition to being an entity providing functional benefits. In contrast, goodwill and willingness to use the automated minibus is high among frequent users of trains; 31% of the critical goodwill uses a train on a daily basis, and 25% of sceptical goodwill, compared to 11% of refusers.

Table 4.11 Current use of transport per cluster

		Enthusiasts	Uncritical goodwill	Indifferent	Sceptical goodwill	Refusers	Overall
		n=76	n=304	n=157	n=140	n=84	N=981
Car	daily users	26%	19%	15%	30%	47%	24%
Train	daily users	21%	31%	18%	25%	11%	23%
Bike	daily users	33%	48%	48%	22%	29%	40%
Bus	daily users	19%	23%	21%	28%	18%	23%
Walking	daily users	77%	72%	78%	59%	64%	71%

Speed, travel time and punctuality are the most important drivers for preference of transport systems, as is depicted in Table 4.12. These mobility needs are consistent across the clusters. Price is of lesser importance, but it is important that the price should not be higher as for traditional public transport as the majority of respondents (82%) is not willing to pay more than they pay for current public transport (see Figure 4.9). Even the majority of the enthusiasts (62%) is not willing to pay more than for current public transport. It is currently unclear what the price for automated minibus will be, but a system without drivers could lead to lower fares. Based on the assumption that the automated minibus will be cheaper than owning your own private automated car, we see that cross-cluster a cheaper automated minibus is preferred over private car, see Table 4.13. The only exception is the group of refusers. This group prefers the traditional private car, above both automated options.

Table 4.12 Importance of aspects in selecting preferred means of transport per cluster

	Enthusiasts	Uncritical goodwill	Indifferent	Sceptical goodwill	Refusers	Overall
	n=76	n=304	n=157	n=140	n=84	N=981
Comfort	5	5	5	4	4	5
Accessibility	7	7	7	6	7	7
Safety and trust feeling	4	4	6	5	5	4
Speed and travel time	1	1	1	1	1	1
Pleasure and joy	6	6	4	7	6	6
Punctuality	2	2	2	2	2	2
Price	3	3	3	3	3	3

Ranking: 1 = most important aspect, 7 = least important

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Safety, trust feeling or accessibility are less influencing personal preferences. This is also supported by the experiences of the safety drivers, that claim that the bus is safe and that users feel safe (Frank 2020). There is no clear support for the presence of a safety driver in the bus; this is important for 35% of the respondents, whereas 44% report that this is not important to them. However, for the group of refusers, a clear majority of 76% state that the presence of safety drivers is important, whereas this is only 6% for the enthusiasts. Hence, the presence of safety drivers could help to alleviate fears of the refusers, but does not strengthen goodwill/support of the other groups.

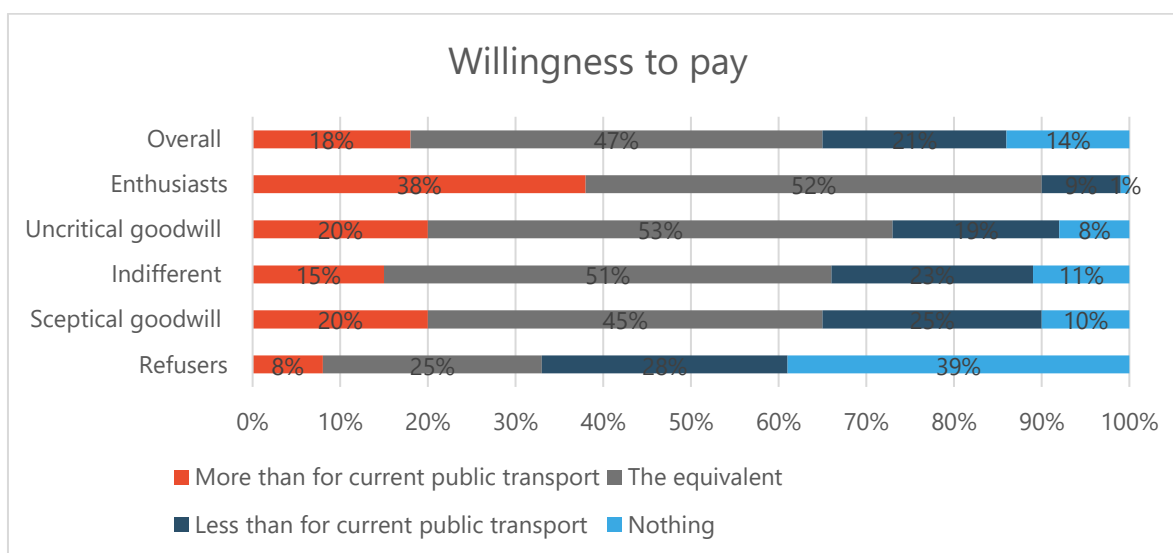


Figure 4.8 Willingness to pay

Table 4.13 Preferences between conventional cars, automated private cars and automated minibus

	Enthusiasts	Uncritical goodwill	Indifferent	Sceptical goodwill	Refusers	Overall
	n=76	n=304	n=157	n=140	n=84	N=981
Cheaper automated shuttle	82%	43%	46%	40%	13%	44%
Much more expensive automated private car	5%	6%	5%	11%	11%	7%
Traditional private car	10%	25%	18%	23%	47%	21%
I don't know	3%	23%	18%	15%	4%	15%
Wouldn't use any of these options	0%	13%	13%	11%	25%	13%

4.3.4 Attitudes toward mobility

The majority of our respondents was aware of the existence of automated minibuses (with an overall rate of 82%, differing between 77% in the group of uncritical goodwill, to 86% in the group of enthusiasts), but only a smaller part (12-15%) was aware of actual pilot-projects in their own city. Only a small proportion of our respondents (14%) has travelled with an automated minibus prior to conducting the survey. The analysis shows that there are differences between the sources of information used to form an opinion on

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automated minibus between the five target groups. The use of conventional sources, such as newspapers, television and radio is highest among the more sceptical attitudes (refusers, sceptical goodwill). The use of social media as a source of information about automated minibus is highest with enthusiasts (Table 4.14). This is consistent with Zmud and Sener (Zmud and Sener 2017) who found that individuals with a higher intent to use automated vehicles were the ones using Smartphones, text-messaging, Facebook, and transportation apps, and with Lavieri et al. (Lavieri et al. 2017) who found that tech-savvy individuals are likely to be early adopters of automated vehicles.

Table 4.14 Source of information*:

	Enthusiasts	Uncritical goodwill	Indifferent	Sceptical goodwill	Refusers	Overall
	n=76	n=304	n=157	n=140	n=84	N=981
Newspaper	30%	27%	35%	23%	41%	30%
Radio / TV	27%	31%	32%	40%	30%	33%
Internet	45%	29%	31%	19%	31%	30%
Social media	39%	21%	16%	11%	17%	19%
Seen on test-site	20%	18%	16%	11%	20%	17%
Friends	20%	19%	25%	18%	25%	21%

* answer-options lower than 20% are not shown

* More than one answering option was allowed in this question

Willingness to use is highest among the cluster of enthusiasts, with 81% (very) willing to use the automated minibus (**Fehler! Verweisquelle konnte nicht gefunden werden.Fehler! Verweisquelle konnte nicht gefunden werden.**). Contrarily, 84% of the cluster of refusers, is not willing (at all) to use the EASB. These results show consistency between the perceived concerns and benefits that were used as factors to build the clusters, and the willingness to use the automated minibuses.

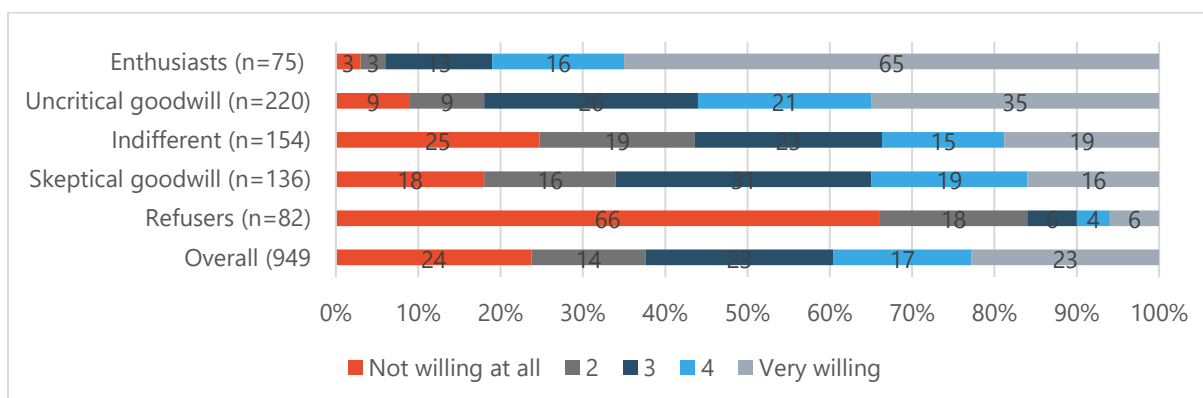


Figure 4.9 Attitudes regarding willingness to use

An important aspect in upscaling the AESB services, is whether potential users are willing to reduce or give up the use of their car. Under the condition of a on-demand service, 52% is (very) willing to reduce the use of their car. Here we see major differences between the clusters, as indicated in **Fehler! Verweisquelle konnte nicht gefunden werden.Fehler! Verweisquelle konnte nicht gefunden werden.** As expected, the enthusiasts are willing to reduce the use of their car, whereas the refusers are not willing to do so. A follow-up question on whether respondents are willing to give up the use of their car, under the condition of an on-demand service, rendered similar results (see **Fehler! Verweisquelle konnte nicht gefunden werden.**).

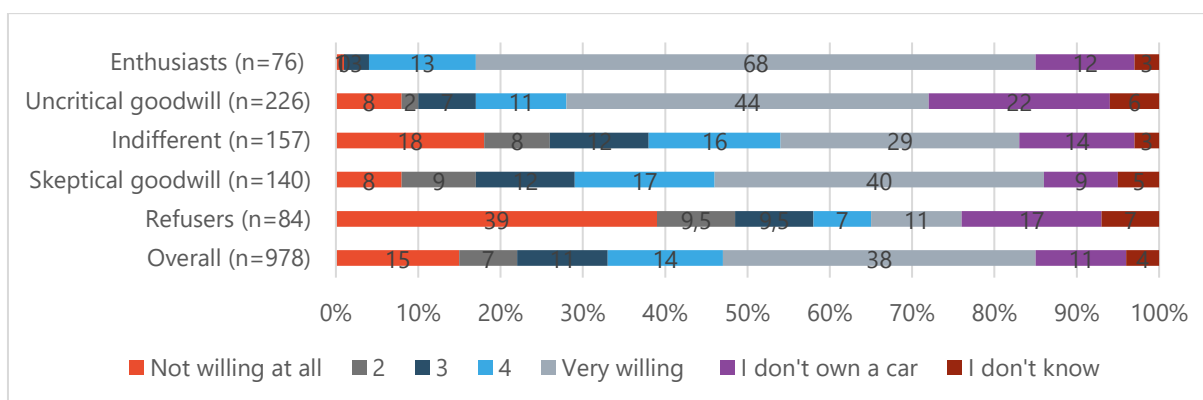
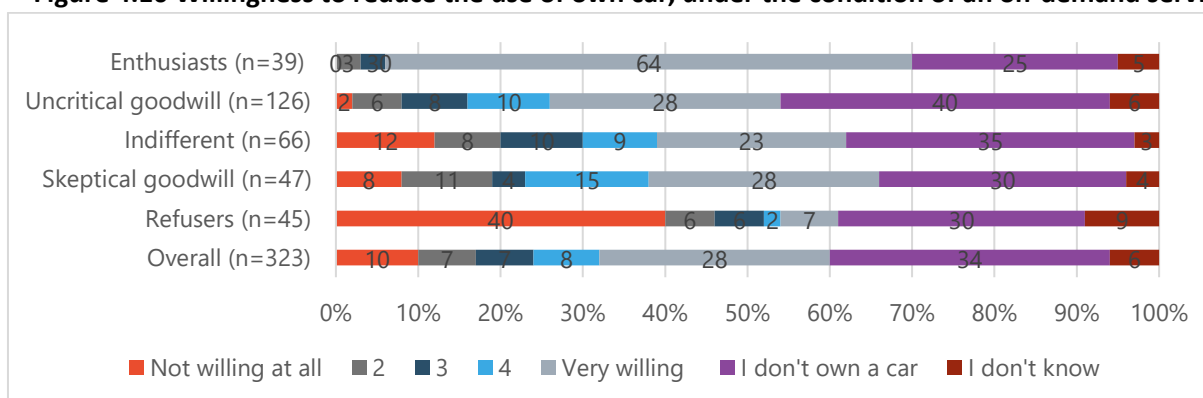


Figure 4.10 Willingness to reduce the use of own car, under the condition of an on-demand service



4.3.5 Requirements set by user profiles for structural assets

The analysis shows that there is great variation in the willingness to use and acceptance of automated minibus. The division of potential users clustered into five target groups, depicts that a one-fits-all strategy aimed at change in mobility behaviour through an increase in (willingness to) use and acceptance of automated minibuses is not desirable. However, we can decipher lessons that influence a change in mobility behaviour that will increase acceptance, willingness to use and actual use of automated minibus in public transport systems.

First, the willingness to use the automated minibus and to reduce use of own car strongly increases in case were the automated minibus are operated as a service on demand (see table 10). This means that the automated minibus does not operate as a normal bus-line with fixed stops and timetables, but is callable at any moment in a specific geographic area. The increase in willingness to use the automated minibus does especially increase among sceptical, indifferent or even refusing potential users. An on-demand service is an important driver for acceptance. The effect of an on-demand service is not considered by the majority of studies into the acceptance of automated minibus, but is supported by the few studies that have taken this into account. On demand services may increase the attractiveness of car sharing services with automated (Piao et al. 2016; Merat et al. 2016). The risk of disappointment of the actual performance of the automated minibus in terms of speed and flexibility is especially high for the groups of enthusiast and potential users with uncritical or sceptical goodwill.

Second, speed, travel time and punctuality are the most important drivers for preference of transport systems. It is therefore important that the automated minibus can compete with other means of transport regarding speed, travel time and punctuality. At the current state of technology, the automated minibus operates at low speed (between 8 – 15 km/h). This low speed results in low ratings by users (Nordhoff et al. 2018b). These results are confirmed by Kreuger and colleagues (Krueger et al. 2016) that define travel time and waiting time as critical determinant of the use and acceptance of automated minibuses. These insights are also confirmed by safety drivers⁵, stating that people will only use the shuttle in case of bad weather, otherwise walking is faster. However, low speed can increase feelings of safety, positively impacting acceptance (Bekhor et al. 2003).

4.4 Conclusions and planning

4.4.1 Conclusions

In this study we focused on understanding profiles of potential users. Gaining a deeper understanding in user profiles, consisting of mobility behaviour, needs and attitudes could lead to a more focused and optimized integration of automated minibuses in the public transport system. Based on a questionnaire study, five target groups of potential users can be distinguished. These target groups are clustered based on their perception on automated minibuses; their expectations on potential benefits and concerns.

The five target groups (enthusiasts, uncritical goodwill, indifferent, sceptical goodwill and refusers) do not only differ in their perception on perceived benefits and concerns, but also on their degree of knowledge, preferred transport system, their willingness to use and pay for automated minibuses, and information sources used to build their attitudes. We can therefore conclude that it is advisable to target, focus and optimize communication of automated minibuses integration as well as the actual implementation of new on-demand and door-to-door services, to these target groups.

An important finding of this study, is that the majority of respondents (hence, potential users) have not taken a clear position towards automated shuttles yet, but tend towards a positive, receptive (goodwill) attitude. We do see potential to convince those who are not yet refusing but open-minded, through well-targeted communication campaigns. In doing so, it is important to use the right communication channels.

In mainstreaming automated minibuses in the public transportation system, it is crucial to match the actual use-experience with this positive attitude. Local, user-oriented studies are required to perform this reality check. Important aspects to focus on are the implementation of automated minibuses lines as a first-and-last mile solution, connecting a train station to a point of interest and secondly, to reduce travel time and effort through greater flexibility in terms of time and location, to increase speed / reduce time of travel and ideally the offer of an on-demand / door-to-door service. For enthusiasts and potential users with uncritical or sceptical goodwill there is a high risk that they may be disappointed if they recognize actual performance in terms of speed and flexibility. In order to ensure that the high level of goodwill actually leads to a high level of acceptance of the new systems, it is very important to increase both the speed and the flexibility of use via an on-demand service. The exact configuration of the on-demand

⁵ See chapter 6 of this deliverable

system / door-to-door is still object of study. The flexibility towards locations, hence a full door-to-door system or a system with greater distances between the stops, has to be discussed more differentiated. Follow-up studies should provide insights in the accepted distance from door to stopping location, as well as the accepted waiting time, to be able to provide customized solutions.

4.4.2 Planning

The results of the representative survey provide insights into the status quo, hence without automated minibus services. To gain insight in changes in mobility behaviour and attitudes towards automated minibuses, a second round of the survey is planned to be conducted in spring 2021, and will be reported in the final iteration. One major difference between the current data collection round, and the upcoming round, is the collection of the sample. Within AVENUE, funds have been made available to buy appropriate samples (with a sample size of $n=500$ in all four AVENUE cities) through specialized agencies.

However, the samples taken across the four cities do not adequately consider the characteristics of the pilot project areas: Contern, for example, is located in the state of Luxembourg, but is not part of the city of Luxembourg. Similarly, Belle Idée is in a peripheral location (rural area) of Geneva. Awareness, knowledge, attitudes, willingness to use etc. should also be analysed on this local (project site) level. In addition, we expect more differentiated attitudes and therefore as well more likely changes in these dimensions, because we can expect more frequent experiences with the automated minibuses. Moreover, the goals of the automated minibuses most probably better tailored to the mobility demands of residents in the pilot project. Hence, we expect different results, and therefore, it was proposed to include an additional study: representative survey at local (pilot site) level. This will include two local tablet-based surveys (a zero-measurement planned in end of 2020 and control-measurement in autumn 2021) for each pilot area to assess local acceptance and changes. The results of this additional survey, will allow us to make a comparison between the city and the local areas and will furthermore improve the reliability of the economic models.

The representative survey at local (pilot-site) level is designed to be comparable with the representative survey at city level. To reach respondents at the pilot site level, it was decided to use two methods for data collection. The first method, that will be applied in Geneva, Lyon, and Copenhagen, entails a tablet-based, face-to-face interview. Researchers will ask people on the street to conduct the interview. The second method, that will be applied in Luxembourg, entails an online questionnaire, that is distributed via email through employees of Campus Contern (see Table 4.15). To design the questionnaire, it was important to reduce the original representative survey. Based on the results of the representative survey at city level, we reduced the questionnaire to the questions that are necessary to gain an understanding of the mobility behavior and attitudes about the automated minibus services. The questionnaire is extended with part of the user survey, to gain information on user experiences for those in the area that have experience with the automated minibus. The full survey is programmed in Unipark/Questback and is available for all test-sites in the relevant languages.

Table 4.15 Description of additional study: representative survey at pilot-site level

City, pilot site	Data collection method	Planning field campaign
Geneva, Meyrin	Tablet-based, face-to-face interviews	Spring 2021
Luxembourg, Campus Contern	Email-based	Spring 2021
Lyon, Groupama Stadium	Tablet-based, face-to-face interviews	Spring 2021 (pre-tested in Lyon, postponed due to COVID-19 related lock-down)
Copenhagen, Nordhavn	Tablet-based, face-to-face interviews	Spring 2021

Currently, none of the studies have been conducted. The representative survey in Lyon was pre-tested by the researchers in Lyon that would be conducting the survey, but a lockdown due to COVID prevented the researchers to start conducting the interviews. The survey in Luxembourg is still halted as most employees of Campus Contern are currently in home office and the shuttle has not been in operation. Conducting the representative survey at pilot site level is dependent on the measures that are imposed to condemn the COVID-19 pandemic. The survey is programmed and ready, but it is currently impossible to conduct it. The study will resume as soon as conditions allow for it.

5 User experiences – survey among actual users

5.1 Introduction

To gain insights into the experiences of people that use the automated minibuses and to examine the usability of the new service, a well-recognized instrument is a user survey (see also deliverable 8.8). In a user survey, people reflect on their experience when using the automated minibus and evaluate their usability. The users experienced the automated minibus in a real natural situation. They were not specifically asked to do so for the survey. It was their own decision to use the service.” The goals of the user survey are the following:

- the experiences of the users with the automated minibus, their satisfaction with the automated minibus,
- Frequency of use, motivation for use, occasions for use
- Perception and evaluation of the transport service regarding specific features
- Willingness to use in the future, willingness to recommend, willingness to reduce use of own car or even to give up own car
- Demographic data

In this chapter we will report on the results of the user survey in Nordhaven, Copenhagen. Out of the four pilot cities, we have only been able to conduct the survey in Copenhagen. In Luxembourg operations were stopped due to damage (vandalism), in Geneva (Belle Idée) there are still no users. Lyon was prepared but had to be stopped due to the Covid-19 pandemic.

5.1.1 Impact of COVID-19 on data collection

The user survey was planned to start in all cities in March 2020. The user surveys were developed, checked and programmed in the period September 2019 – February 2020 in cooperation with the WP8 partners (Sales Lentz, Keolis, TPG, Amobility, ECP and Siemens)⁶. However, due to the COVID-19 pandemic all operations were halted, and therefore, the user surveys had to be postponed. In addition to waiting for a restart of the operations, and keeping in close contact with our partners, we developed a guideline for continuation after the COVID-19 pandemic⁷.

In June 2020, we were able to start a user survey in the pilot site in Oslo. This user survey was originally not planned, but included to allow for as much input on user experiences as possible. Unfortunately, we have not been able to get enough respondents to include Oslo in our data analysis. According to Amobility, the reason for non-response was that there were too few passengers. Due to travel restrictions, HS PF has not been able to visit the site to conduct alternative user surveys. To increase responses, a shortened paper-pencil survey has been developed, but unfortunately, this also did not result in more replies.

⁶ The process of developing the User survey has been detailed in Deliverable 8.8: First iteration Social Impact Assessment. Available on: <https://h2020-avenue.eu/public-delivrables>

⁷ Risk assessment: influences of COVID-19 on AVENUE

In October 2020, we were able to start the user survey in the Groupama Stadium pilot site, in Lyon. Unfortunately, we experienced low respondents in this site as well. According to Keolis this low response is due to a limited number of frequent users of the automated minibus line. Around 30 users travel with the automated minibus on a regular basis. The three respondents do therefore account for a response rate of 10%. However, this is a too small basis for an analysis. To increase responses, a shortened paper-pencil survey has been developed, that will be conducted in 2021.

5.2 User survey Nordhavn, Copenhagen

The user survey has been conducted online, using Questback software (for an example, see **Fehler! Verweisquelle konnte nicht gefunden werden.**). Passengers were given a leaflet with brief information and with a link to the online survey by the safety drivers (see Figure 5.2). As the questionnaire could also be filled out via mobile devices passengers could choose whether they wanted to complete the questionnaire during their ride or later on after their ride.

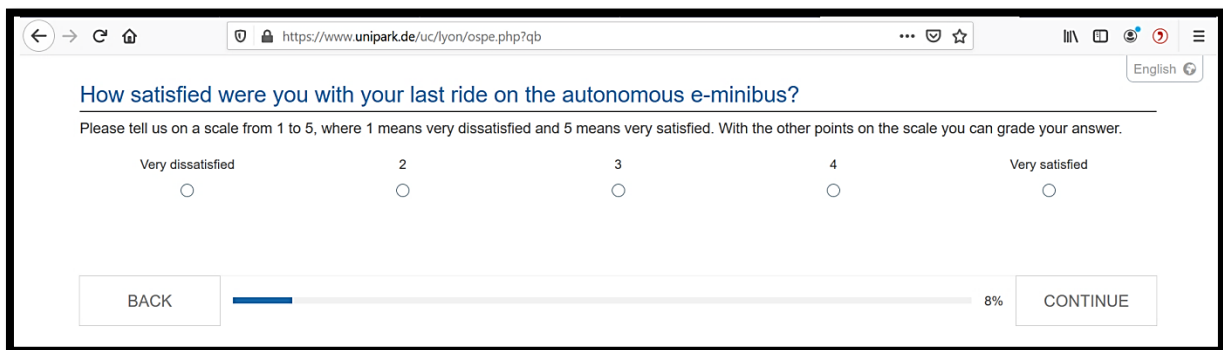


Figure 5.1 Example of question lay-out in Questback

The distribution of the flyers started on Monday, August 24th 2020, and continued to December 1st 2020. The survey was open for respondents until December 15th 2021 to allow users to provide feedback sometime after receiving the invitation flyer. This is a total of 13 weeks. We see a relatively even distribution of respondents throughout this period. In total 58 respondents completed the entire survey, and 68 answered the questionnaire at least up to and including the question about overall satisfaction with their last ride. For the analysis, we also included the answers of participants that dropped out later in the questionnaire.



Figure 5.2 Invitation flyer to survey as distributed

5.2.1 Sample structure

The demographic structure of the users is heterogenous: young age groups as well as elder people, male and female (male being somewhat overrepresented with 67%), students (7%) as well as (self-) employees (about 50%) and retired (29%). The user survey has primarily reached first users (94%). Only four respondents stated to have already used the automated minibuss for several times. More than two thirds of the respondents' state that the usage was not driven by any specific occasion.

Table 5.1 Sample structure

Total respondents	N=58 (FN – 10 respondents didn't complete the questionnaire up to demography)
Age	16 to 25 years: 5% 26 to 35 years: 21% 36 to 45 years: 10% 46 to 55 years: 10% 56 to 65 years: 21% 66 to 75 years: 28% 76 years and older: 5%
Sex	67% Male 31% Female 2% unknown/others
Occupation	36% employee 7% student 16% self-employed 29% retired 10% other
Household composition	71% have children in household 28 % do not have children in household 1% refused to answer
Experience	94% first experience 4%: 1 to 2 times 2%: more than 11 times

5.2.2 General Insights

In the user survey, we included a question about overall satisfaction with the local traffic situation, public transportation offers and the local environmental situation. The reason that these questions were included (near the end of the survey) is that they can provide information on the general level of satisfaction of respondents. Including these questions, can provide insights in whether respondents have a general positive or pessimistic attitude – this will also influence their responses regarding the point of interest in the topic of interest here: the user experiences with the automated minibuss.

In general, we see that the respondents of our survey have a rather positive view (see also Figure 5.3). About a third of the users mention to be (very) satisfied with the environmental (average 3.2) and traffic (3.0) situation in Copenhagen, where 1 is not satisfied at all and 5 is very satisfied. Nearly two thirds of the asked users state to be (very) satisfied with the public transport offer in Copenhagen (with an average value of 3.6). This may explain that potential users of public transport systems in Copenhagen are on the

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one hand very open-minded (see representative survey) but do not experience an acute need for alternative transport systems. Compared to the results of the representative survey with potential users in Copenhagen (see Chapter 3), we see that the satisfaction with the local traffic situation (3.1), the public transportation offer (3.4) and the local environmental situation (3.4) is rated similarly.

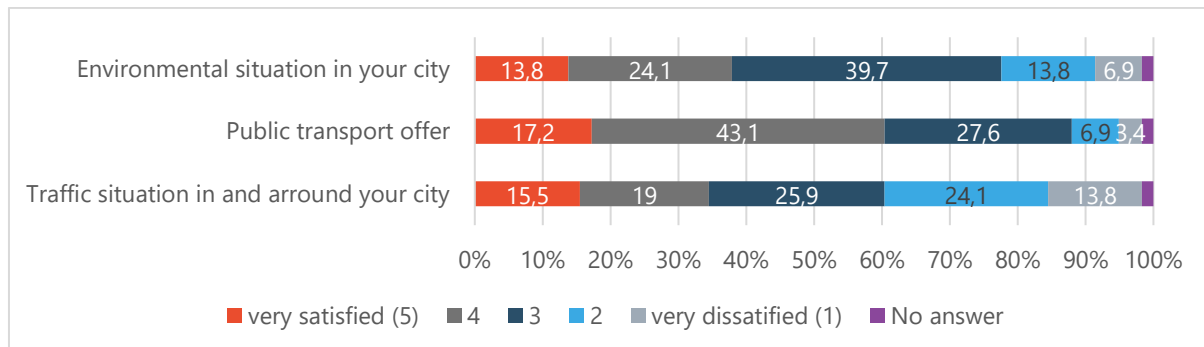


Figure 5.3 General satisfaction with the environment, public transport and traffic (n=57)

5.2.3 Motivation to use an automated minibuss

The analysis of the motivation to use the automated minibuss shows that the users did not plan on using the automated minibusses, but rather made a spontaneous decision, following emotions such as curiosity (88%) or cannot give a concrete reason at all (43%) (see Figure 5.4). This shows that the barriers to use are quite low, but on the other hand it shows that there is still a lack of real conviction in favour of the new mobility system. Positive attitudes that could lead to planned use (see Theory of Planned Behavior (Ajzen 1991)) have not yet been established. Only 4% state that they use the automated minibuss because they are already convinced by positive experiences.

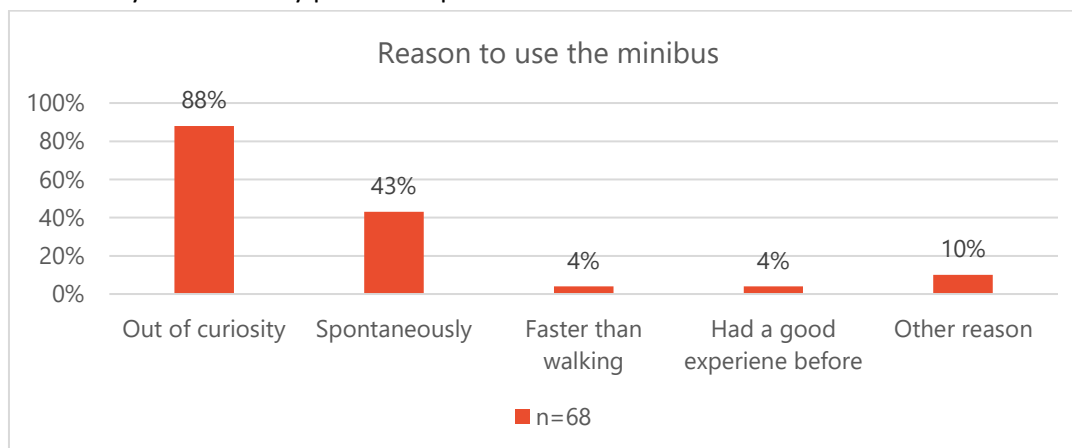


Figure 5.4 Reason to use the automated minibuss

The automated minibuss seems to replace primarily bikes (46%), and not so much other motorized transport systems (see Figure 5.5). In this particular case, this might have to do with the length and location of the line.

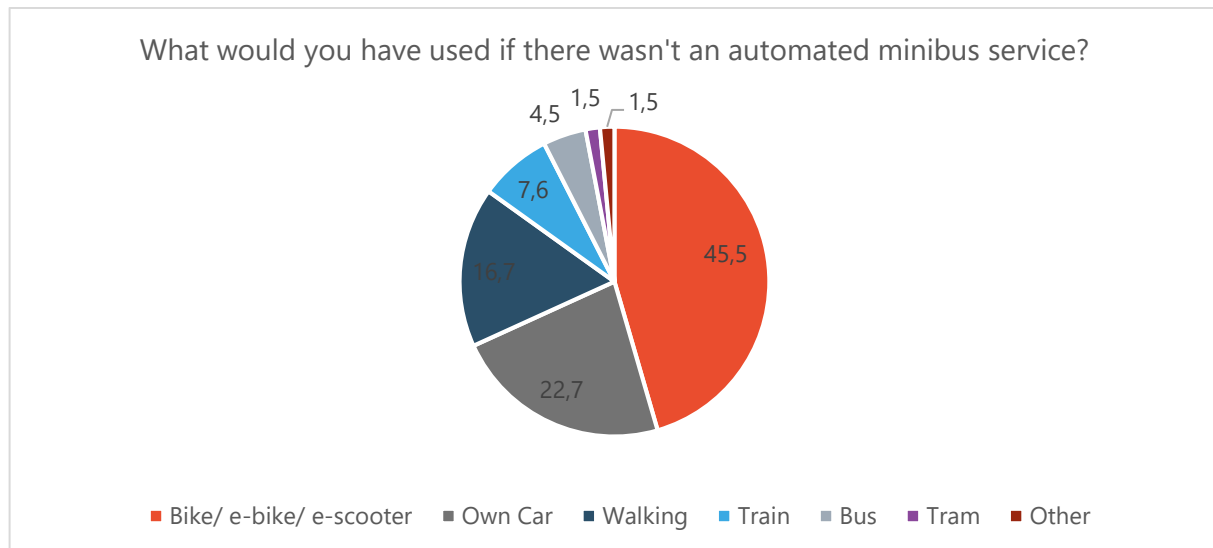


Figure 5.5 Means of transport replaced by the automated minibus (n=66)

When asked whether people brought anything with them on the trip, the majority indicated (89%) that they did not take anything with them. Those that brought something with them on the automated minibus brought luggage (5%), a shopping trolley (2%) or something else (8%). Nobody brought a baby stroller with them. This information is relevant for the discussion on the usability of automated minibuses for people with reduced mobility (that does also include people travelling with luggage and/or baby strollers).

The analysis of the current motivation for use shows that use is currently not motivated by market presence in the sense of concrete knowledge and conviction, but is mainly controlled by spontaneous interest.

5.2.4 User Experience and Satisfaction

Users were asked to their satisfaction of their last ride. Overall, users were highly satisfied with their last ride (mean 4.5 on a 5 point-scale, 5 being very satisfied). Nearly two-thirds (59%) of the users stated to be very satisfied. An analysis of what was most satisfying shows that especially the atmosphere in the automated minibus was experienced comfortable (see Figure 5.6)

- temperature (4.6)
- cleanliness (4.6)
- noise level in the bus (4.5)
- atmosphere in the bus (4.4)
- and comfort (4.0).

Also convincing and satisfying are:

- accessibility (4.1)
- as well as security form outside the bus (4.4)
- and safety in the bus (4.1).

Items that are more difficult to evaluate, due to a lack of experience of the users, are aspects related to quality of service, such as punctuality. As a result, over 50 % of the respondents did not answer these items. If they were able to evaluate the quality of service the following features were satisfying:

- location of stops (4.3)
- punctuality (4.2)
- location of pilot site (4.1)

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- reliability (4.1)
- and waiting time (4.1).

In comparison to these highly satisfying aspects the following aspects were rated slightly worse on average:

- speed/travel time (3.9)
- frequency of service (3.9)
- connection to other transport means (3.0).

The offer of information in the bus is again satisfying (4.5), other offers of information are rarely evaluated. This again stresses that current users did not schedule their ride straight away and therefore did not have any need for more detailed information in advance.

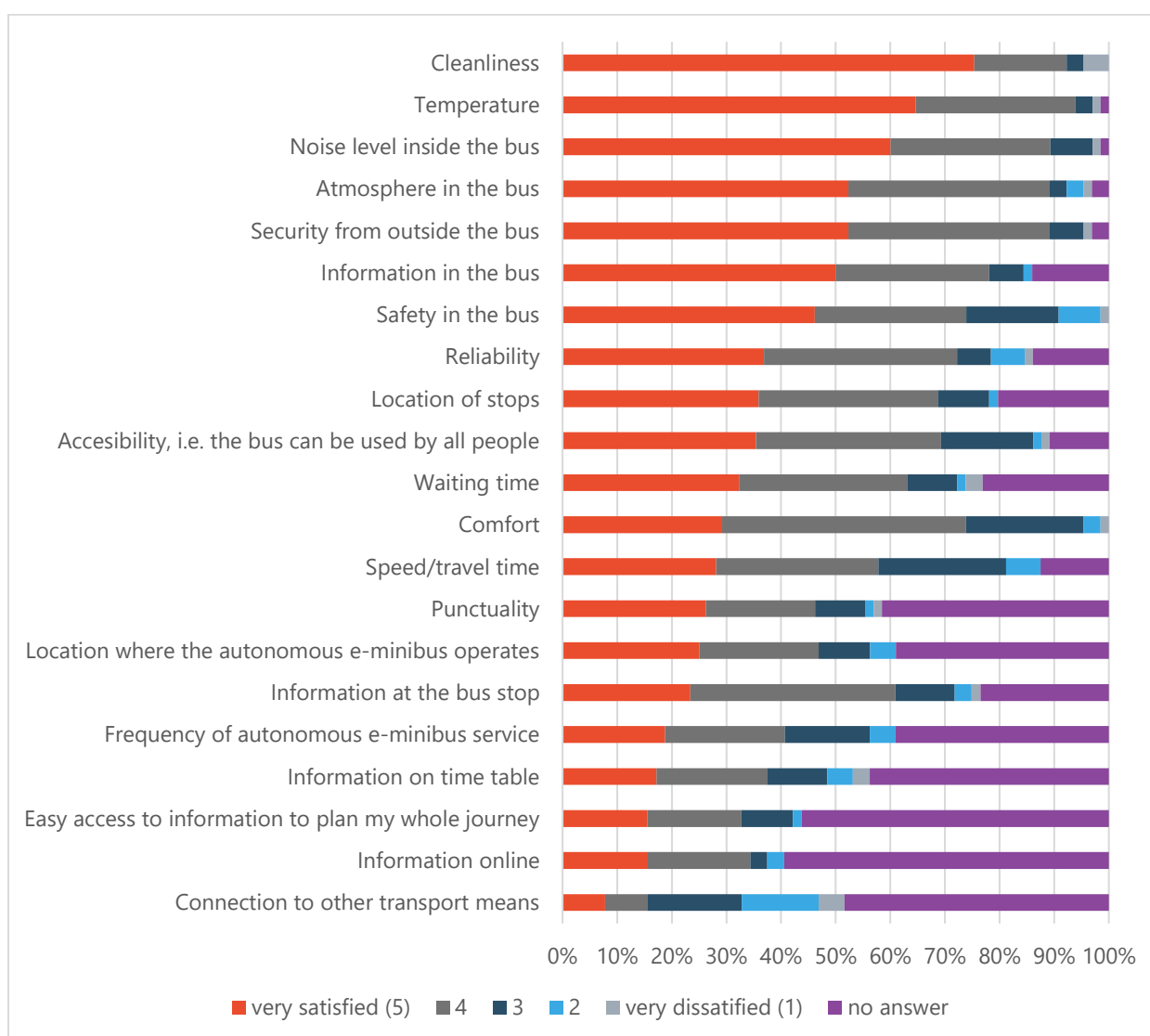


Figure 5.6 Detailed satisfaction with last ride (n=68)

Users seem to experience the ride in a relaxed atmosphere. This is supported by the results of the question ‘what describes your feeling/emotions toward automated minibuses best?’ These subjective feelings are described as being characterized by optimism (74%) and curiosity (68%). Suspicious or anxious feelings extremely seldom occurred (less than 5%).

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These positive feelings are reinforced by low occurrence of problems. When explicitly asked for 26% of the respondents (16 users out of 62 users that answered this question) mention problems during their trip: unplanned stops, conflicts with other road members, long interruptions, sudden breaking manoeuvre (see Figure 5.7 **Fehler! Verweisquelle konnte nicht gefunden werden.**).

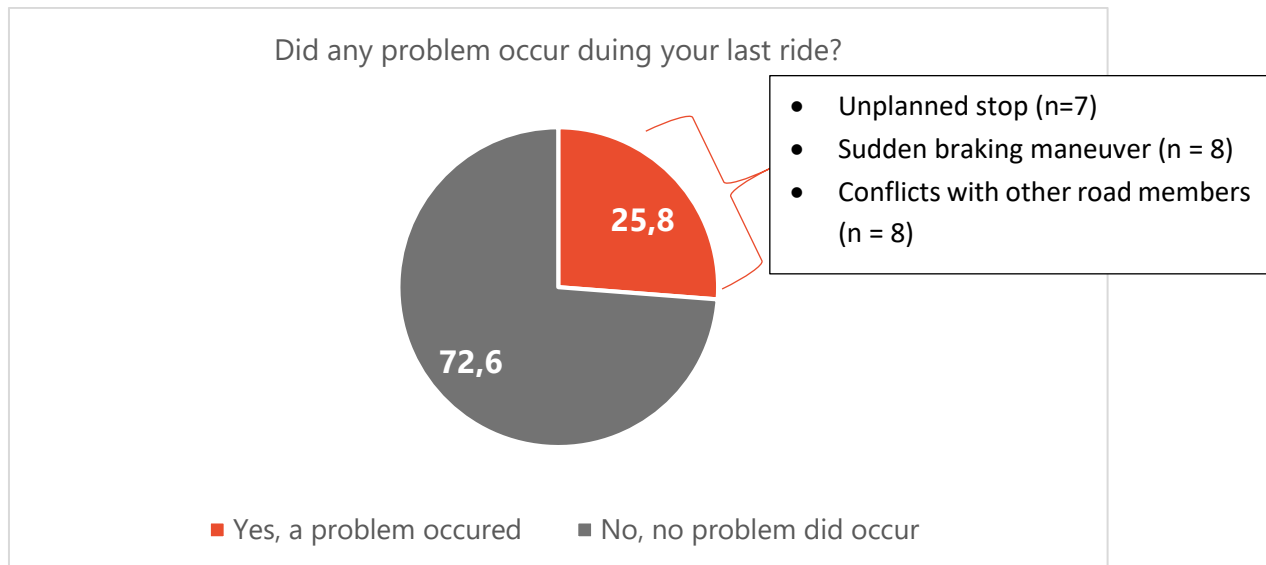


Figure 5.7 Problems occurred during the ride on the automated minibus (n=62)

5.2.5 Influences of COVID-19 on users

During the survey phase – August to December 2020 – the COVID-19 pandemic was still influencing daily life in Copenhagen. As the use of the automated minibus (and public transport in general) can be influenced by the pandemic, questions about the influence of COVID-19 were included in the survey. The majority of respondents (85%) state that in times of Covid-19 they feel just as safe in the automated minibus as in other transport systems. A majority of 53% state that their transport behaviour is not influenced at all, see **Fehler! Verweisquelle konnte nicht gefunden werden..**

About a third (29%) mention that the Covid-19 pandemic influenced their transport behaviour, that it is still altered, and will remain altered for a longer time (Figure 5.8). A total of 15% mention changes but expect that it already has returned to normal (3%) or will return to normal soon (12%). In a follow-up question on the type of changes, 81% state that they use less public transport; only 8% use more public transport and the remaining 11% indicate other changes.

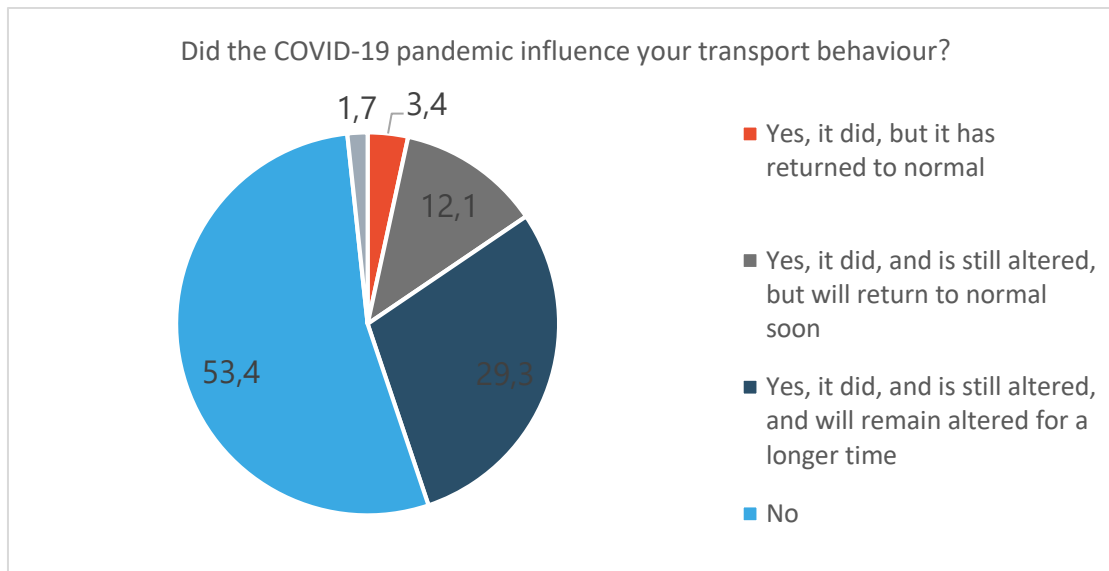


Figure 5.8 Effects of the COVID 19 pandemic on mobility behaviour (n=58)

5.2.6 Evaluation of Special Features for PRM

An important niche for the automated minibus service is the accessibility for people with reduced mobility (PRM, see also chapter 8 of this deliverable). In this survey we asked all users to reflect on the features of the automated minibus that could increase accessibility and ease of use for PRM. This survey has only reached 4 users indicating reduced accessibility (2 visually impaired, 2 with reduced mobility, none indicating that they require assistance, such as a walking stick). The section therefore reports on how ‘average’ users evaluated features that are designed for PRM.

The results show that people respond either positively, or do not have an opinion about the special features for PRM (see Figure 5.9). Positive evaluated items are the recognizability of the automated minibus; the timeframe of the doors opening; the quality of the interior lightning and; and the location of the stops. The number of grab handles seems to be sufficient, but not all users agree. Due to a large proportion of users answering ‘no opinion’ (the purple bar in Figure 5.9) it is difficult to evaluate the other items that were asked

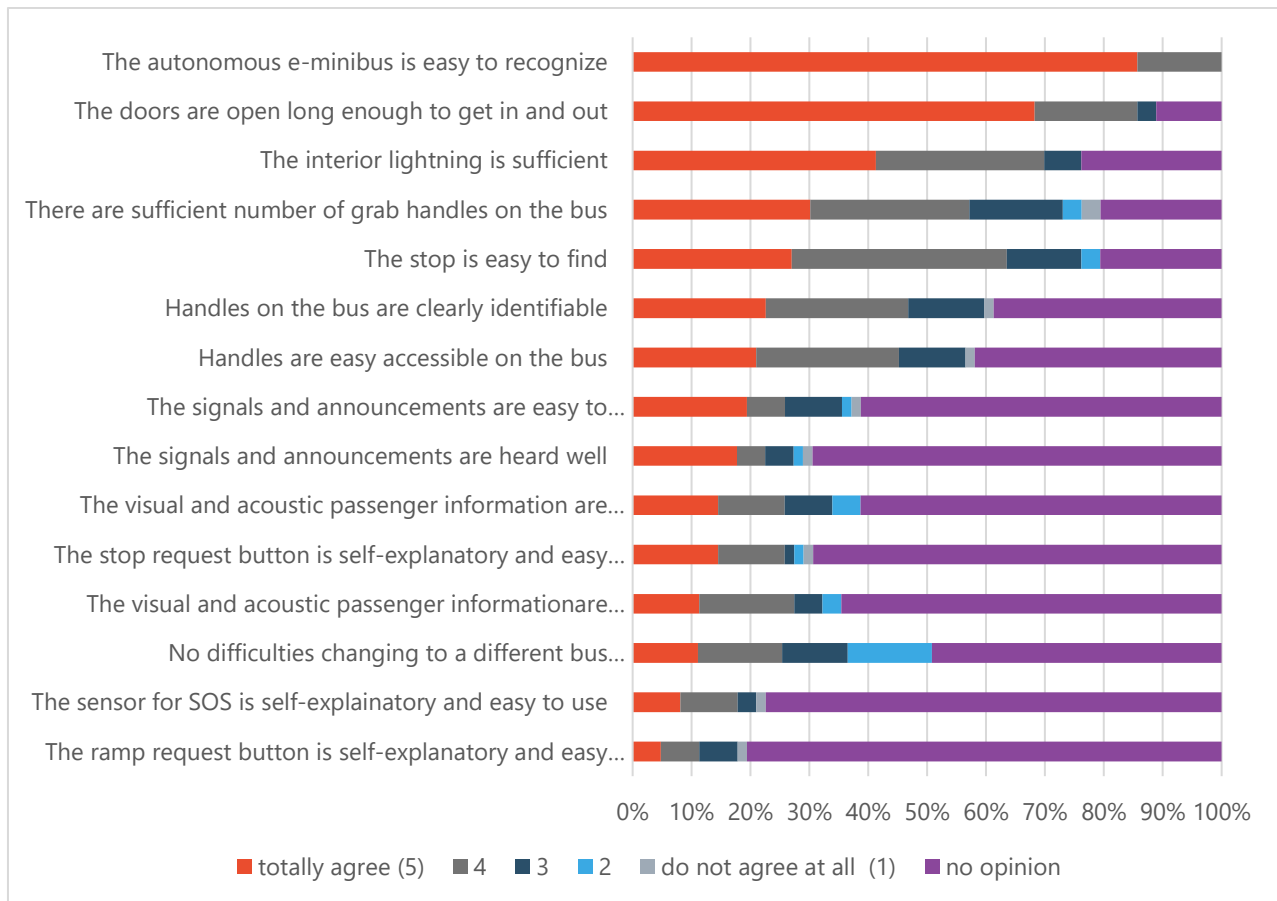


Figure 5.9 Evaluation of features for PRM

5.2.7 Services in the Automated minibus

In the development of the automated minibuses, there is a quest for developing services beyond the service of transportation. An argument that is used to support the development of these services, is that it can increase the number of users, and can be an additional benefit of this system, compared to other transport systems. A service that is discussed is the presence of a safety driver. The opinion on whether a safety driver is necessary on board the automated minibus is diverging. For a smaller proportion of users (18%) the presence of a safety driver is (very) important. A larger proportion of users (53%) think that the safety driver is not important (at all). Whereas in Copenhagen, on the contrary, 54% of the potential users (see results chapter 4) state that a supervisor is (very) important.

The proposed services, including giving feedback via QR-codes, In-vehicle entertainment, access to Wifi, and an app to help plan your journey are generally not regarded important by the respondents of this survey, see Figure 5.10. Services that were proposed by respondents in the answer category 'other' include:

- Feedback from the vehicle with respect to its decision making and status
- Screen indicating the journey status (number of stops, estimated time of arrival, etc.)
- More handles in the bus, primarily for the passenger seat in the middle
- A plan indicating the location of the bus stops

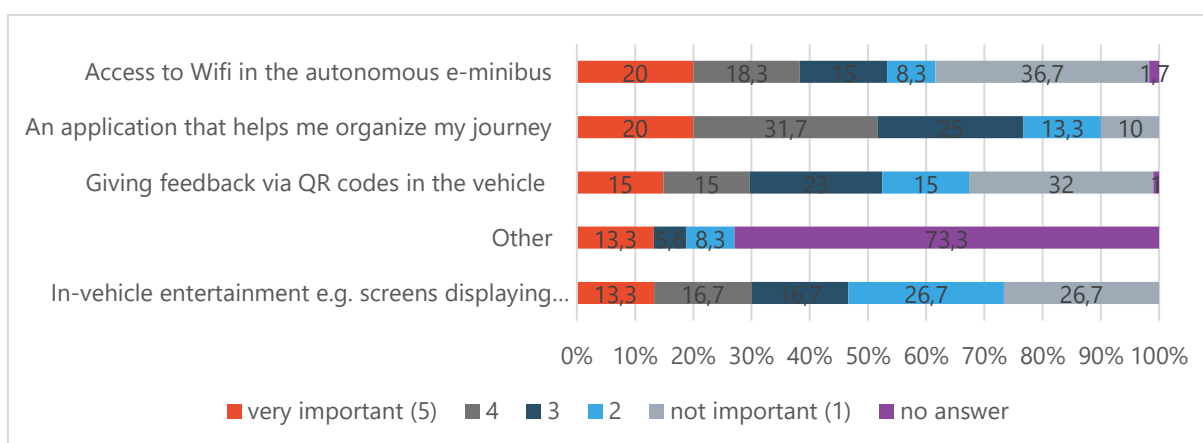


Figure 5.10 Evaluation of services

5.2.8 Awareness and Acceptance of the Automated minibus

There is a wide range of sources of information through which users became aware of the automated minibus (Figure 5.11): the main sources are the internet (28%, especially social media 16%), direct contact on test site (28%) or informal sources such as word of mouth (17%) and friends (10%). Only every fifth user read about it in newspapers (18%) or heard a news item on the radio (16%).

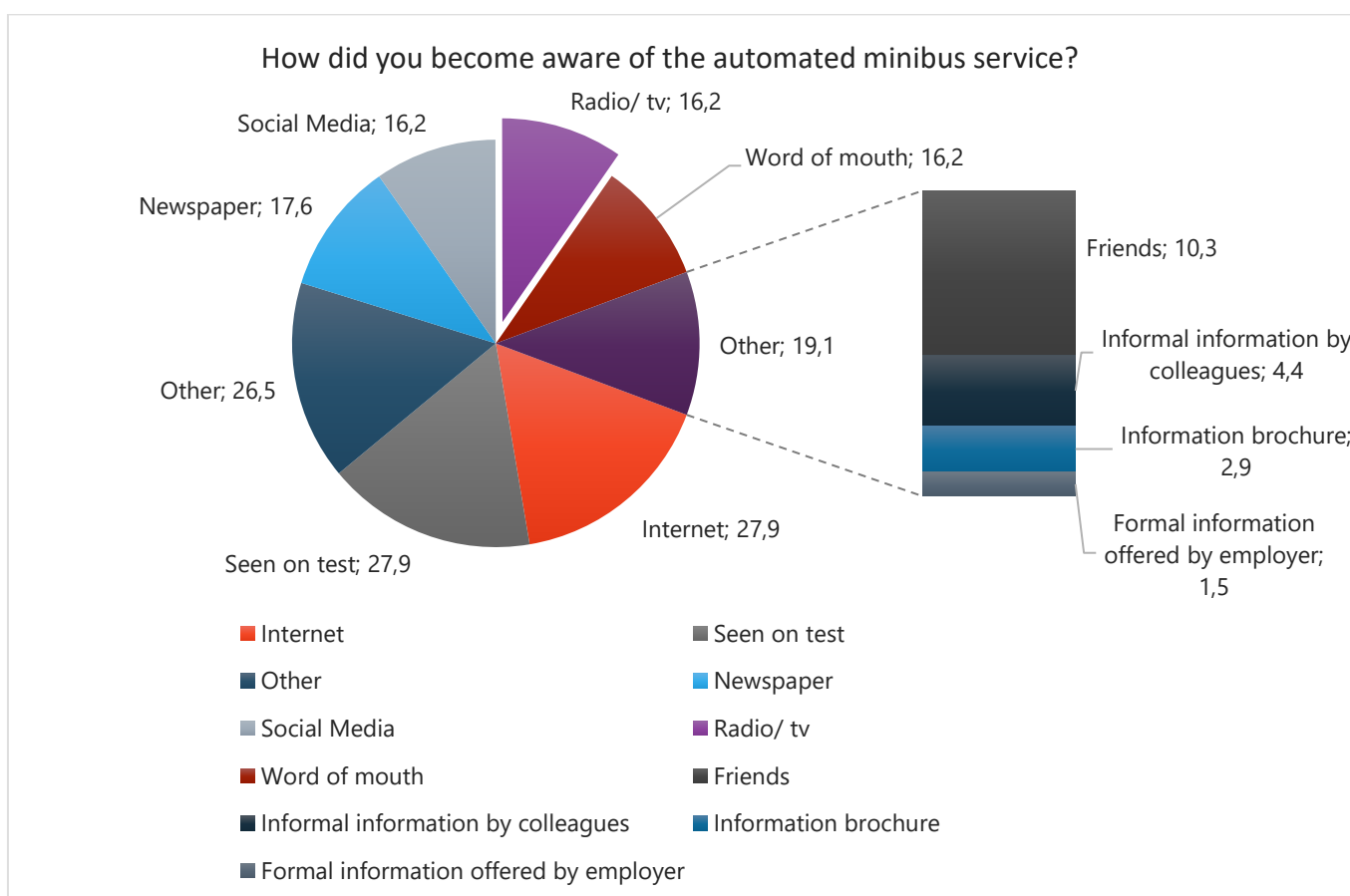


Figure 5.11 Sources of information

The willingness to use the automated minibuses again is extremely high; 76% are very willing to use the automated minibus again, as is indicated in the first column of Figure 5.12 and Table 5.2Fehler!

Verweisquelle konnte nicht gefunden werden.. Only 4% of the users hesitate to use it again, and none of the users indicate that they are not willing to use it again. The results of the representative survey among potential users, (see chapter 4), also point to a high willingness to use the automated minibus. If we filter the results from Copenhagen out of the general outcomes of the representative survey (see Chapter 4), we see that the willingness among potential users in Copenhagen is 3.9 out of 5 (the overall average being 3.1). So, the willingness to use the automated minibus (again) is significantly higher among users with specific experience (4.7) than among potential users (3.9).

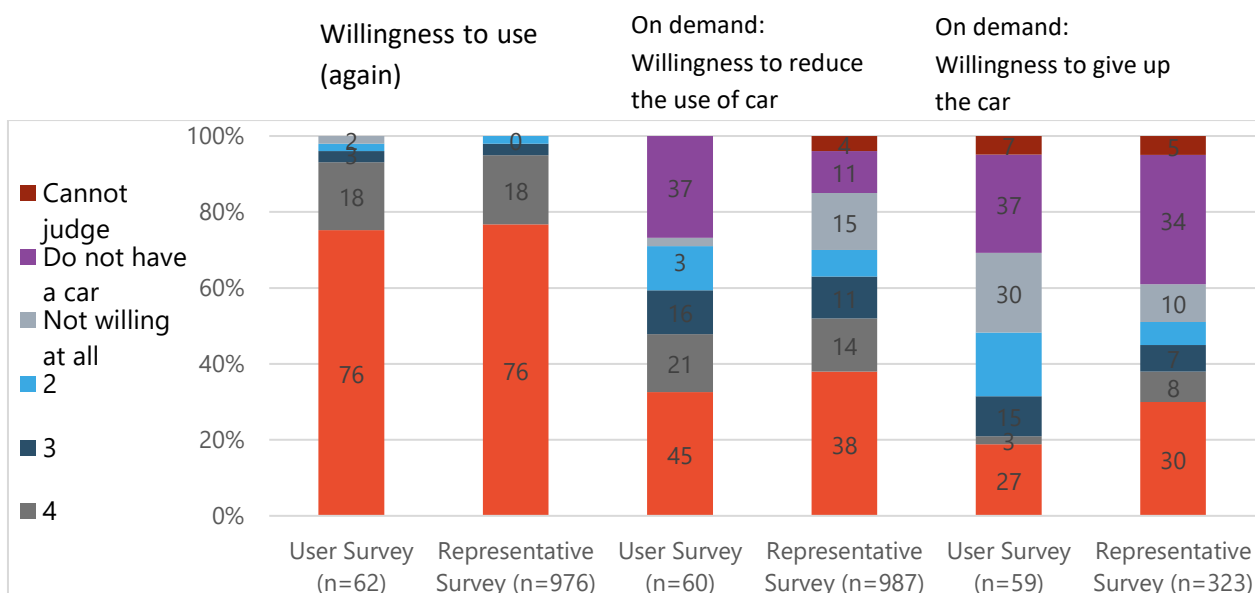


Figure 5.12 Willingness to use, comparison between users and potential users

If automated minibuses drive on demand the willingness to reduce the use of one's own car is high with 3.9, but somewhat less than it was observed in the representative survey for Copenhagen (4.1 see chapter 2). The willingness to give up one's own car if the service is offered on demand is also highest in Copenhagen (3.9 in the representative survey - see Chapter 2), but extremely lower among users: 2.7; only every third person is really willing to give up his own car after having experienced the minibuses. It should be mentioned, however, that only about a half of the surveyed users currently own a car. It can therefore be assumed that users who currently urgently need a car even in a city like Copenhagen do not see any real alternative in the automated minibuses.

Table 5.2 Willingness to use an automated minibuses, comparison with representative survey

		Copenhagen user survey	Copenhagen representative survey	Overall representative survey
Willingness to use automated minibuses	Mean value ¹	4,7	3,9	3,1
Willingness to reduce use of own car – under condition of on-demand service	Mean value ¹	3,9	4,1	3,6
Willingness to give own car - under condition of on-demand service	Mean value ¹	3	3,9	3,6

¹Mean values (higher values mean higher consent, where 1= lowest, 5=highest)

The opinions about the readiness of the technology are heterogeneous; 32% of the users think that the technology is (completely) ready to be used on public roads, whereas 28% think that it is not ready (at all),

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as is visualized in Figure 5.13. The results from the representative survey (see chapter 2) show comparable results: 30% of the potential users in the representative survey in Copenhagen say (completely) ready. Based on this comparison, we say that users are not more convinced than potential users. Nevertheless, 66% do not (at all) feel concerned that parts of the road traffic could become more and more “automated”. A study in Switzerland (Neuhausen am Rheinfall and Stein am Rhein) shows comparable results with averages of 3,1 to 3,3 (Bernauer and Wicki 2018).

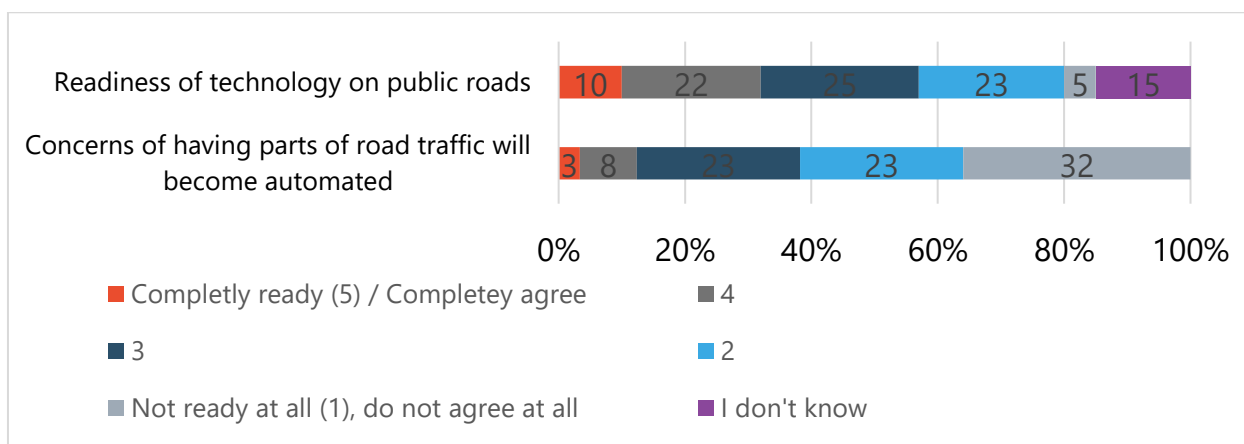


Figure 5.13 Readiness of technology (n=60)

To be able to assess the acceptance of automated minibuses, it is important to gain more detailed insights in the perceived advantages (Figure 5.14) and perceived concerns (Figure 5.15). A general impression is that the respondents have a positive perception on the benefits of automated minibuses. All items asked for have a minimum agreement of 50%, going up to an agreement of 76% for the perceived benefit that automated minibuses can be used for routes that are less popular. The perceived benefit that automated minibuses can reduce congestion is most critically assessed, with a small majority of 51% agreeing. These figures are comparable to those in the original survey of Keolis Downer in Australia (Keolis Downer 2018), the potential benefits were scored on a 10-point scale, ranged between 8.9 for the enhanced freedom for PRM to 8.1 for more efficient use of time.

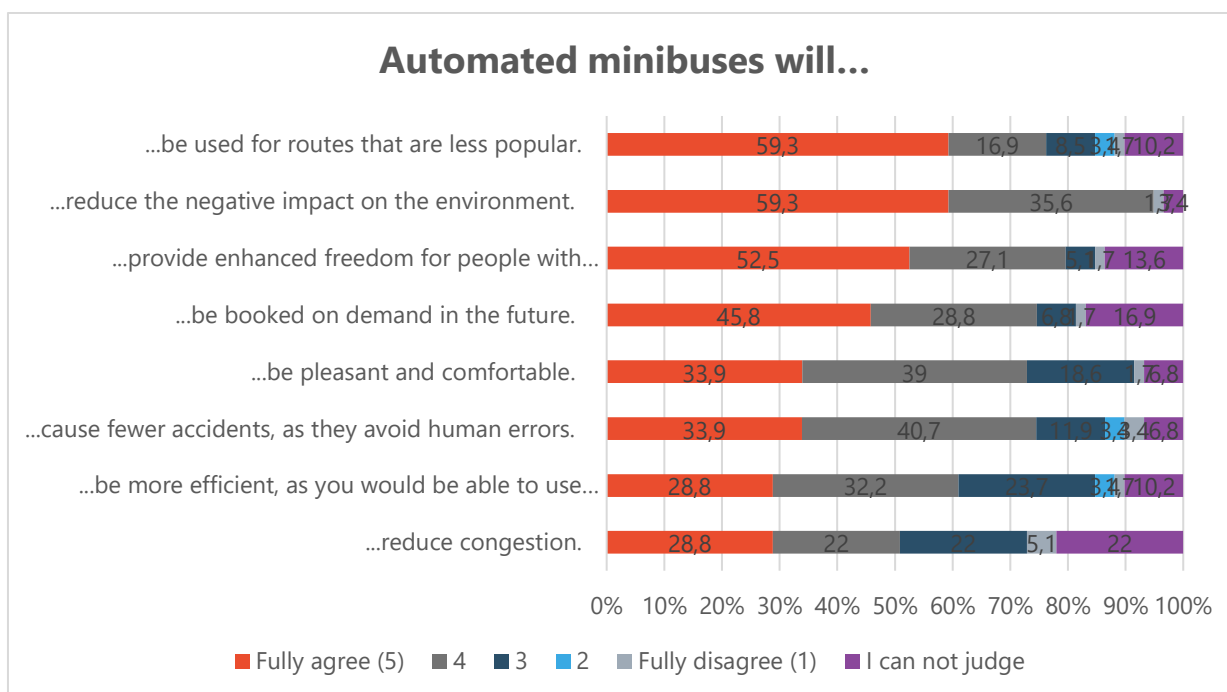


Figure 5.14 Perceived benefits of automated minibuses (n=57)

On the perceived concerns we see a slightly more differentiated picture. Five out of ten concerns are not valued as such, by the majority of the users. Hence over 50% of the users do not agree with concern of privacy, pleasure of driving, learning to use the new system, loss of jobs and reliability of the systems. A smaller percentage of users do not agree with concerns regarding the functioning of the automated minibus (this includes the interaction with motorized and non-motorized traffic, its reaction to unforeseen situations and issues of liability in the case of an accident).

In a comparable study in Switzerland in 2018 (Neuhausen am Rheinfall and Stein am Rhein) (Bernauer and Wicki 2018) respondents were most concerned about software misuse, liability, loss of pleasure of driving, privacy issues and job loss (all >3, on a 5-point scale). Items that the respondents in Switzerland were less concerned about (all <3, on a 5-point scale) include system safety, system reliability and job loss. Thus, it seems that the results are not comparable. Whereas the users in Copenhagen are more concerned of the system functioning, the Swiss respondents were more concerned about the other items.

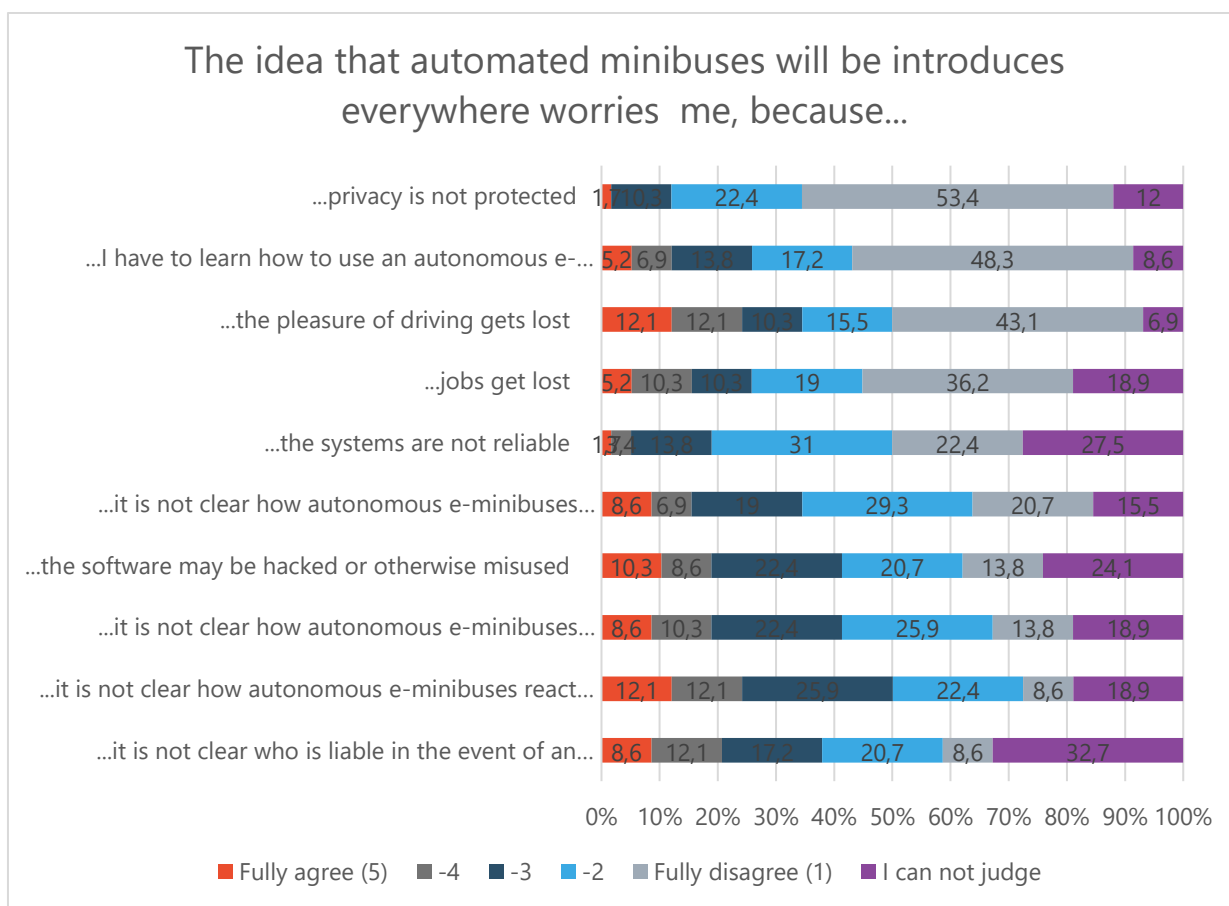


Figure 5.15 Perceived concerns about automated minibuses (n=54)

In consequence the vast majority of the users (89%) expects the automated minibuses to be going to be an important mode of transportation in the future and is willing to promote it among friends and family (92%).

5.2.9 Price and business case opportunities

Price is an important selection criterion for users to use the automated minibus, a majority of 58% state that the price is (very) important for the decision to use the automated minibus. No one stated that price is not important at all (see Figure 5.16).

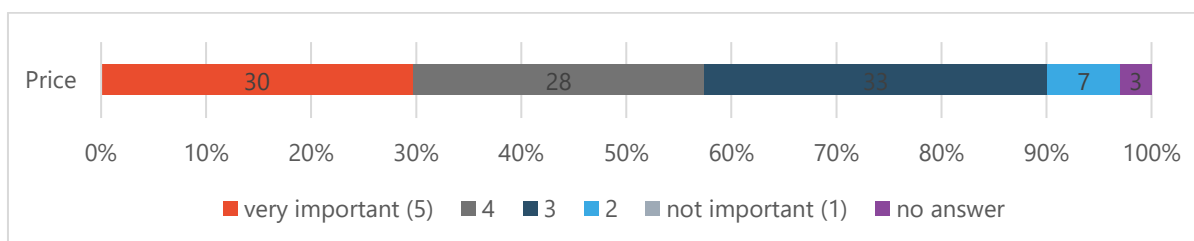


Figure 5.16 The importance of price in deciding to use the automated minibus (n=59)

To investigate the possibilities for future use and business cases, a question was included to compare the willingness to pay for the automated minibus compared to other means of transport (Figure 5.17). While around a third (35%) of the potential users are not willing to pay at least the same amount or even more for using the automated minibus as for regular public transport, only 24% of the users refuse to pay the

same or even more. Nevertheless, the fact that only 11% of the users are willing to pay more shows that users do not see such a strong improvement that would justify a higher willingness to pay. This can again be interpreted to mean that the automated minibus cannot completely replace other systems, but that this is seen as an obvious necessity which does not justify additional cost for the user.

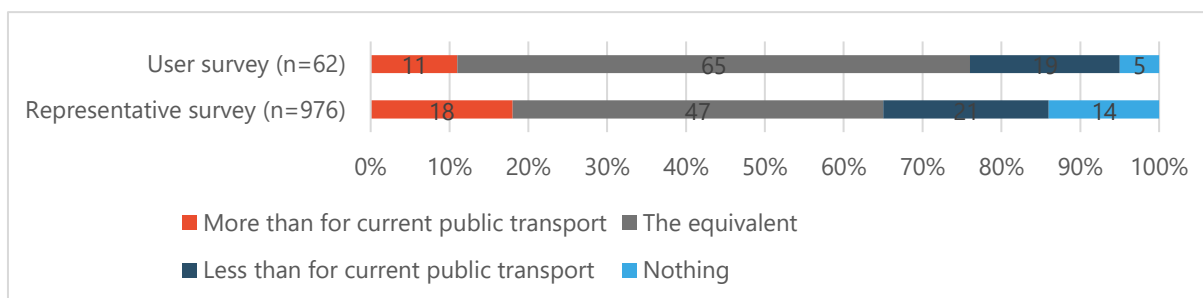


Figure 5.17 Willingness to pay, compared to results of representative survey

5.3 Conclusions and planning

In this chapter we reported on the results of the user survey, conducted in the Nordhavn line, in Copenhagen. We conducted the survey in the period between 4 August 2020 and 1 December 2020. In total 68 people completed the survey. It must be noted, that due to the COVID-19 situation, the number of users has been low on the Nordhavn line⁸. However, the users that did use the automated minibus service, have been highly satisfied with their experiences and most of them are willing to use the automated minibus again.

In general, there is a high satisfaction with the public transport offer in Copenhagen, the majority of the users would normally use their bike, or their own car. Based on these results, it seems there isn't an acute need for improved transport services. This does explain why the majority of users used the automated minibus at random, motivated by spontaneous interest and curiosity. Thus, even though users are satisfied, and state that they are willing to use the service again, the lack of an acute need for better alternatives prevents a situation of regular users.

The users state that, under the condition of an on-demand service, they are willing to reduce the use of their own car. Willingness to give up their own car, does only account for a smaller proportion of the users. It can therefore be assumed that users who currently urgently need a car even in a city like Copenhagen do not see any real alternative in the automated minibus even they were highly satisfied with their experience.

The users perceive risks less often, compared to potential users. User experience therefore, seems to be an important factor to reduce the perceived concerns and to increase acceptance of the automated minibus. Real experience in the automated minibus, does also have a positive effect on the trust in the system: Of the potential users, 35% state that the presence of the safety driver is important (chapter 4), whereas this only accounts for 18% of the users. This is an important result for the economic viability and

⁸ In total 1300 used the automated minibus service in Nordhavn (data from HOLO), this is an average of 0,26 passenger per trip. See also the calculations in D8.2 Second Iteration Environmental Impact Assessment

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possible business cases for the operation of automated minibuses. An additional insight for the economic analysis is that price is an important factor in deciding the automated minibus, and only about 10% is willing to pay more to use an automated minibus than current transport systems. Therefore, attractive economic models are needed.

Based on the user survey in Copenhagen, we can conclude that users are very open-minded, very satisfied but not yet convinced that the automated minibus could completely substitute their need of an own car. As user experience seems to be very convincing and reducing expectations towards any risks the awareness of the test sites and therefore the probability of its use should strongly be increased by communication, esp. using social media.

The results and conclusions as presented here are only based on the experiences in Nordhavn, Copenhagen. As the other pilot-sites will attract other users, and have other circumstances, it is of utmost importance to add and compare insights from users from the other AVENUE pilot sites. Therefore, we will restart with the user surveys in Lyon, Luxembourg and Geneva as soon as the restrictions imposed due to the COVID-19 pandemic are relieved.

6 Safety drivers' experiences

Safety drivers are employees of the Public Transport Operators (PTOs) working in the automated minibuses. The automated minibuses are meant to drive without representatives of the PTOs, but the presence of a person that can interfere and control the minibus is still a requirement by law for all test-sites of the AVENUE project. The safety drivers are in a daily interaction with the users and collect numerous valuable observations on user behaviour as well as on the interaction of the users with the automated minibuses. In this study we aimed to gain insights on the observations of the safety drivers, more specifically on the following topics:

- Self-image and responsibilities of the safety drivers;
- General perception on test sites and automated minibuses in practice
- Observations about user profiles, behaviours, questions, conversations, and critical situations.

6.1 Qualitative interviews

A qualitative approach was selected to gain deep and comprehensive understanding of the perceptions and insights on the experiences of the safety drivers. The data were collected through semi-structured guided interviews. The semi-structured interviews were structured by a guideline. Due to the flexibility of the method it is possible to generate new information that is particularly important to the interviewee. Aspects that are irrelevant for the interviewee are only briefly or not addressed at all. Thus, the interviewer adapts to the interviewee to explore his or her point of view as intensively as possible (Jandura et al. 2011). The guideline used in this study was an adapted guideline that has been used for the AVENUE stakeholder analysis (Fournier et al.; Nemoto et al. 2019). The results of the study presented in this chapter, will also be integrated in the AVENUE stakeholder analysis ⁹.

The interviews were conducted between February and March 2020 via telephone or video call. The interviewees were selected with the support of the Public Transport Organisations (PTOs). A total of eight safety drivers from Geneva, Lyon, Luxembourg and Oslo¹⁰ could be recruited. One interview was conducted as a double interview – two safety drivers were interviewed at once – which brings a total of 7 interviews (see also Table 6.1). Three interviews were conducted in English and French respectively, one in German. Each interview lasted around an hour. The interviews were recorded with an audio device and transcribed afterwards. In total 60 pages of interview material are available.

The interviews were analysed using qualitative content analysis. Qualitative content analysis is a method for analysing and reducing text meaning and is particularly suitable for comparing different texts (Mayring 2015). The aim is to create a category system that structures the text material and filters out those aspects that are relevant for answering the research question. The category system can be developed either inductive, deductive or mixed. With the inductive approach, the categories are derived directly from the material, whereas in the deductive approach they are already defined in advance. Mixed means, for example, that the main categories are determined inductively, but the subcategories are worked out

⁹ The results will be integrated in the final deliverable of the WP2.5; Deliverable 2.9, that is due March 2021

¹⁰ As at the time of the data collection no minibuses were driving in Copenhagen, safety drivers from Oslo were interviewed instead. They are working for the same transport company HOLO and accompanying the same minibuses from NAVYA in the pilot project.

inductively. The category system of the operator interviews was mainly created in an inductive manner. However, aspects of the mixed way are included, as the guideline already gives a first structure of the content and indications for the main categories.

Table 6.1 Sample description

ID	City / TPO	Sex	Working experience as safety driver at the time of the interviews	Duration of the interview
I1	Oslo / Amobility	Male	Approx. 3 months	174 min
I2	Oslo / Amobility	Female	Approx. 5 months	52 min
I3	Oslo / Amobility	Male	Approx. 2 months	55 min
I4	Lyon / Keolis	Male	Approx. 6 months	45 min
I5	Lyon / Keolis	Male male	Approx. 4 months Approx. 4 months	36 min
I6	Genf / TPG	Female	Approx. 18 months	60 min
I7	Luxemburg / Sales-Lentz	Male	Approx. 18 months	55 min

6.2 Results

The results are discussed by the central themes that were revealed through the analysis: role of the safety drivers, a reflection on practical quality of user experiences; a reflection on hedonistic quality of user experiences and; user motives and target groups.

6.2.1 Role of the safety drivers

The safety drivers experience that their presence on board is important both for operational reasons as for user acceptance. As the technology is not yet sufficiently developed – from the perspective of the supervisors - to allow a driving without monitoring or interventions by humans, their presence is required for a smooth operation. Moreover, being present in the automated minibus has a positive influence on the passenger's sense of comfort and security. Users ask many questions, they are curious and excited about driving automated. According to the safety drivers, users would feel uncomfortable without them in the minibuses. Nevertheless, they are convinced that their relevance will decrease in the course of time. With a further development of the technology, users want to ride completely automated. It is interesting that not all users (see Chapter **Fehler! Verweisquelle konnte nicht gefunden werden.**) experience the supervisors being as important as reported by the supervisors themselves.

6.2.2 Reflecting on safety drivers' experiences

We can distinguish four topics of practical quality that influence the user experience in relation to the quality of service: Safety, accessibility, speed & braking system (the braking system does include both technology and communication with other road users). When safety drivers reflect on their own experiences and observations they distinguish four topics of practical quality that influence the user experience in relation to the quality of service: Safety, accessibility, speed & braking system (the braking system does include both technology and communication with other road users).

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Low speed and the frequent braking of the minibuses are evaluated as a problem by the safety drivers. The low speed is a problem, especially for other road users (i.e. cars, buses, taxis, etc). who are slowed down by the minibuses. In some cases, the low speed results in dangerous overtaking manoeuvres by car users, causing dangerous situations for pedestrians or bike users. Moreover, the speed is a lowlight that drives people away from using the minibuses. All safety drivers stated that once there is another public transport option, people will choose the alternative over the minibus, as that one will definitely be faster. In case there is no other public transport option, passengers accept the speed, but nevertheless ask for the reasons behind having it. Safety drivers state that speed is an obstacle for a full implementation of the minibuses. They suspect that, as soon as the automated minibuses will run with an appropriate speed, peoples' choice won't differ between the minibuses and other public transport options.

Frequent braking is also a problem that needs to be solved. The braking is described as unpleasant and hard. The frequency of braking is caused by a combination of (mis)communication with other road users and the status of the technology. The situation has improved thanks to 'new updates', but brakes still happen too often. The safety mark of the minibuses is described as a bit over exaggerated. Operators stated that the minibus should be able to distinct between real obstacles and harmless things like rain or leaves and plants. According to the safety drivers, the frequent braking could be reduced, if other road users know more about the technology and the minibuses in general, as they often cause the braking by coming too close to the minibuses. More consideration of other road users for the automated minibuses could allow increasing the speed. The lack in awareness and thoughtfulness is seen as the biggest obstacle in the integration of the minibuses into the society and transport systems. Some operators suggested in this respect to offer information events at the pilot sites.

The aspects of safety/security regarding traffic accidents as well as the accessibility of the minibuses do not pose any problems. However, it must be considered, that the operator seems to have quite an influence on the passengers' feeling of safety on board, so that no statement can be made on how the safety aspect would be assessed without the presence of the operators. Based on the analysis, we can state that the four categories, safety, accessibility, braking system and speed are evaluated differently (Figure 6.1 **Fehler! Verweisquelle konnte nicht gefunden werden.**). Safety and accessibility are qualities that are evaluated as satisfactory, they are fulfilling the needs and demands of the users, and contribute to a positive user experience. The braking system and speed are qualities that are (currently) evaluated as being unsatisfactory, and contribute to a negative user experience.

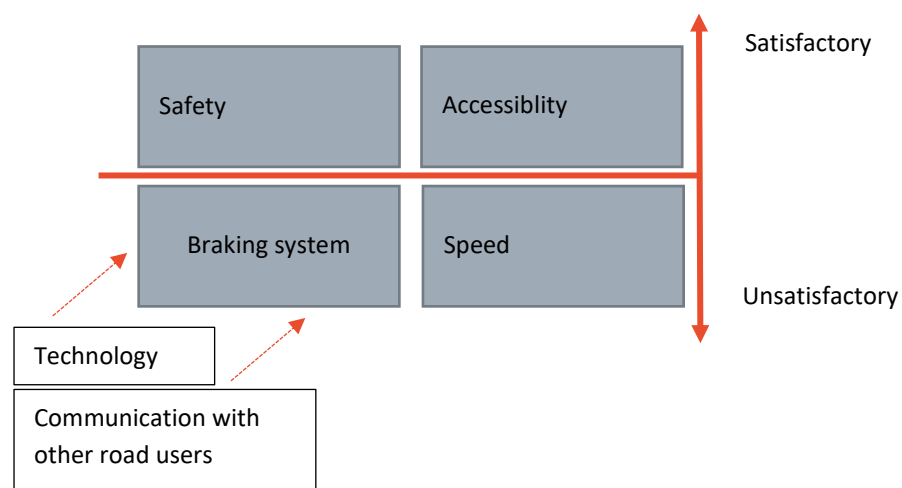


Figure 6.1 Reflection on practical quality

6.2.3 User Perception based on safety drivers' observations

In addition to the generic basic use of the transport service, the experience of a product or a service can also be evaluated by their 'hedonistic quality' (Hassenzahl et al., 2018 **Fehler! Verweisquelle konnte nicht gefunden werden.**). This means that products or services can also provide for more subjective experiences, such as pleasure, fun, learning, and self-development. These qualities do not necessary depict the qualities of the product/service, but do affect the user and their perception of the product/service.

As a consequence of the innovative character of the automated minibuses, users experience their ride as positive, exiting and interesting. The minibuses are not (yet) considered as a normal means of transport, but represent innovation, transport of the future and as an experience to learn from. The operators state that people use the minibus to learn about the innovation first hand.

The automated minibuses are considered an attraction. Users come travel to the pilot sites from towns further away to test the service. This is especially seen during weekends. The shuttles are considered something exciting, an innovation that has not yet been experienced by the majority of people. Using the service in its current pilot-state phase is exiting, and something to tell your family and friends about. The service is considered something that is 'future-proof'. For example, a parent in Oslo told their children that *'this is your future, when you will be finished with school; all cars will be automated'* (I3)¹¹.

Users expect to experience something new, before boarding the shuttle. This curiosity continues to be important during the ride, especially for "first time" users. Users have a ride to acquire knowledge about the shuttle, and this is expressed by users since they were asking questions about the technology, speed, and the reason for the presence of the operator. This – by the way – is again an indicator that not all users see a reason for having a supervisor on board. Figure 6.2

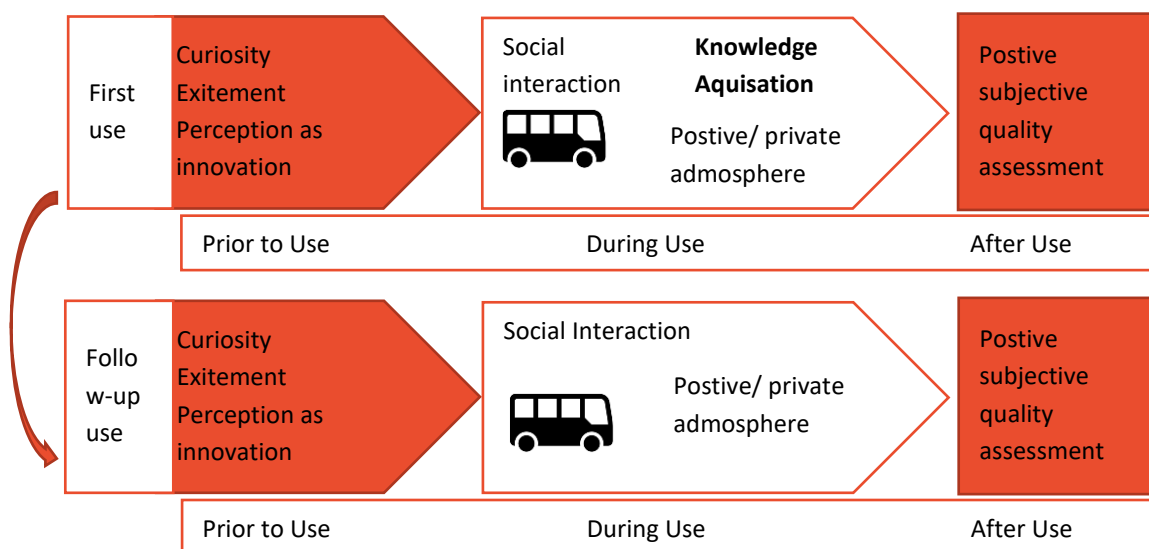


Figure 6.2 Aspects of the subjective quality assessment in the automated minibus

¹¹ To make sure that the interviewees remain anonymous, we coded the interviewees, see table 6.1. The quote referred to here was made by interviewee with the corresponding code ID3

6.2.4 User Motives and Target Groups

In the current state of the pilot project, curiosity is a key driver for people to test the minibus. This especially stands for people who travel with the minibuses for the first time. Safety drivers report that users come from all around to test them. This excitement is also visible in the behaviour of users. Users tend to ask questions and be engaged in a conversation with the safety operator or other passengers. The safety drivers are especially positive about the social interactions and the private atmosphere in the minibuses which is quite special for a public transportation mode. This does also apply to people who use the minibuses more often.

The safety drivers could not identify specific type of users, based on their experiences. Depending on the location of the route and the time of the day some differences in the user groups are visible. There is no major difference between the number of younger and older users. Especially children seem to enjoy the rides with the minibuses. There seem to be differences between the test-sites, whereas in Oslo and Lyon, the automated minibuses are primarily used by regular users, in Luxembourg the service is more often used by tourists.

Safety drivers do not see any problems for PRMs using the bus as the minibus is easy to access and safety precautions are sufficient. However, PRMs are not using the minibuses often or frequently, but if they do, they do not behave different to other users. It should be noted here, that this is the perception of the safety drivers, based on their experiences in the bus, not real experiences of PRM.

6.2.5 Conclusions

In general, the safety drivers observe that most of the current uses are driven by curiosity. This indicated that there is a high goodwill for this innovative service. In the opinion of the supervisors the users are highly satisfied, especially considering subjective aspects such as good atmosphere. This mirrors what is described in the chapter 5 “User survey”. It is also interesting that not all users experience the safety drivers being as important as reported by the safety drivers themselves.

Safety and accessibility are qualities that are evaluated as satisfactory by the safety drivers, they are fulfilling the needs and demands of the users, and contribute to a positive user experience. Safety drivers are convinced that if the technology is further developed and especially speed is on a comparable level to other public transport modes, as well as the awareness of other road users has increased, the society will use the minibuses as a normal means of transport. The role of the safety drivers currently goes well beyond the technical and safety purpose. However, this might be due to the newness of the service, and the attraction of primarily first users.

7 Social impact of integrated automated vehicles in public transport on PRM

Persons with reduced mobility (PRM) are highly dependent on public transport (PT) in all areas of life. The lack of accessibility, even in one component of the entire system, results in hindering the participation to education, social and working life. Depending on the type of disability, driving a car, taking an e-scooter or riding a bike is not possible, therefore public transport is the only means to travel without assistance from others e.g. from Home to Work. Accessible and frequent PT service is therefore an essential criterion for people with reduced mobility when choosing a place of residence: the availability of a higher frequency of PT connections in larger cities offers more flexibility compared to rural areas. When introducing automated vehicles to persons with disabilities, one of their first statements often is that this development can have positive effects on their way of life, with automated vehicles they no longer have to live in a city in order to have a good infrastructure. *“This opens up space for life in the countryside as well.”* With regard to those statements the work situation of the majority of PRMs must also be considered, which is statistically worse than that of non-PRM (see Table 7.1 Table 7.1) and thus results in a lower, if at all, income.

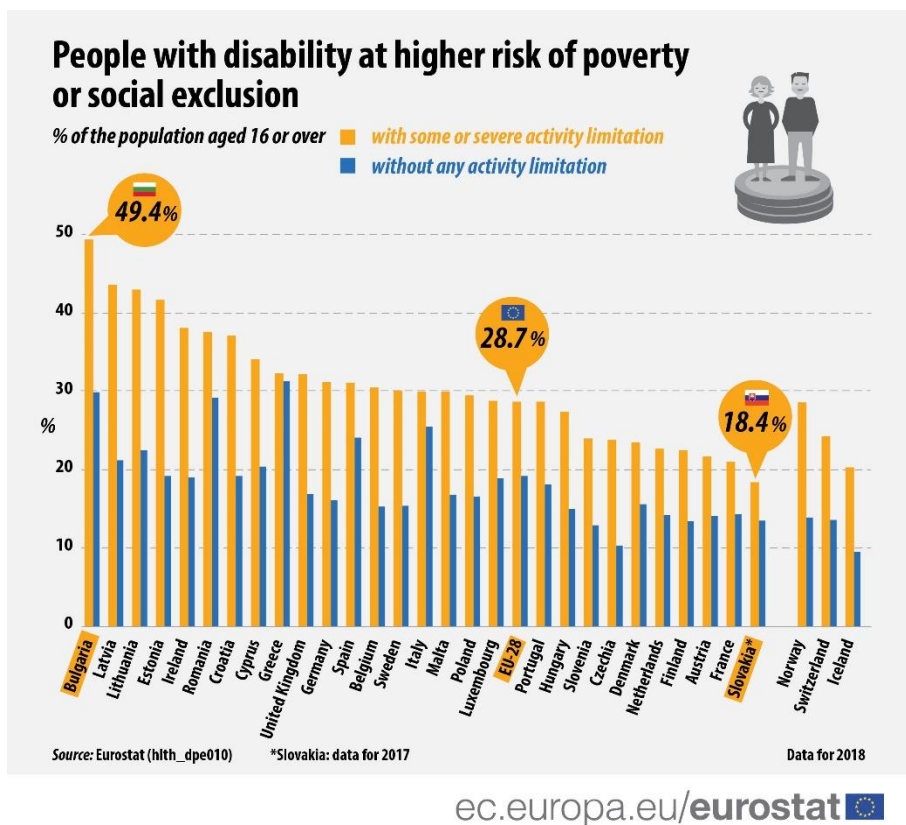


Table 7.1: People with disability at higher risk of poverty or social exclusion.¹²

¹² Eurostat: https://ec.europa.eu/eurostat/documents/4187653/9451024/People+with+disability_AROPE.jpg

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Hence, the amount of financial resources available for rent are limited which, in many urban areas, results in nearly none to sparse affordable living quarters. Therefore, opening up rural areas through accessible AVS as potential place of residence to PRM would give them the equal choice where to live.

A survey conducted for Deliverable D2.4 *First Passenger needs analysis and specification* with 58 persons concerning the acceptance of AVs confirms this assumption: Automated public transport will be accepted more easily with increasing distance and decreasing frequency of public transport, while age seems not to play an important role.

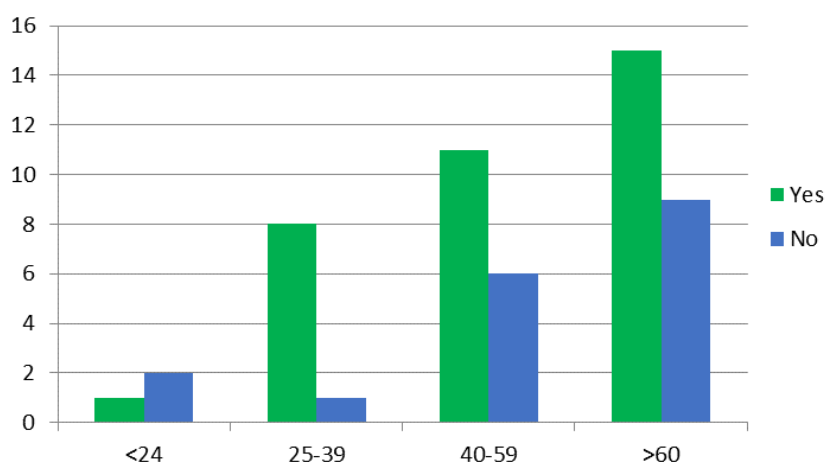


Table 7.2: "Would you take a driverless bus?"

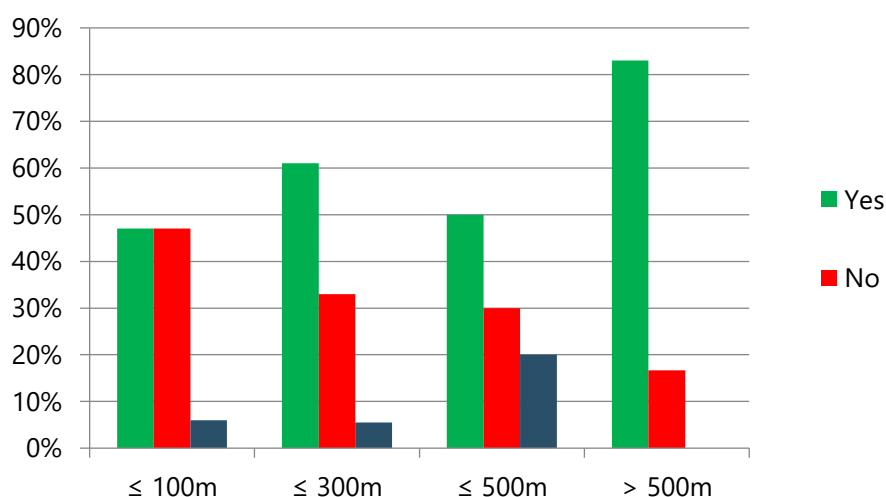


Table 7.3: "Would you take a driverless bus?" in relation to the distance to the next bus stop

7.1 AV as solution for ageing population in rural areas and the infrastructural deficiencies

It is presumed as common knowledge that in the last decades, in Europe, a rural exodus of young people is still taking place. Therefore, the remaining population in rural areas is significantly ageing. This trend is due to the current infrastructural environment with regard to education, leisure activities, shopping possibilities, medical provision and, last but not least, the public transport connectivity. In many rural areas public transport service is often limited to only a few routes per day, from Monday through Friday,

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and even less on the weekend. Thus, people in rural areas are more dependent on having a driver's license and a vehicle to commute to work, go shopping, take care of children (driving them to school depending on their timetable), organize visits to the doctor, etc.

Considering the previously stated rural exodus and the limited PT service the majority of rural based people belong to the age group 65+ and would therefore benefit substantially from accessible AVS. Accessibility is particularly critical for this age group (the majority, 65% of disabilities are acquired by older people (Table 7.4)). Without adequate public transport they face social isolation, inadequate and severely needed medical care and insufficient or very limited access to everyday necessities.

Thus, AVS in general and accessible AVs in particular would substantially benefit rural areas. For older people the life quality would increase and for younger people and people with disabilities rural areas would be opened as main focus point of life.

Severely disabled people (Germany): 7.8 Mio.

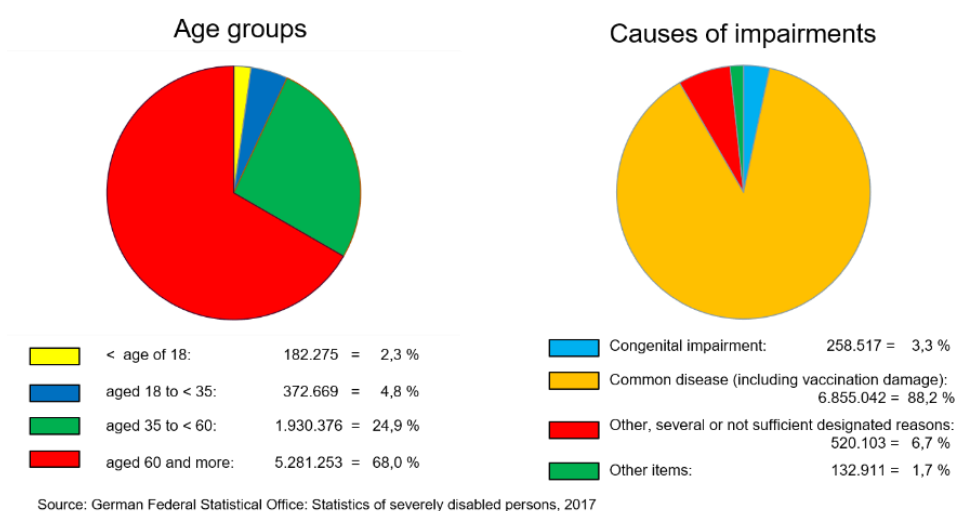


Table 7.4: Age groups and causes of impairments

7.2 Accessible services and accessibility of AVs

It is expected that AVs will provide the necessary frequency and that the vehicle will be able to stop even at location with low passenger frequency, thus better meeting the individual needs of users as public transport becomes more individual. This can lead to a significant improvement in the participation of people with disabilities, as it is another building block that enables them to be mobile and able to manage their daily lives without assistance from others. Especially for blind passengers AVs provide particular added benefit because they could ensure a higher degree of individual independence.

This is also emphasized in the report "Self-Driving Cars: Mapping Access to a Technology Revolution" of the National Council on Disability (NCD): *"Lack of personal independent mobility has resulted in the exclusion of people with disabilities from education, employment, and social life."* [...] *"AVs present a tremendous opportunity to end exclusion and promote independence for anyone who presently cannot obtain a driver's license, but significant work remains to ensure that technological systems currently in development will enable independent use by people with disabilities. It is important that manufacturers and government agencies collaborate with stakeholders, such as the disability community, to ensure that*

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these technologies are fully accessible and available to all.” (NCD 2015). As mentioned in this report, vehicles, the related services (ordering, communication, payment, etc.) and the stops must be accessible in order to benefit from this technology.

The lack of accessibility of today’s vehicles (identification of the right vehicle, ramps, ...) is compensated (in many cases) by assistance given by the driver. Having no driver on an AV means, that the accessibility of the vehicle and the bus stop needs to be increased to avoid an exclusion of PRM. The impact of missing accessibility in combination with a missing driver could be demonstrated during the current pandemic situation: During the CORONA crisis, the bus driver was isolated from the passengers, so that the passengers could not receive assistance from the driver. Newsletter and relevant mailing lists of people with disabilities, personal observations, and discussions with PRMs showed that even previously frequent users of public transport stopped using public transport because they feared that they would be helpless without the driver’s help.

Therefore, accessible services and accessible vehicles play a crucial role for AVs, as they will not have a driver that could compensate missing accessibility: To increase the user acceptance of PRM, the specific assistance systems required for these user groups must be provided by the AVs. It should be ensured that the various assistance systems can be operated by the affected passengers on their own without any problems and completely without the help of third parties. For example, persons with limited vision or hearing should be able to perceive all necessary passenger information while on the go. Currently there is no accessible passenger information available, neither onboard nor via an accessible app. Wheelchair users or persons with walkers should be able to comfortably request and use the ramp for a safe entry and exit at normal or alternative bus stops on their route, without any risks. Currently not all AVs are equipped with a ramp, some only have a manual ramp which can only be operated by a PTO. A further problem arises inside the vehicle because the wheelchair/walker cannot be fixed without help.



Table 7.5: Fixating a wheelchair in AV

The following list contain the most important features that have to be realized:

- Two channel principle for all related information (APP, website and onboard information)
- Possibility to identify the correct bus by blind or visual impaired persons
- Vehicle must have a ramp to allow wheelchair users to enter the bus
- There must be the possibility to fix wheelchairs, walkers, etc.

Only if the reliability of these assistance systems is 100% guaranteed AVs will be a real alternative to other public or private transport systems and, moreover, a real step forward for mobility and thus for the inclusion of people with disabilities.

7.3 AVENUE services as an opportunity for persons with disabilities

The Avenue project focuses on easy-to-use services that provide real added value for the various user groups in everyday use. For example, the project will provide an automated tracking service, primarily designed for school children, but also offering persons with mild-cognitive difficulties an additional protection in public transport. Thus, a continuous location tracking can be activated and guaranteed for these persons, which enables a kind of transport escort. Relatives or friends can use this service to track affected persons during planned bus trips and to provide immediate support if necessary, e.g. in complex situations such as bus transfers. With its unobtrusive assistance potential, the tracking service promotes the maintenance of the self-determined action of this user group and also relieves relatives who now have less to worry about.

Another example is the Door 2 Door Services realized in the AVENUE project. Such service would be a revolution, it would enable the provision of public transport in areas with fewer passengers, it would connect people without private cars and it would open up a new mobility for people with reduced abilities: Persons with reduced mobility often require a high level of assistance, which could be drastically reduced by special door-to-door services; this would be the first time that persons with reduced mobility would have almost the same (mobile) flexibility as persons without reduced mobility. Such door-to-door services result in short walking distances that have to be covered by this user group, which also reduces the risk of accidents in their everyday life.

Another service is the detection of aggression and theft. This service is especially interesting for people with limited abilities, as they often become victims of theft because they do not notice it, or they notice it too late and because they are usually not that mobile. Such a service could help to make the journey more enjoyable because passengers do not have to be on their guard all the time.

In general AVs will improve rural areas and areas with a low number of public transport connections.

Thus, AVS in general would substantially benefit rural areas and regions with poor public transport serves. For people living in these regions the quality of life would increase and for younger people and people with disabilities rural areas would be opened as main focus point of life.

However, all these services have one common issue: to reach all passengers, including those with a disability, the complete service must be accessible: Booking of the service, finding and identification of the vehicle, the necessary onboard information (e.g. arrival or departure delays) to word only a few.

8 Social media monitoring

The objective of this Chapter is to offer an insight regarding the monitoring of comments from readers/users present on dematerialized versions of traditional media as well as on different social networks such as *Twitter*, *Facebook*, *Instagram*, and *Linkedin*. We will also be interested in comments posted on the video sharing platform *Youtube* and on community sites such as *Reddit* or *Quora*. The aim is not only to focus on comments related to the *AVENUE* project, but also to include all those related to automated public transportation in general. We will also conduct a reflection based on the analysis of these contributions, which will help to determine where it is necessary to emphasize and shape communication strategies accordingly, which can be tailored to the channel or geographic context. Paying attention to these comments, particularly the more critical ones, will help to better identify consumers' demands, needs and fears and to reflect on what could be undertaken to better meet their wishes/demands. This while reflecting on how this can be done without creating new problems/criticisms. Some of these criticisms are precisely elements that the *AVENUE Project* is intended to solve, so it would be unfair to attribute all these flaws to it, but this remains a good way to quantify the need for these changes.

Table 8.1 Count of the sources referenced across this monitoring (total and by channel)

Nb of sources	*On approx. 60'000 researched
Total	781
Conventional press	141
Youtube	96
Reddit	25
Quora	6
Facebook	99
Twitter	300
Linkedin	39
Instagram	75

The database, in its current form, contains 5'500 comments from about 800 sources. The sample seems numerically large enough to have a satisfactory level of significance, the representativeness is also very

good, the panel being geographically diverse, based on a large number of channels and sources and very diversified in terms of their audience. As far as traditional media are concerned, the sources come from ten different countries: Germany, France, Denmark, Sweden, Switzerland, Great Britain, Austria, the United States, Luxembourg and Japan. The sources were sometimes found through the search engine of the different social networks or through *Google's* search engine for the traditional press. The keywords (or # and @) used were: *automated, driverless, selfdriving in* combination with *shuttle, bus, public transport* (and their equivalents in different languages) but also the names of private and public operators that offer this type of service such as *Zoom, Keolis, Sales-Lentz group, TPG, RATP, Holo* etc.. The names of automated vehicles (*Olli, Arma, Aurigo* etc.) or their manufacturers (*Navya, Aurigo, Localmotors* etc.) and companies associated with these technologies (*Easymile, Bestmile*) were also used for these searches. Other sources have sometimes been found from one thing to another (hypertext links).

8.1 Overall analysis of comments

Comments have been grouped in the database according to their type (approximately 60 distinct types were isolated). Below we present the top 15 comments among all the media/social media channels we are interested in.

8.1.1 Top 15 comments

1. Problem of job losses of drivers related to the automation of their function: 645 comments, i.e. 14.8% of them. This fear that emerges during the automation of any human task is not unfounded and in certain contexts and circumstances job losses will be possible. During media communications, it could be insisted on the fact that these situations could be avoided by redirecting drivers to other functions made necessary by the adoption of A.Vs (within the same company), or more generally to promote a transition to new types of jobs that will appear in other fields related to the emergence of these technologies. It is therefore a change that will require the labour market to adapt over a period of time, as the transition period may prove more painful. The geographical areas that will be much more easily accessible thanks to A.Vs will also see employment flourish. Thus, when it was possible to respond to the comments that denounced these future layoffs, many people "counter-reacted" by refuting this idea, stating that jobs have always been evolving, that they are disappearing and reappearing, that bus drivers will now be engineers or teleoperators, jobs that are more rewarding, better remunerated and less repetitive. The argument then often comes that it is impossible to keep unnecessary burdens on society if progress makes it possible to automate tasks, and that if we had always tried to maintain jobs artificially, there would still be coachmen around the streets.
2. Travel speed is too low which concerns about 400 remarks (8.5% of the total). To prevent accidents, the maximum speed of automated shuttles is often limited well below their actual capacity. Here it is possible to communicate that when they have proven that they are capable, this speed will be increased considerably without having to renew the fleet (software update). It could also be pointed out that in cities, traffic speeds are often limited to 30km/h, and that traffic jams even greatly reduce this speed. The claim that it is faster to walk is false and the bicycle is subject to a higher risk of accidents with more serious consequences; comfort is also lower, especially in bad weather conditions, and some individuals do not have the physical condition to use it on a daily basis.
3. A.Vs cannot be trusted, they are intrinsically dangerous: this type of comment was found almost 400 times (8.1% of the cases); in the same vein, those who claim that A.Vs are stupid or that they can be

easily hacked or bugged are also present (3.2% of the panel). Here, many people point out that their personal computer/smartphone frequently bugs and imagine the consequences when this will happen with A.Vs. Others point out that ill-intentioned people might want to hack A.Vs, by simple technical challenge or to turn them into weapons and perpetrate attacks. We will later compare this number with the number of those who do not fear A.Vs. It would be necessary here to communicate on figures which show that A.Vs are less accident-prone.

4. A.Vs in public transportation would only result in an excessive expenditure of money, these comments emphasizing in many cases that it would be public funds (4.8%). In projects where transport operators are state-owned or subsidized, the money invested is often considered a waste of public funds. According to these critics, this money should be invested in more noble causes, such as social assistance or ecology. When it comes to private companies, comments affirm they will go bankrupt. Figures can be put forward to show that A.Vs can benefit the society financially.
5. Those who are happy with the current advent of A.Vs in the public transportation represent 4.5% of cases. These are the ones who formally express that they are looking forward to A.Vs with impatience or are happy they are coming.
6. A.Vs are not ready for real world experimentations, daily confrontation (for 180 people, i.e. 3.8% of the cases). Here we can give some statistics on the high distances travelled by A.Vs, or show they have been circulating without hindrance for so many years, that they are active in dozens of projects in so many countries and continents around the world.
7. A.Vs are a danger for cyclists and pedestrians (141 remarks or 3% of the panel). Most often these comments are devoid of well-founded arguments, but they sometimes refer to accidents that have taken place in several places in Europe. It should be noted that when it is possible to respond to comments of this type, it is often pointed out that the danger comes from pedestrians because they are the ones who are not paying attention.
8. The Safety-driver is useless, it is not a progress at all if he is needed and the bus cannot be considered as automated (129 remarks or 2.7%). Some of the comments also underline the fact that he's paid and that there is then no financial advantage not to simply keep a conventional driver. Commenters could not get used to the idea that there is no one in charge of the bus and they would like robots to replace the current Safety-drivers. This idea that they would be useless is however strongly questioned directly and indirectly by those who fear the absence of a manager in case of an emergency, or fear job losses or violence.
9. 2.6% of the panel believes that A.Vs can reduce the risk of accidents.
10. Automated shuttles will create congestion and traffic jams (for 2.4% of the sample) because they add to the existing car fleet or because their slowness or radar problems forces them to stop unexpectedly. The reasoning is largely false, since their arrival will mean the disappearance of the large conventional buses, but also the disappearance of some of the individual vehicles whose owners will have been seduced by the advantages of the public transit A.V. Encouraging the media publication of figures that challenge these criticisms could be judicious.

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11. Additional comments indicate that automated shuttles drive too defensively and stop or even get stuck all the time due to a radar that is faulty or not adapted to everyday situations (92 comments or 2% of the panel).
12. A.Vs in public transportation would be an excellent solution to serve areas that are currently insufficiently served (often referring to rural areas); this has been noted for 91 comments.
13. A.Vs in the public transportation context are a simple show-off, projects with no future, empty shells (86 comments or 1.9% of the panel).
14. The robotization of society: fear that A.Vs are only one of the steps towards a society in which robots will, little by little, insidiously, take over humanity until they enslave and then destroy it (84 comments or 1.9% of the total). Comments referring to *Skynet* are often present, implicitly referring to the movie *Terminator* in which the robot took over the human.
15. As there is no driver, there is no legal responsible in case of an accident (1.8% of the remarks with 75 occurrences). Who will be morally responsible, who will pay the damages, will A.Vs be free to kill in total impunity? It can be said in media communications that the transport operator is insured and that the care and support in case of an accident does not differ from that which would have been offered if a driver had been on board.

8.1.2 Remaining comments

Then come the comments asserting that automated shuttles will suffer from incivilities (1.6% of the panel, i.e. 69 comments), followed by those who claim that they pollute and consume a lot of energy (57 comments, i.e. 1.4%). These comments sometimes point out that battery components are rare, that their extraction has serious ecological/social consequences and will soon become wastes whose treatment are problematic. At other times, it is mentioned that the energy is not produced cleanly, which means that A.Vs pollute in a hidden way. Some comments also sometimes point out that A.Vs will intensify road slowdowns, which will generate more pollution. Figures concerning the reduction of CO² emissions can help make A.Vs' image greener.

Then come the remarks according to which public transit A.Vs compete with cabs and the *Uber* network whose business are *door-to-door/on demand* services (perceived as unfair), precipitating job losses (for 1.1% of the panel). These comments state that these functions will become obsolete because they are redundant and that they will not be able to match the much lower prices offered by this new service. To put these comments into perspective, it can be noted that cabs maintain a higher level of comfort and offer the privilege of human contact. The same proportion of the panel affirms that the upcoming advent of A.Vs in the public transport system are revolutionary and that they will change daily lives, whereas 46 people (1% panel) state that these vehicles are only a sporadic phenomenon that will not see any further development and that they don't have any future. Those who think that A.Vs have nothing more to offer than traditional public transport are also 1%, as do those who say that there is no tendering process and that there is clientelism/corruption surrounding public transit A.Vs projects.

The comments cited in less than 1% of the cases were the most common. Although rarely mentioned, these topics are multiple and reveal real concerns.

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0,8%: -There will be no assistance from the driver in the case of an emergency.

0,7%: -There are/will be no interested customers.

-Journeys are not long enough.

-Journeys are badly placed.

-Would be a precious help for the elderly.

0,6%: -Automated shuttles are unreliable and always out of order.

0,5%: -A.Vs in the public transit will be a precious help to disabled people.

-Night-time mobility will be greatly improved.

-The absence of the driver will promote/increase insecurity.

A total of 0.4% of the comments stated that public transit A.V services are or will be too expensive because of the need to amortize the investment or simply to generate more profit. In this respect, 0.3% of the panel thinks that operators are only concerned about their own profits. The same proportion of people think that automated shuttles are braking too abruptly. It is also the number of those who are followers of conspiracy theories (linked to the 5G and Chinese supremacy theory etc.) or those who think that A.Vs are beautiful and that they will replace the buses advantageously. The remark that automated shuttles are unsightly also comes back frequently, the *Aurrigo* shuttle is unanimously described as ugly and some go up to affirm that it causes them nightmares. Biomorphism and aggressive shapes seem to frighten, it is then more judicious to turn to purer, softer and rounded forms, because it is much less simple to trust a technology if even its very image inspires us fear. Some *Youtube* videos highlight automated shuttles in a more artistic way, the comments associated are then very positive about their appearance and it is therefore important not to neglect the quality of the shots on which we base every media communication. The *ARMA (Navya)* and *OLLI (Local motors)* shuttles are much more appreciated, but not unanimously, while the *GACHA (Muji)* is always considered very pleasing aesthetically.

In bulk we still find comments such as: passengers will be filmed without their consent, their privacy will not be respected because of a problematic use of the data. The fact that a correct service is not provided and that public transit A.Vs are often late is also mentioned as well as their insufficient autonomy, their abrupt acceleration, the fact that it's too hot inside or that there is waiting times... It is also mentioned that they are a danger for the fauna, that they will push urbanization even further but also lead to the privatization of public transit operators. Others, more optimistic, point out that public transit A.Vs will greatly improve the urban landscape, that they will allow the disappearance of many parking spaces and will reduce congestion in the city but also generate a lot of money. Comments also included many questions linked to the accessibility: for the handicapped, the bicycles or simply for the public.

8.1.3 Link between sources and number of comments

It is undeniable that the only sources that provoke a lot of comments/views are the dematerialized platforms of the national print and televisual media with very large audiences, but also and above all influencers whose communications are debated by a large audience regardless of their subject. It is through these means that it is necessary to communicate as a priority if the project wants to gain in visibility and perceived importance, but also if one wishes to highlight certain other aspects such as those mentioned in this document. The fact of proposing *posts/tweets* on the specific accounts of the different actors of the *AVENUE* project is of course important, it's a means of making announcements, of presenting

advances, partnerships, collaborations and is a way of promoting his image. Realistically, however, their impact remains limited. *Easymile* and *Navya*, for example, have more than 1'500 *tweets*, but only a few *likes/retweets* for each of them; the visibility and the feedback are therefore not very important.

8.1.4 Analysis of comments related to AVENUE project

In addition to knowing what the population thinks about public transit A.Vs in general, it is interesting to analyse its perception of the projects under the *AVENUE* umbrella more specifically. We will also be able to see whether the population is well aware of the specificities related to the project and whether they are well understood. As is the case in general, we note that the *AVENUE* panel's main concern is the problem of job losses (14.6% of comments), followed by the slowness of the automated shuttles (7.3%). More specifically to this panel, complaints about the lack of transparency in tenders as well as suspicions of corruption are recurrent (7.3% of the *AVENUE* cohort compared to seven times less in general). The fact that there is a "useless" Safety-driver on board is also a greater concern in the *AVENUE* panel (7.3% vs. 2.7% in general). It can be seen that A.Vs are less perceived as dangerous across the project's panel.

The fact that a proper service is not guaranteed is mentioned seven times more in the *AVENUE* sample than in the full one, and the concern about the misuse of passengers' personal data is almost three times greater. The comments also mention twice as often that *door-to-door/on demand* is a technically infeasible utopia, as is the case for those who find that automated shuttles accelerate too abruptly. The fact that public transit A.Vs represent a waste of public funds is also more present across the *AVENUE* panel comments. Comments stating that public transportation's A.V services are expensive and that the journeys are not long enough are almost 3 times more common. On the other hand, comments denouncing the danger for pedestrians and cyclists are almost 3 times less present in this specific panel, as are those stating they are happy about the arrival of A.V services, which are 5 times less present. In the *AVENUE* panel, the comments are also 4 times less numerous to affirm that A.Vs are eco-friendly but also to worry about the absence of the driver in case of emergency. There are also 4 times less comments to affirm that public transit A.Vs will open up the countryside or that they will help the elderly. The *AVENUE* panel is also almost three times less concerned about pedestrian safety.

Comments stating that the project is not a novelty/an innovation are interesting regarding the *AVENUE* panel analysis, as this allows us to realize whether the project is perceived as innovative and whether the specific aspects that make it different than its predecessor are well understood. In other words, this will allow us to establish if the population has understood that these specific projects are much more than a simple demonstration on fixed routes and schedules as seen previously. This does not seem to be understood by everyone since 2.7% of people explicitly pointed out that one of the *AVENUE*-related projects did not bring anything new and that this had been in existence for a long time and all over the world... The specificities of the project are not highlighted enough and asserting that the project is unique without proving it only sharpens this criticism induced by the amalgamation of the multitude of public transportation's projects that involved A.Vs. Criticisms related to specific projects appear, such as "it takes place in *Belle-Idée*".

8.1 Thematic analysis

In a second step, the types of comments were grouped into thematic categories. In some cases, it was difficult to establish these groupings. It is possible to add categories with different combinations of comment types at any time. The details of the categorization can be consulted in the database by looking at the colour of the "🌀" signs.

Here are the 8 main categories/thematics chosen: *Technical Insufficiency*, *Safety Concern*, *Social Concern*, *Service unsuited to its environment*, *Service unsuited to the consumer*, then *Economy*, *Ecology* and *Technology*. A comment can of course belong to several categories. I have also counted positive and negative comments and those suggesting that there is still room for improvement.

Table 8.2 Count of the sources referenced across this monitoring (total and by channel)

Categories	Total	Percentage (of the total)	Specific percentage (regarding other categories)
Social concern	1607	39,7%	59,4%
Technical insufficiency	980	24,2%	36,2%
Security concern	921	22,8%	34%
Services ill-adapted/ maladjusted to the customer	805	19,9%	29,7%
Services inadapted to their environment	734	18,1%	27,1%

Thematic	Total	Percentage (of the total)	Specific percentage (regarding other categories)
Economy	1235	30,5%	56,8%
Technology	812	20,1%	37,3%
Ecology/ landscape	128	3,2%	5,9%

We note that in almost a third of the cases the comments are of social concern. Just under a quarter of the comments are related to technical inadequacies. Fears about safety per se represent 22.7% of the comments. Those who raise the point that A.Vs are not adapted to their environment (18.1%) or the clientele (19.9%) are slightly less present.

Only 3.2% of the panel's comments were related to the ecology and landscape, while more than 20% were related to technological aspects and 30.5% to economical ones.

Table 8.3 Count of the sources referenced across this monitoring (total and by channel)

		Percentage (of the total)	Specific percentage (regarding other categories)
Positivity	213	5,3%	14,2%
Negativity	234	5,8%	15,6%
Needs improvements	1050	25,9%	70,1%

Positivity is present in 5.3% of the comments, only slightly less than negativity (5.8%). Comments that suggest a need for improvement are present in 25.9% of the cases; put into perspective, a total of 14.2% are positive, 15.6% negative and 70.1% raise the need for improvement.

Table 8.4 The weight of opinions; opposing viewpoints analyses

Comparison (Ratio)	
1,6 times more to think it pollutes more than the opposite	131,33 times more to think it's too slow than the opposite
0,8 times more to think it will increase accidents than the opposite	9 times more to think travelling with it will be more expensive than before than the opposite
9,3 times more to think it will increase traffic jam/congestion than the opposite	72 times more to think it's a waste of money than an investment
0,9 times more to be negative than the opposite	3,5 times more to think it will be bad for the environment than the opposite
0,96 times more to think Safety-drivers are not needed than the opposite	

Further groupings can be made and be linked together to arrive at further conclusions (see opposite).

8.2 Channel by channel analysis

If we look at the distinctions specific to each channel, we can see for example that it is on *Instagram* that users are proportionally by far the most numerous to think that A.Vs are dangerous (20.5%); this is the most significant remark on this channel. However, this concern remains important and constant on all other channels. It is more on the social networks and on *Youtube* (16.2%) than in the written press (0.9%) that public transit A.Vs are the most welcomed. On the other hand, it is in the traditional media (and on

Youtube) that the problems of the obstacles' management as well as the fact that these vehicles can be hacked (6.2%) are the most preoccupying. The comment stating that automated shuttles need a Safety-driver is also the most prevalent in the traditional media and *Reddit* (4.8 and 9.3% respectively). In the traditional media, comments are also by far the greatest number to assert that public transit A.Vs are only *show off* (3.2%), as for the fears of corruption and lack of tenders (2.5%, while almost none in the other channels). In the traditional press, there are more comments saying that the number of accidents will be reduced (4.2%) than in the other channels.

Facebook users particularly mentioned the loss of jobs (24.7% of comments) but all other channels are very concerned about this topic (more than 10% for all except *Reddit*). *Facebook* users have the highest proportion to say that it is a waste of public funds (10.1%) and there are also many people on this channel who are concerned about the fact that A.Vs pollute and consume too much energy (this is also the case on *Linkedin* with 2.8%).

On *Reddit* (1.4%), *Twitter* (1.3%) and *Linkedin* (2.1%) it is the fact that there would be insecurity without the presence of a driver that poses a problem; this is not the case on the other channels. The fact that automated shuttles are slow is a fairly constant and high recrimination on all channels, but it is on *Instagram* that it is the strongest with 16.3% of the panel (this complain is also stronger than the average on *Facebook* and *Twitter*). The absence of the driver in case of emergency is a predominant concern on *Linkedin* (3.5% of the comments). On *Quora*, a large proportion of comments say that public transit A.Vs will change their life (in 8.3% of the cases, which is between 4 and 8 times more than on other channels). Paradoxically, it is also on *Quora* that we find the remark that public transit A.Vs have no future the most (also in 8.3% of the cases). The statement that their arrival will cause unemployment among cabs also particularly affects *Quora* (8.3%, seven times more than the average), as well as the fear that A.Vs are not ready for daily life (20.8% of the comments). *Quora* and *Linkedin* had the highest proportion of comments expressing concern that A.Vs are not legally responsible drivers, while on the other hand no one on *Instagram* was concerned. A particularly recurring concern on *Linkedin* was the lack of emergency assistance (3.5% of the comments). *Instagram* and *Twitter* have the highest proportion of comments stating that A.Vs can injure pedestrians or cyclists. *Linkedin* and *Reddit* had the highest awareness that public transit A.Vs will open up rural or currently underserved areas (7.1% and 4.2%). It is also on *Reddit* that comments most evoke the fact that night/weekend mobility will be improved (2.9%). The fact that A.Vs in the public transportation system will help disabled people is particularly present on *Twitter* and it is on *Linkedin* that comments notice the most that they will help the elderly (4.2%). Even if it is more rarely the case than on other channels, some traditional media audiences are receptive to the benefits offered by the public transit A.V model, such as *Le Figaro*. All these specificities have to be taken into account according to the channel we are addressing.

8.3 Country by country

This analysis allows for the emergence of specificities linked to local contexts that could be taken into consideration during media communications. This geographical information has only been found for traditional media (it is legitimately assumed that the comments associated with these come mostly from a local audience), at this regard, the uncertainty is most often too strong in social media. The fact that A.Vs are dangerous is a very present remark in Denmark (16.1% of the cases) whereas in the other nations it is less the case. This concern remains central (between 6 and 13%) in the other regions except in France where only 2% of the comments are concerned. Less widespread, the fear of hacking is fairly constant in

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all countries. Unemployment is at the heart of the concerns in all countries but it is particularly so in Luxembourg (24.6%) and surprisingly not at all in Denmark.

The fear of incivility is the highest in Great Britain (5.4%) and very low in Switzerland and Denmark. The British are also much more likely to think that public transport A.Vs has no future (6.9% of the panel) unlike other nations where this proportion is much lower, and even nil in the United States and Denmark. British are also in high proportion to say that A.Vs will pollute a lot (7.2%), as for Americans, and in contrast to Danes and Germans who do not express so.

Table 8.5 The weight of opinions; opposing viewpoints analyses

By country	Total sources	Total comments	Top concern	Top 2 concern	Top 3 concern
Germany	9	61	Jobs	Can't trust/ dangerous	Stupid/can be hacked
France	58	460	Jobs	Waste of public funds	Slow
Denmark	9	56	Can't trust/ dangerous	Can't handle real life situations	Slow
UK	8	130	Jobs	Slow	Can't handle real life situations
Switzerland	10	141	Jobs	Can't trust/ dangerous	Not unique
Austria	14	376	Jobs	Slow	Can't handle real life situations
USA	14	63	Can't trust/ dangerous	Can't handle real life situations	Slow
Luxembourg	14	199	Jobs	Operator, so no progress	Waste of public funds

* Concerns only (exclude things they like)

The fact that there is a "useless" Safety-driver particularly disturbs the Luxembourgers (10.6% of them) but much less the English (only 0.8%) and the Americans; other countries are approximately 5% to be so. Luxembourgers and Swiss are particularly concerned that, due to the absence of a driver, there is no legal responsible in case of an accident (respectively 5 and 3.5%), while the Americans and the Danes do not care at all about it. Luxembourgers, like the Austrians and the French, are afraid that insecurity will increase due to the absence of the driver who would have a dissuasive effect whereas this remark is not found in any other region. Americans are by far the most likely to think that A.Vs can be a danger to cyclists and pedestrians (12.7% of them), as opposed to Frenchs, who are much less concerned about it on average (0.9% of cases), and Germans, not at all concerned in this sample.

The Swiss are quite positive, they are the largest proportion to think that A.Vs are *eco-friendly* (1.4%) but also to say that these vehicles are welcome (with the Americans who are 4.8% to make the remark). The

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Swiss and Austrians are also the most numerous to think that the number of accidents will decrease thanks to the arrival of A.Vs (respectively 6.4 and 7.2% of the comments) while the Germans and Danes have made this comment much less. On the other hand, the fact that passengers are filmed bothers Swiss people (1.4% of the comments) whereas this does not trouble anyone in other countries. The fear of a problematic use of the data is also found particularly in the Swiss comments, whereas it is totally absent in many other countries.

The Germans are very concerned about the fact that there is no one on board in case of emergency (3.3%), whereas in Switzerland, France, the United States and Denmark this is never the case in the sample. Germans are particularly aware of the benefits that this innovation can bring them and mention those for the rural areas (11.5%, the second most frequent type of comment in Germany) and for the elderly (8.2%), but also in terms of night/weekend mobility (this is also the case in the United States in the latter case); these three categories are very little represented in the other countries (in Switzerland, there is not the slightest comment related to these categories!).

The United States (11.1%) and Denmark (12.5%) have the highest proportion of comments that say that A.Vs are not ready for an use in real-world conditions. The French are the most concerned about the small size of vehicles (3.5% of comments), while this is only marginally the case in other regions. The French sample is also, like the *US* one, particularly concerned about potential traffic congestion caused by public transit A.Vs (1.7 and 3.2% respectively), while the German and Danish samples do not. The French, like the Americans and the Danes (8.7%, 9.5% and 10.7%) are the most worried about the relative slowness of the automated shuttles. Only the French and the English fear that A.Vs in the public transportation context will be too expensive (1.7 and 0.8%). The French are also a lot to think that it is a waste of public funds (almost 10% of the comments), which is much more than in the other countries. They are also proportionally the most numerous to think that the journeys are too few and/or badly placed.

8.4 Limit of the analysis

The comments are very strongly influenced by the content of the various sources: if an article or publication concern the Safety-drivers, then the comments will refer to the subject much more frequently. One of the biggest problems has been the handling of minimalist comments like a *thumb up/good/cool/nice* without any other indication; it may be encouragement to an editorial team/poster, it may mean they find the vehicles pretty, it's too ambiguous to be part of the count.

8.5 What can we learn from these results?

Now that the problematic areas have been identified, the next step is to think about what changes to make in communication, to develop strategies to implement these changes, and to think about their direct and indirect consequences. In addition, in terms of the service itself and its implementation, this also gives ideas of what could be implemented/modified to meet the identified demands. For this I'll make a table that presents the rationale/logic behind each type of comment, describes what is misunderstood, how the argument is wrong and what we can change in our communication to avoid/rectify misunderstandings and make these criticisms disappear.

More than the fact that there is no driver, we must insist on what these new services will actually have to offer and on, the only thing that really matters to potential customers, what will be the benefits for them,

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individually, as users. Individuals need to have concrete examples of what they can gain from A.V technologies in the context of public transportation, by publishing information such as: you will have a vehicle right to your door, less average waiting time, you will save money and be able to take a ride on Sundays and in previously unserved areas etc. The population also needs to understand that it is not just another *last-mile* project but a much larger scale project that aims to revolutionize daily lives. At the moment, the public sees the advent of A.Vs in the public transportation as something that won't change anything for them; driver or not, electric or not, as far as they are concerned no change at all. This mainly explains the lack of comments and interest for such a disruptive technology.

It is very important to understand the implications and impacts of each of the movements that are undertaken in terms of communication; choices must be thought through and made in full knowledge of the facts. For example, it is important to be aware that insisting on the fact that the Safety-driver will disappear will encourage criticism regarding job losses and lack of security. If the choice is made to communicate on the fact that the Safety-driver will remain, those who say that it is wasted money and that the vehicles are not automated will be comforted in their opinion. This chapter gives a good idea of the central concerns related to A.Vs in the public transportation context and this could help, for example, to make choices when the population adopts two diametrically opposed positions on a subject and we have to decide who “we want to please” (of course we also have to look for parades to avoid offending those who adopt the other position). It is also important to take other aspects into consideration: should we talk more about such and such points at such and such audience because they seem to interest them or, on the contrary, they are already convinced on this level and we must communicate on other points?

9 Conclusions and outlook

The AVENUE Social Impact Assessment focuses on the social impacts of the deployment of automated minibuses in the four official AVENUE cities, Luxembourg, Copenhagen, Geneva and Lyon. The primary aim is to understand whether the introduction of automated minibuses in the public transport system will result in a changed mobility behaviour, which corresponds to the following research question:

What is the social impact of automated public transport systems, and how does this contribute to a changed mobility behaviour?

To answer this research question, five studies have been conducted and reported upon in this ‘second iteration of the social impact assessment’. A first study focused on the mobility needs, mobility gaps and the question whether automated minibuses can fulfil these mobility gaps. A second study focused on the social acceptance of automated minibuses in the four AVENUE cities. This study investigated expectations, attitudes and acceptance of automated minibuses among potential users. The third study focused on the user experiences of passengers of the automated minibus service in Nordhavn, Copenhagen. A fourth study took the perspective of the safety drivers. Their own experiences with the automated minibus, their observations and interaction with the users provided input on the AVENUE user experiences. The fifth study conducted takes a different perspective; not the (potential) users are the object of study, but the social media content about automated minibuses. This should also contribute to understand the social acceptance of automated minibuses. A sixth study that was conducted is not reported yet in this second iteration. In this study, local residents of the pilot area Nordhavn shared their mobility behaviour, attitudes and mobility needs with us for a longer period of time. These results will be reported upon the final social impact assessment.

Based on these studies, we can draw some preliminary conclusions. The final social impact assessment, due in December 2021, will provide the final conclusions. A first general insight, based on the results of all included studies, is that there is no acute need for a complete substitution of current public transport offers in the perception of citizens. In the following, the central conclusions are presented in detail. Hereafter we will present the work that is planned for the final stage of the AVENUE social impact assessment.)

9.1 Mobility needs

Satisfaction with the current offer of public transportation is negatively correlated with the need for improved local public transport services as offered by the automated minibuses. Our results show that in Singen, low satisfaction with the public transportation offers, results in a at least latent need for alternative transportation options, such as an automated minibus service. In cities like Copenhagen where the satisfaction with the offer of public transportation is higher, the need for new transportation services is lower and not acute. The social media analysis shows similar results; more than the fact that there is no driver, people insist on social media what these new services will actually have to offer in addition to existing services. We can conclude that the only thing that matters to potential customers, is the benefit for them, as individual users. Potential benefits include; higher temporal and local flexibility, less waiting time, and cheaper transportation offer. We can therefore conclude that the automated minibus is

primarily perceived as a possible solution for the current gaps in public transport offers, but only if it highly fulfils these benefits.

Potential users interviewed in the AVENUE cities perceive the current offer of public transport as being sufficient. Therefore, acute need for alternative offers is not indicated. This is also reflected in the user survey. The majority of users used the automated minibuses at random, motivated by spontaneous interest and curiosity. It is not used out of conscious conviction. The use is rarely planned. Thus, even though users are satisfied, and state that they are willing to use the service again, the lack of an acute need for better alternatives prevents regular use. This insight is also confirmed by the observations and experiences of the safety drivers.

9.2 Positive attitudes towards automated minibuses

An important finding is that the majority of the potential users interviewed in the AVENUE cities have not yet taken a clear position towards automated minibuses, but tend towards a positive, receptive (goodwill) attitude. Therefore, there is the potential to convince those who are not yet refusing but open-minded, through well-targeted communication campaigns esp. in social media. We defined five target groups (enthusiasts, uncritical goodwill, indifferent, sceptical goodwill and refusers) which do not only differ in their perception on perceived benefits and concerns, but also on their degree of knowledge, preferred transport system, their willingness to use and pay for travelling with automated minibuses, and information sources used to build their attitudes.

A question that was raised in the social media monitoring, is *'if two opposing logics are opposed, should we talk more about such and such points at such and such audience because they seem to interest them or, on the contrary, they are already convinced on this level and we must communicate on other points?'* Based on the different target groups identified, we conclude that both is necessary: increase the interest of the indifferent but also confirm enthusiasts with additional relevant information.

9.3 From high goodwill to regular use?

A risk for the target groups of enthusiasts, uncritical goodwill and sceptical goodwill is that they may be disappointed if they recognize actual performance in terms of speed and flexibility. In order to ensure that the high level of goodwill actually leads to a high level of acceptance of the new systems, it is very important to increase both the speed and the flexibility of use via an on-demand service or at least improved temporal and local flexibility in comparison to the existing public transport offers.

This concern is also shared based on the users interviewed in Copenhagen. They state that, under the condition of an on-demand service, they are willing to 'reduce' the use of their own car. But willingness 'to give up' their own car, does only account for a smaller proportion of the users. It can therefore be assumed that users who currently urgently need a car even in a city like Copenhagen do not see any real alternative in the automated minibuses even they were highly satisfied with the experiences they made during their ride with the automated minibuses.

In addition, the safety drivers also mention that they observe a high level of goodwill for the innovative service. In the opinion of the safety drivers the users are highly satisfied, especially considering subjective aspects such as good atmosphere, not least because of the smaller number of passengers.

Based on their observations safety and accessibility are qualities that are also evaluated as satisfactory. In the viewpoint of the safety drivers the automated minibuses are fulfilling the needs and demands of the users, and contribute to a positive user experience.

However, a high level of goodwill among potential users and a high level of satisfaction among users translates into a high level of willingness to use (again) and experience the new system for several times, the use is currently not deliberately planned, does not result in a regular usage or substitution of privately-owned car. This is especially visible in Copenhagen. Most of the users just used the automated minibus at random, motivated by spontaneous interest and curiosity. In general, users were highly satisfied with their experiences and most of them are willing to use the automated minibus again. However, due to the lack of an acute need for better alternatives, regular users could only be observed very rarely in Nordhavn.

9.4 Experience as key to increase acceptance

Most important factors for the social acceptance are the (perceived) need for improvement of the current situation and whether the proposed alternative service fulfils this need for improvement. Fears towards a lack of safety or security are currently of less importance for the social acceptance.

Real experience in the automated minibus, has a general positive effect on the trust in the system: A comparison of the results of the quantitative survey with potential users and the quantitative survey with users in Nordhavn shows that user experience is an important factor to reduce the perceived concerns and to increase acceptance of the automated minibus. Where potential users perceive risks in the unknowing of how the system reacts to unforeseen situations or how it interacts with motorized or non-motorized road users, users do not perceive these risks. Also, users attach higher advantages to the automated minibuses, than the potential users. Whereas only every second potential user expects that the automated minibuses cause fewer accidents, among the users three out of four expect this advantage to be realistic. Differences are also visible in the economically important factor of safety drivers. Of the potential users, 35% state that the presence of the safety driver is important, whereas this only accounts for 18% of the users.

The interviewed safety drivers expect that their importance will decrease with an increasing number of passengers. This would mean that, depending on the business case and target group of various lines, buses can or cannot be equipped with a safety driver.

As user experience seems to be very convincing and reducing expectations towards any risks the awareness of the test sites and therefore the probability of its use should strongly be increased by communication, esp. using social media.

9.5 Economic considerations

A very interesting insight for the economic analysis is that among potential users only about 18% are willing to pay more, among the interviewed users in Nordhavn this amount is even lower with only 10%. This can be seen as an indication that the automated minibus represents an additional offer, but does not yet represent a real improvement in personal mobility. To increase the willingness to pay or even to pay more for the use of the automated minibus – as mentioned before - esp. temporal and local flexibility of the service has to be improved.

9.6 Further research

The results on the user experience are only based on Nordhavn, Copenhagen. The results show that knowledge and experience may change attitudes, behaviour and acceptance. This in combination with the fact that the other pilot-sites will attract different type of users, under different circumstances, it is of utmost importance to add and compare insights from users from the other AVENUE pilot sites. Therefore, we will restart with the user surveys in Lyon, Luxembourg and Geneva as soon as the restrictions as imposed due to the COVID-19 pandemic are relieved.

Critical factors for social acceptance are speed, the level of local and temporal flexibility and cost. The important insight that flexibility does not mean necessarily on-demand but very short waiting-time and short distances to the (physical and virtual) bus-stops. It is remarkable that temporal flexibility was prioritized over the local flexibility. To provide better insights in the accepted distance and waiting time, the need for a real on-demand service will be questioned in more detail in upcoming surveys.

A second topic that should be studied in more detail in the upcoming surveys is the willingness to pay. A general conclusion is that general potential users and users are not really willing to pay more than for the current transport systems. However, we also found that in the case of an acute need for a solution to an existing mobility gap, and under the condition that the proposed solution will provide very high temporal and local flexibility, citizens state that they are willing to pay a higher price compared to currently used means of transportation. Can quantitative studies confirm that users are willing to pay a higher price compared to currently used means of transportation, under the condition that the automated minibus service is a real improvement in terms of temporal and local flexibility?

Persons with reduced mobility (PRM) are highly dependent on public transport (PT) in all areas of life. The lack of accessibility, even in one component of the entire system, results in hindering the participation to education, social and working life. Neither among the interviewed potential users nor among the interviewed users a relevant number of PRMs could be achieved. Therefore, future surveys have also to focus more detailed on the need and user experience of PRMs. However, to increase the probability that PRMs will use the automated minibuses one major challenge will be that this target group is reached better. To word only a few: the ease of booking the service, finding and identification of the vehicle, the necessary on-board information (e.g. arrival or departure delays) to word only a few.

To conclude, in the final stage of the social impact assessment, we will conduct more studies to validate and enrich the results and insights gained in this second iteration. As soon as restrictions in operation due to the COVID 19 pandemic are relieved, we will start with conducting the user surveys in the AVENUE pilot sites in Lyon, Luxembourg and Geneva, and aim to conduct a second round of the user survey in Copenhagen. Secondly, we will conduct a second round of the survey among potential users in the AVENUE cities. Furthermore, we will include the results of the qualitative, longitudinal study among residents of the pilot sides in the final AVENUE social impact assessment.

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Appendix A: Interview guideline

mobility needs

Leitfaden: Projekt Avenue - Autonome Shuttles

‘What are the citizens’ needs and acceptancy towards the new mobility solutions and services?’

Allgemeine Hinweise und Vorstellung

5 Min.

- Vorstellung des Interviewers
- Aufzeichnung und Datenschutz (MP3 Aufnahme, Datenschutz...)
- Offenes Gespräch, das heißt: es gibt keine falschen Antworten, Gespräch auf Augenhöhe
- Ziel: umfassendes, einführendes Verständnis für die befragte Person
- Kurze Vorstellung des Probanden: aktuelle Lebenssituation, berufstätig, Kinder

Warm-up

5 Min.

- Kommen Sie aus Singen?
 - Was hat Sie nach Singen geführt?
 - Wie lange wohnen Sie in Singen?
 - Wie gefällt Ihnen Singen?
 - Was finden Sie gut/schlecht an Singen?
 -

Aktuelle Mobilitätssituation

15 Min

a) Erkundung des aktuellen Mobilitätsverhalten

→ **explorativ, Befragte/r soll erzählen**

- Was sind typische Wegstrecken, die Sie im Laufe der Woche abfahren?

→ **narrativ, einen Anlass von vorheriger Exploration aufgreifen**

- Denken Sie an das letzte Mal, als Sie zur **[Arbeit]** gefahren sind, wie haben Sie sich fortbewegt bis Sie zur **[Arbeit]** gelangt sind, beginnen Sie bitte ab dem Zeitpunkt, wo Sie ihre Haustür verlassen haben

→ *explorativ*

Welche Fortbewegungsmittel nutzen Sie generell bevorzugt und warum?

Checkliste:

- Werden öffentliche Verkehrsmittel oder private Fahrzeuge genutzt?
Bus, (S-) Bahn, Auto, Fahrrad, zu Fuß, Motorrad, e-Scooter/ Bike
- Wie häufig werden öffentliche Verkehrsmittel genutzt?
- Was sind die typischen Anlässe für die Nutzung von XY?/ Zu welchen Anlässen werden öffentliche Verkehrsmittel genutzt?
Arbeit, Einkaufen, Freunde treffen, Schule, Arztbesuche
- Was spricht für die Nutzung von XY? Was spricht gegen die Nutzung von XY?
Bequemlichkeit, Kosten, Umwelt, Zeitersparnis, Spaß
- Gibt es Verkehrsmittel, die man gerne nutzen möchte, es aber aufgrund der aktuellen Situation nicht möglich ist?

b) _____ Mobilitätslücken _____ und _____ -bedürfnisse _____ in _____ Singen

→ *explorativ, Hauptfortbewegungsmittel aufgreifen*

→ *Genutzte Verkehrsmittel und die, die gerne genutzt werden würden explorieren*

- Wie sind Ihre Erfahrungen mit diesen **Hauptfortbewegungsmittel** in Singen?

Checkliste:

- Wie ist die Zufriedenheit bezüglich der aktuellen Situation?
Was muss geändert werden, sodass eine Zufriedenheit erreicht wird?
→ Lösungsvorschlag erfragen
- Gibt es Probleme? Welche Probleme gibt es?
Unpünktlichkeit, unbequem, häufiges Umsteigen, weiter Fußweg zur Haltestelle, Wartezeiten, unpassende Abfahrtszeiten, Parkplatzsituation, Stau, andere Verkehrsteilnehmer, Straßenführung, Baustellen, fehlende Fahrradwege,
- Wo/Wann treten diese Probleme auf?
Arbeitsweg, Freizeit, Stadtmitte, unter der Woche/Wochenende, Feiertage
→ **Instruktion: Bedürfnisse aufgreifen je nach Situation**
- Wenn man an das Busfahren in Singen denkt, was wäre einem persönlich wichtig?
(→ **Instruktion: nur bei Autofahrer; Proband soll sich Situation „Busfahrt in Singen“ vorstellen**)
- Gibt es Angebote, die im öffentlichen Nahverkehr in Singen vermisst werden? (Carsharing, minibus, e-bike/-Scooter Leihservice)
- Weitere Anmerkungen/Probleme/ Meinungen zu dem Thema „Mobilität in Singen“

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a) Zukunftswünsche/ -vorstellung

→ **Instruktion: explorativ, projektiv, Fokus auf Mobilität**

- „Stellen Sie sich Singen in 5 Jahren vor, wie würde da die Fortbewegung aussehen.“
Art der Mobilität?
Wie würde da die Fortbewegung zur Arbeit/ zum Einkauf aussehen?
Welche Fortbewegungsmittel werden genutzt? Wie sieht der Verkehr aus?
Wie sehen Ihre Wünsche dafür aus? Und was ist realistisch?
- „Wenn man nochmals 15 Jahre weiterdenkt, wie würde man sich Singen vorstellen?“
Wie sehen Ihre Wünsche dafür aus? Und was ist realistisch?

Checkliste:

- Technischer Fortschritt, gesellschaftliche Entwicklung, ökologischer Fortschritt
- Lösungsstrategien für Probleme, die bereits erwähnt wurden
- Unterschied zwischen Wünschen und realistischen Vorstellungen machen

b) Autonomes Fahren

→ **assoziativ, klar differenzieren zwischen PKW und ÖPNV**

- Haben Sie schon einmal von „autonem Fahren“ gehört? Was denken Sie darüber?
- Was fällt Ihnen zu dem Begriff „autonomes Fahren“ ein? Was bedeutet für Sie „autonomes Fahren“?

→ **Instruktion: Falls Fokus auf PKW/ÖPNV: „In welchen anderen Bereichen könnte autonomes Fahren anzutreffen sein?“**

- Haben Sie bereits Erfahrungen mit autonomem Fahren gemacht?
- Autonomes Fahren als Lösung für Mobilitätslücken? Welche Probleme / Mobilitätslücken können beseitigt werden?

Checkliste:

- Erläuterung und Beschreibung von persönlichen Erfahrungen selbst gefahren, gesehen, gehört, gelesen, Filme,
- Definition und persönliches Verständnis des Begriffs
- Informationsquellen der Probanden
- Wahrnehmung
 - Ablehnung (Ängste, Sorgen) → Gründe für diese Wahrnehmung?
 - Zustimmung (Präferenz, Hoffnungen) → Gründe für diese Wahrnehmung?

Überleitung: Filmmaterial zu Autonomen Shuttles

a) Erste Assoziationen

- Was kommt Ihnen beim Betrachten dieses Films als erstes in den Sinn?
- Welche 3 Begriffe fallen Ihnen spontan zu diesem Film ein?

→ **Instruktion: Begriffe explorieren**

b) Nutzungsbereitschaft und Motive für die Nutzung

→ **Instruktion: Skala zeigen, 1 bedeutet „auf keinen Fall“ und 5 bedeutet „auf jeden Fall“**

- Würden Sie so einen Dienst nutzen?
Wie schätzen Sie sich selbst auf dieser Skala ein?

→ **Laddering Methode: einzelne Aspekte/ Motive/ Eigenschaften aufgreifen und erörtern (Notieren der vom Probanden genannten Aspekte für die spätere Erörterung)**

Checkliste:

- Warum genau dieser Wert?
- Was spricht für die Nutzung? Was spricht gegen die Nutzung?
 - Soziale Aspekte: gesellschaftliches miteinander/Umgang/Entwicklung, ethische Einschätzung bei Problemen (Verkehrsunfälle, Einschreiten der KI), Datenschutz, Sicherheit, Vertrauen
 - Wirtschaftliche Aspekte: Arbeitsplatzverlust/-schaffung (Busfahrer), deutsche Automobilindustrie, günstiger, teurer als herkömmliche Verkehrsmittel, schneller, flexibler
 - Umweltaspekte: Lärmschutz/-belästigung, CO2-Ausstoß, erneuerbare Ressourcen, Nutzung fossiler Brennstoffe
- **Laddering Methode: Bedeutung und Wichtigkeit des genannten Aspektes**
→ **Instruktion: Bei 1,2,3 erfragen:**
- Was muss gegeben sein, damit ein Shuttle-Dienst genutzt werden würde?
- Würde man in Zukunft häufiger öffentliche Verkehrsmittel nutzen, falls solch ein Projekt umgesetzt wird?
 - Wenn ja, warum? In welchen Situationen?
Welche anderen Fortbewegungsmittel würden dadurch weniger genutzt?
Wenn nein, warum nicht?
 - Service auf Abruf vs. fester Zeitplan *
 - Linienbasiert vs. Gebietsbezogen *
 - Gedanken zu App als Medium (eigene App vs integriert) *
 - Welchen zusätzlichen Service wünschen Sie sich in einem Minibus?
Unterhaltung, Nachrichten, Getränke und Snacks

c) Autonome Shuttles als Lösung für Mobilitätslücken in Singen

→ **explorativ**

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- Wie würde sich ein solcher Shuttle Service auf [konkretes Problem] auswirken?
- Wie könnte die Nutzung eines solchen Shuttle Services aussehen?
- Also alles in allem, wie könnte das für Sie ideale Konzept für Singen aussehen?

Checkliste:

- Lösungsansätze für persönliche Bedürfnisse
- Wünsche/Bedürfnisse für die Nutzung

Abschluss

5 Min

-
- Offengebliebene Fragen
 - Anmerkungen
 - Bedanken für die Teilnahme

Appendix B: Full Survey representative survey

No.	Question	Sub-question	Source	Included in Lyon
1	Overall, how satisfied are you with your life these days	-	Eurofound, 2016 ¹³	
2	How satisfied are you with each of the following items	Your present standard of living Your accommodation Your family life Your local area as a place to live Traffic situation in and around your city Public transport offer Environmental situation in your city	Eurofound, 2016	
3	How important each of the following items are in your life	Work Family Friends Making new experiences Politics Climate protection Health	European Value Study	
4	Would you consider the area in which you live to be open countryside/ small town/ medium to large town/ a city or suburb		Eurofound, 2016	
5	Please think about the area where you live now – the immediate neighbourhood of your home. Do you have major, moderate or no problems with the following items	Noise Air quality Litter or rubbish Heavy traffic Safety/security Nature/green space Public transport Access to supermarket	Eurofound, 2016	
6	What is your preferred transport system		x	

¹³ European Quality of Life Survey, <https://www.eurofound.europa.eu/surveys/european-quality-of-life-surveys/european-quality-of-life-survey-2016/questionnaire>

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7	Could you indicate what aspects are important in selecting your preferred means of transport?		Wohr, 2016 ¹⁴	
8	How often do you use the following means of transport			
9	Are there differences in your means of transport depending on good or bad weather conditions?			
10	Which means of transport do you mainly use when commuting between: ¹⁵	Your home and the place you work/study Your home and the supermarket Your home and family/friends	Adapted from Wohr, 2016	
11	Regarding one-way transport, how much time do you on average travel between	Your home and the place you work/study Your home and the supermarket Your home and family/friends		
12	Regarding one-way transport, how many km do you travel between:	Your home and the place you work/study Your home and the supermarket Your home and family/friends		
13	In your opinion, what should be improved in public transport?	Information Accessibility, i.e. the can be used by all people Price Safety Speed/travel time Environmental friendliness Mobility on demand Entertainment		
14	Have you ever heard of automated minibuses before participating in this survey?	If yes, source of information	Adapted from Schoettle & Sivak (2014) ¹⁶	

¹⁴ Adapted from: Wöhr, M. (2016). Social Acceptance of Alternative Mobility Systems in Tunis, Tunisia. Exploring Social Acceptance Based on an Innovative Mobility System Called “Minibus”. University of Pforzheim, Pforzheim, Germany.

¹⁵ Adapted from: Wöhr, M. (2016). Social Acceptance of Alternative Mobility Systems in Tunis, Tunisia. Exploring Social Acceptance Based on an Innovative Mobility System Called “Minibus”. University of Pforzheim, Pforzheim, Germany.

¹⁶ Adapted from: Schoettle, B. and Sivak M. (2014). A survey of public opinion about automated and self-driving vehicles in the US, the UK, and Australia. The University of Michigan, Michigan, USA.

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15	Have you ever travelled with an automated minibus?			
16	16. Do you know whether tests with automated minibuses are planned or already taking place in your city?	If yes, source of information	Adapted from Wicki & Bernauer (2018) ¹⁷	
17	Do you think that automated minibuses are going to be an important mode of transportation in the future?		Adapted from Keolis Downer (2018) ¹⁸	
18	How willing are you to use automated minibuses?		Adapted from Wöhr (2016) ¹⁹	
19	Imagine that automated minibuses could be called like a taxi and bring you from door to door to your destination, how willing would you be to reduce the use of your own car?			
20	Imagine that automated minibuses could be called like a taxi and bring you from door to door to your destination, how willing would you be to give-up your own car?			
21	Imagine that your private car could be automated but the car would be much more expensive, would you prefer the cheaper automated minibus, the expensive automated private car or a none automated private car?			

¹⁷ Adapted from: Wicki, M. and T. Bernauer (2018) Public Opinion on Route 12. Interim report on the first survey on the pilot experiment of an automated bus service in Neuhausen am Rheinfall, *ISTP Paper Series*, **3**, Institute of Science, Technology and Policy (ISTP), ETH Zürich, Zürich.

¹⁸ Adapted from: Keolis Downer (2018). Future-driven autonobus pilot project at la Trobe University. Australia.

¹⁹ Adapted from: Wöhr, M. (2016). Social Acceptance of Alternative Mobility Systems in Tunis, Tunisia. Exploring Social Acceptance Based on an Innovative Mobility System Called “Minibus”. University of Pforzheim, Pforzheim, Germany.

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22	How important is it to you that there is a supervisor on board the automated minibus?		Adapted from Amobility (...) ²⁰	
23	In your opinion, is the current technology ready to have automated minibuses on the public road?			
24	How much do you agree with the following statements? Automated minibuses will...	<p>... provide enhanced freedom for people with mobility issues</p> <p>... reduce the negative impact on the environment.</p> <p>... be used for routes that are less popular</p> <p>... be booked on demand in the future</p> <p>cause fewer accidents, as they avoid human errors</p> <p>... be more efficient, as you'd be able to use your time better than in a car, walking or cycling</p> <p>... be pleasant and comfortable</p>	Adapted from Keolis Downer, 2018 ²¹	
25	To what extent do you agree with the following statements? The idea that automated minibuses will be introduced everywhere worries me, because...	<p>... privacy is not protected</p> <p>... jobs get lost</p> <p>... it is not clear who is liable in the event of an accident</p> <p>... it is not clear how automated minibuses interact with motorized road users</p> <p>... it is not clear how automated minibuses interact with non-motorized road users</p> <p>... the software may be hacked or otherwise misused</p> <p>... I have to learn how to use an automated minibus</p> <p>... The systems are not secure</p> <p>... the pleasure of driving gets lost</p> <p>... it is not clear how automated e-buses react in unforeseen situations</p>	Adapted from Keolis Downer, 2018 ²²	

²⁰ Adapted from amobility

²¹ Adapted from: Keolis Downer (2018). Future-driven autonobus pilot project at la Trobe University. Australia.

²² Adapted from: Swiss Federal Institute of Technology Zurich - ETH (2019). User Survey on automated shuttles in Neuhausen am Rheinfall.

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26	You have thought about concerns and benefits of automated minibuses, considering all; what would you be willing to pay to use automated minibuses in general?		Adapted from ETH, 2019 ²³	
27	Do you have any further thoughts on automated minibusses?			

²³ Adapted from Amobility

Appendix B: Representative survey at pilot site level

FULL SURVEY

- Introduction, with selection question to filter out residents of the area
- Language selection
- Data regulation

1. How satisfied are you with each of the following items:²⁴

Please tell us on a scale from 1 to 5, where 1 means very dissatisfied and 5 means very satisfied with the other points on the scale you can grade your answer.

	Very dissatisfied				Very satisfied	
	1	2	3	4	5	
Your local area as a place to live	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Traffic situation in and around your city	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Public transport offer	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Environmental situation in your city	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	

2. How important each of the following items are in your life²⁵

Please tell us on a scale from 1 to 5, where 1 means not important at all and 5 means very important with the other points on the scale you can grade your answer.

	Not important at all				Very important	
	1	2	3	4	5	
Work	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Family / Friends	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Making new experiences	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Politics	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Climate protection	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Health	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	

The following questions concern mobility, public transport and your needs, as well as your preferences towards the different means of transport.

²⁴ European Quality of Life Survey

²⁵ European Value Study

D8.7 Second iteration social impact assessment

3. What is your preferred transport system? One answer only, please.

- Own car
- Motorbike
- Scooter
- Bus
- Train
- Metro
- Tram
- Taxi
- Shared Taxi
- Taxi on demand (Uber, Grab, etc)
- Car-sharing
- Bike, e-bike, e-scooter
- Walking

Could you indicate what aspects are important in selecting your preferred means of transport?

Please rank the following items, with rank 1 as most important and rank 7 as least important (drag&drop).

Interviewer: Please show the different items to the participant.

- Comfort
- Accessibility
- Speed and travel time
- Safety and trust feeling
- Pleasure and joy
- Punctuality
- Price

4. How often do you use the following means of transport? //

	Daily	weekly	monthly	rarely	Never
	1	2	3	4	5
Own car	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Motorbike	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Scooter	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Bus	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Train	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Metro	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tram	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Taxi	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Shared Taxi	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Taxi on demand (Uber, Grab, etc)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Car-sharing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Bike, e-bike, e-scooter	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Walking	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

5. Which means of transport do you mainly use when commuting between....

Multiple answers possible

	...Your home and the place you work/study?	...your home and the supermarket?	...your home and family/friends?
	1	2	3
Own car	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Motorbike	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Scooter	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Bus	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Train	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Metro	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tram	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Taxi	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Shared Taxi	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Taxi on demand (Uber, Grab, etc)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Car-sharing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Bike, e-bike, e-scooter	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Walking	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

6. Regarding one way transport, how much time do you need on average to travel between...?

	...Your home and the place you work/study?	...your home and the supermarket?	...your home and family/friends?
	1	2	3
< 30 min	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
30 min – 1h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
1h – 2h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
> 2h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I don't know	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

7. Regarding one way transport, how many km do you travel between:

Please click on the field to fill in the amount of kilometre for each situation.

- ...your home and the place you work/ study:
- ...your home and the supermarket:
- ...your home and family/friends:

In this part of the survey, we will explicitly ask questions concerning automated minibuses. Automated minibuses are small electrically powered buses for up to 15 people that operate in public transport systems and drive automatically, i.e. without an active driver.

Interviewer: Please show picture to respondent.

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8. Have you ever heard of automated minibuses before participating in this survey?²⁶
- Yes, I have heard of automated minibuses before
 - No, I have not heard of automated minibuses before

Filter: only if question 7 = 1 (yes)

9. What was the source of information? (Multiple answers possible)

- Newspaper
- Radio/tv
- Social Media
- Friends
- Seen on test side
- Word of mouth
- Internet
- Information brochure
- Formal information offered by employer
- Informal information by colleagues
- Other

10. Have you ever travelled with an automated minibus?

- Yes, I have travelled with an automated minibus
- No, I have not travelled with an automated minibus before

Filter: only if question 9 = 1 (yes)

11. Do you think that automated minibuses are going to be an important mode of transportation in the future?²⁷

Click on your answer and fill in the reason

- Yes, why?
- No, why?

Filter: only if question 9 = 2 (no)

12. Even if you haven't had any experiences with the automated minibuses, do you think that automated minibuses are going to be an important mode of transport in the future?

- Yes, why?
- No, why?
-

Filter: only if question 9 = 1 (yes)

²⁶ Adapted from: Schoettle, B. and Sivak M. (2014). A survey of public opinion about automated and self-driving vehicles in the US, the UK, and Australia. The University of Michigan, Michigan, USA.

²⁷ Adapted from: Keolis Downer (2018). Future-driven autonobus pilot project at la Trobe University. Australia.

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13. You have already tested the automated minibuses, how willing are you to use it again?

Please tell us on a scale from 1 to 5, where 1 means not willing at all and 5 means very willing. With the other points on the scale you can grade your answer.

Not willing at all				Very willing
1	2	3	4	5
0	0	0	0	0

Filter: only if 9 = 2 (no)

14. How willing are you to use automated minibuses?²⁸

Please tell us on a scale from 1 to 5, where 1 means not willing at all and 5 means very willing. With the other points on the scale you can grade your answer.

Not willing at all				Very willing
1	2	3	4	5
0	0	0	0	0

15. Imagine that automated minibuses would bridge paths between your home and train station , bus or tram station, how willing would you be to reduce the use of your own car?

Please tell us on a scale from 1 to 5, where 1 means not willing at all and 5 means very willing. With the other points on the scale you can grade your answer.

Not willing at all				Very willing	I don't have a car	I don't know
1	2	3	4	5	6	7
0	0	0	0	0	0	0

16. Imagine that automated minibuses would bridge paths between your home and train station or bus station, how willing would you be to give up your own car?

Please tell us on a scale from 1 to 5, where 1 means not willing at all and 5 means very willing. With the other points on the scale you can grade your answer.

²⁸ Adapted from: Wöhr, M. (2016). Social Acceptance of Alternative Mobility Systems in Tunis, Tunisia. Exploring Social Acceptance Based on an Innovative Mobility System Called "Minibus". University of Pforzheim, Pforzheim, Germany.

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Not willing at all				Very willing	I don't have car	I don't know
1	2	3	4	5	6	7
0	0	0	0	0	0	0

Filter: only if question 14 = 3, 4 or 5

17. Imagine that your private car could be automated but the car would be much more expensive: Would you prefer the cheaper automated minibuses, that bridge paths between your home and train or bus station, the expensive automated private car or a none automated private car?

- Cheaper automated minibuses, that bridge paths between home and train/bus station
- Much more expensive automated private vehicle
- Traditional private car
- I wouldn't use any of these options
- I do not know

Filter: only if question 14 = 3, 4 or 5

18. What would you be willing to pay if the automated minibuses would bridge paths between your home and train station or bus station?

- A lot more than for current, classic public transport
- A bit more than for current, classic public transport
- The equivalent to current, classic public transport
- A bit less than for current, classic public transport
- A lot less than for current, classic public transport
- Nothing

19. Imagine that automated minibuses could be called like a taxi and bring you from door to door to your destination, how willing would you be to reduce the use of your own car?

Please tell us on a scale from 1 to 5, where 1 means not willing at all and 5 means very willing. With the other points on the scale you can grade your answer.

Not willing at all				Very willing	I don't have car	I don't know
1	2	3	4	5	6	7
0	0	0	0	0	0	0

20. Imagine that automated minibuses could be called like a taxi and bring you from door to door to your destination, how willing would you be to give-up your own car?

Please tell us on a scale from 1 to 5, where 1 means not willing at all and 5 means very willing. With the other points on the scale you can grade your answer.

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Not willing at all				Very willing	I don't have a car	I don't know
1	2	3	4	5	6	7
O	o	o	o	o	o	O

Filter: only if question 18 = 3, 4 or 5

21. How would you prefer to order the automated minibus?
One answer only, please.

- Phone Call
- App
- Public Call Station
- Other:

Filter: only if question 18 = 3, 4 or 5

22. Imagine that your private car could be automated but the car would be much more expensive, would you prefer the cheaper automated minibus with on-demand, the expensive automated private car or a none automated private car?

One answer only please

- cheaper automated Minibus (with on demand)
- much more expensive automated private vehicle
- a traditional private car
- I wouldn't use any of these options
- I do not know

Filter: only if question 18 = 3, 4 or 5

23. What would you be willing to pay if the automated minibus with on-demand service? (One answer only, please).

- A lot more than for current, classic public transport
- A bit more than for current, classic public transport
- The equivalent to current, classic public transport
- A bit less than for current, classic public transport
- A lot less than for current, classic public transport
- Nothing

24. How important is it to you that there is a supervisor on board the automated minibus?²⁹

Please tell us on a scale from 1 to 5, where 1 means not important at all and 5 means very important. With the other points on the scale you can grade your answer.

Not important at all				Very important
1	2	3	4	5
O	o	o	o	O

25. How much do you agree with the following statements? Automated minibuses will...³⁰

²⁹ Adapted from amobility

³⁰ Adapted from: Keolis Downer (2018). Future-driven autonobus pilot project at la Trobe University. Australia.

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Please tell us on a scale from 1 to 5, where 1 means fully disagree and 5 means fully agree. With the other points on the scale you can grade your answer.

	Fully disagree				Fully agree	I can not judge
	1	2	3	4	5	
... provide enhanced freedom for people with mobility issues.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
... reduce the negative impact on the environment.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
... reduce congestion	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
... be used for routes that are less popular	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
... be booked on demand in the future	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
... cause fewer accidents, as they avoid human errors	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
... be more efficient, as you'd be able to use your time better than in a car, walking or cycling	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
... be pleasant and comfortable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
... guarantee security due to installed video cameras inside the bus.						

26. To what extent do you agree with the following statements? The idea that automated minibuses will be introduced everywhere worries me, because...³¹

Please tell us on a scale from 1 to 5, where 1 means fully disagree and 5 means fully agree. With the other points on the scale you can grade your answer

	Fully disagree				Fully agree	I can not judge
	1	2	3	4	5	
... privacy is not protected	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
... jobs get lost	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
... it is not clear who is liable in the event of an accident	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
... it is not clear how automated minibuses interact with motorized road users	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
... it is not clear how automated minibuses interact with non-motorized road users	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
... it is not clear how automated e-buses react in unforeseen situations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	

³¹ Adapted from: Swiss Federal Institute of Technology Zurich - ETH (2019). User Survey on automated shuttles in Neuhausen am Rheinfall.

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... the systems are not reliable.	O	o	o	o	O	
...the software may be hacked or otherwise misused.	O	o	o	o	O	
... the systems are not secure.	O	o	o	o	O	
... I would not feel secure in an automated minibus in case of harassment and assault						
... I have to learn how to use an automated minibus.	O	o	o	o	O	
... the pleasure of driving gets lost.	O	o	o	o	O	

Integration of questions from user survey
(for those that have experiences with the automated minibus)

Filter for all following questions: only those Question 7 = 1 (Users) until statistics

27. You said, you have already used an automated minibus before.

How satisfied were you with your ride(s) on the automated minibus?

Please tell us on a scale from 1 to 5, where 1 means not important at all and 5 means very important.
With the other points on the scale you can grade your answer.

Not satisfied at all Very satisfied
o O o o O

28. How often have you used the automated minibus? (One answer only, please)

- 1 to 2 times
- 3 to 5 times
- 6 to 10 times
- 11 times and more

29. Would you promote / encourage the use of the minibus among your friends and family?

- Yes, why:
- No, why:

30. We would also like to know more about your user experience. It would be really helpful for our research project. This would cost an additional 5 minutes.

- Yes, I agree with additional questions to my user experience.
- No, I do not agree with additional questions to my user experience.

Filter: only if Question 29 = yes (for the following block till COVID-19 Questions)

31. For what occasion did you use the automated minibus?

- To go to my place of work
- As part of a leisure trip / ride
- For a business trip
- To show the automated minibus to someone else

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- No specific occasion, just wanted to try the automated minibuss
- Other which?

32. Why did you use the automated minibuss (for this trip)?

Multiple answers possible

- Bad weather
- Was waiting for another bus, but the automated minibuss came earlier
- Out of curiosity
- It is faster than walking
- Spontaneously, no concrete reason
- Had a good experience before, just wanted to try it again
- This is the only public transport system on this route
- Routine, I use the automated minibuss on a regular basis
- It is connected to other means of public transport
- Other which:

33. Did you take any of the following items with you on your last ride with the automated minibuss?

Multiple answers possible.

- No
- Yes, a baby carriage / stroller
- Yes, luggage
- Yes, a shopping trolley
- Yes something else:

34. What were you doing during your last ride with the automated minibuss?

- Surfing the internet with my smartphone
- Was occupied with my smartphone without using internet
- Read book or magazine
- Talked to others
- Looked at surroundings
- Answered this questionnaire
- Other:

35. How satisfied were you with following aspects of your last ride?

Please tell us on a scale from 1 to 5, where 1 means not satisfied at all and 5 means very satisfied.

With the other points on the scale you can grade your answer

	Not satisfied at all				Very satisfied	No answer
	1	2	3	4	5	6
Comfort	0	o	o	o	o	0
Cleanliness	0	o	o	o	o	0

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Security in the bus in case of harassment or assault	O	o	o	o	o	O
Interaction with non-motorized road users	O	o	o	o	o	O
Accessibility, i.e. the bus can be used by all people	O	o	o	o	o	O
Punctuality	O	o	o	o	o	O
Temperature	O	o	o	o	o	O
Reliability	O	o	o	o	o	O
Noise level inside the bus	O	o	o	o	o	O
Atmosphere in the bus	O	o	o	o	o	O
Waiting time	O	o	o	o	o	O
Interaction with motorized road users						
Cybersecurity, protection against hacker						
Speed / travel time	O	O	o	o	o	O
Frequency of automated minibus service	O	O	o	o	o	O
Connection to other transport means	O	O	o	o	o	O
Information on time table	O	O	o	o	o	O
Information at the bus stop	O	O	o	o	o	O
Information in the bus	O	O	o	o	o	O
Information online	O	O	o	o	o	O
Easy access to information to plan my whole journey	O	O	o	o	o	O
Location of stops	O	O	o	o	o	O
Location where the automated minibus operates	O	O	o	o	o	O

36. How did you experience the following? Page 1:

Please tell us on a scale from 1 to 5, where 1 means do not agree at all and 5 means agree completely.

With the other points on the scale you can grade your answer

	Do not agree at all				Agree completely	No opinion
	1	2	3	4	5	6
The automated minibus is easy to recognize	O	O	o	o	o	O
The stop is easy to find	O	O	o	o	o	O
The interior lighting is sufficient	O	O	o	o	o	O
The doors are open long enough to get in and out easily	O	O	o	o	o	O
There are sufficient number of grab handles on the bus	O	O	o	o	o	O

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No difficulties changing to a different bus route / mode of transport	O	O	o	o	o	O
The sensor button for SOS is self-explanatory and easy to use	O	O	o	o	o	O
The stop request button is self-explanatory and easy to use	O	O	o	o	o	O
The ramp request button is self-explanatory and easy to use	O	O	o	o	o	O
Handles on the bus are clearly identifiable	O	O	o	o	o	O
Handles are easily accessible on the bus	O	O	o	o	o	O
The visual and acoustic passenger information are easy to perceive	O	o	o	o	o	O
The visual and acoustic passenger information are easy to understand	O	o	o	o	o	O
The signals and announcements are heard well	O	o	o	o	o	O
The signals and announcements are easy to understand	O	o	o	o	o	O

37. How important is price for you in deciding to use the automated minibus?

Please tell us on a scale from 1 to 5, where 1 means not important at all and 5 means very important. With the other points on the scale, you can grade your answer.
Importance of price:

	Not important at all				Very important	No Answer
	1	2	3	4	5	

38. Did any problem occur during your last ride?

- No, no problem did occur
- Yes a problem occurred

Filter: only if question 36 = Yes

39. Which problem occurred?

- Unplanned stop
- Conflicts with other road members
- Long interruption
- Sudden braking manoeuvre
- Other problem:

40. What describes your feeling / emotions towards automated driving minibuses best?

- Curious

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- Optimistic
- Suspicious
- Anxious
- Other feelings / emotions:

END FILTER

End filter: Pose these questions to all participants

Finally, a few questions regarding COVID-19 and some statistics:

41. Did the COVID-19 pandemic influence your transport behavior?

- No
- Yes, it did, but it has returned to normal
- Yes, it did, and is still altered, but will return to normal soon
- Yes, it did, and is still altered, and will remain altered for a longer time

Filter: If question 39 is yes (2,3,4):

42. What has changed:

- Less public transport
- More public transport

Filter only if Question 9 = 1 (yes, I have used them)

43. How safe do you feel in times of COVID-19 in the automated minibus?

- Safer than in other public transport systems
- Comparable to other public transport systems
- Less safe than in other public transport systems

Statistic questions

Thank you very much for participating in this questionnaire.

Appendix C: Interview guides

longitudinal study

KICK-OFF INTERVIEW

General Introduction

7 Min.

- Introduction into AVENUE European Research Project
- The role of HS Pforzheim
- Methodology: Longitudinal Study
- Data protection declarations
- Rules of the Interview

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- Introduction of interviewer and interviewee: current life situation, job/professional background/ career, age, children, hobbies and interests

Warm-Up: Copenhagen & Lifestyle **10 min.**

A) Copenhagen

- Since when do you live here in Copenhagen?

Checklist:

- Relationship to the city Copenhagen (birth/moved to)
- Benefits or Disadvantages living there
- Favorite spots, activities in Copenhagen

B) Lifestyle

- When you are thinking about your life: what is especially important to you?/
What fulfills you especially in your life?

Checklist:

- Importance of different life terms: work/career, family/friends, making new experience/travel, politics, climate protection, health
- Needs: Freedom, Independence, Responsibility, Peace, Truth, Love, Fairness, realizing self actualization
- Feelings when needs are satisfied
- Definition of pure happiness

Mobility of the respondents **7 Min.**

Instructions: explorative, respondent should talk about his typical mobility

- When you are thinking about your last week: Could you tell me about the routes you have done to come from one place to another?

Instructions: narrativ, take up occasions of previous exploration

- Remember when you drove/went to **[work]**, how did you move until you arrived at **[work]**? Which means of transport do you use for those situations? Please start from the time you left your front door)

Checklist:

- Mobility routes last week – distances, duration
- Usage of means of transport:
Which mode of transport for which routes/ situations? How often each mode of transport?
- Private VS. Public: Does the respondent use more private vehicles or more public transport?
For which situations is public transport more preferred? / For which situation are private vehicles more preferred?

→ Typical/not typical?

Mobility: preferences and attitude **15-20 Min.**

A) General

- Which mode of transport do you prefer to use (as most)?

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- What are the reasons that is the most preferred mode of transport?

Checklist:

- Motives behind using a certain mode of transport?
- What are the benefits of using a certain mode of transport?
What are the disadvantages of using a certain mode of transport?
- Important aspects during mobility: Mobility needs (Time saving, convenience, costs, environment, fun): depends on different scenarios/situations?
- Reason behind the importance: children, work, environmental protection, mobility limitations (reduced mobility)

B) Focus on Copenhagen

Instructions: explorative, respondent should talk about the mobility in Copenhagen

- Could you please describe to me the mobility situation:
 - in the area you are living/next to your home
 - next to working place, school etc. (all areas that are regularly visited)

Checklist:

- Current mobility situation in Copenhagen: availability of public transport, the situation of the road traffic and usage of private vehicles
- Satisfaction with the mobility: once with the public transport and on the other side with the private vehicle/ walking etc.
- Problems while moving from one to another place: what kind of problems, with which mode of transport, any limitations of mobility (Unpunctuality, inconvenience, frequent changes, long walk to the stop, waiting times, inappropriate departure times, parking situation, traffic jams, other road users, road layout, construction sites, lack of bicycle paths)
- Dissatisfaction of the motives
- Mobility gaps: Missing offers and possibilities in public transport?

Introduction – Automated driving

7 Min.

Instruction: associative, distinguish between PKW and public transport

- What comes to your mind when you are hearing the term "automated driving"?

Checklist:

- Knowledge and perception regarding automated driving: first impression
- Personal definition and comprehension of automated driving: Functions behind automated driving
- Personal experiences with automated driving: self driving, user experiences with automated shuttles, articles, documentation
- Feelings and Thoughts: acceptance (preferences, well-being, hopes) or rejection (fears, worries, barriers)
- Reasons for a certain perception/ feeling/ thought (bad experience, influenced by a certain source of information/...)

Transition to automated minibuss – Collage

Automated minibuss

25 Min.

A) General

Instruction: Show collage and ask those questions:

- Have you ever heard of automated minibuss?/ Have you ever used the automated minibuss?

A1) Instruction: Ask questions to respondents with user experience(s) and removing images

- First impression: “What are the first 3 terms coming to your mind spontaneously when you are thinking about your experience with the automated minibuss?”

Instruction: Explore those terms detailed

A2) Instruction: Ask questions to respondents with non user experience.

- Have you ever seen the automated minibuss driving around in Copenhagen?
- First impression: “What are the first 3 terms coming to your mind spontaneously when you are looking at those pictures// thinking about the moment when you have seen it driving around in Copenhagen?”

Instruction: Explore those terms detailed

Instruction: Show scale to EVERYONE, 1 means "no way" and 5 means "definitely"

- How is your willingness to integrate the use of the automated minibuss in your typical mobility?: How do you rate yourself on this scale?

Checklist:

- Knowledge and experience regarding automated minibuss
- For users:
 - Occasions/situations of using the automated Minibus in the past, Frequency
 - Feelings during using the automated Minibus
 - Potential for using the automated Minibus in further occasions/situations
- **For non-users:** Potential occasions/Situations of using the bus
 - Reason for choosing a certain value on the scale
 - For what occasions will the shuttle be used? Substitution of own car, bike, walking? Why?
- What are the arguments for its use? What are the arguments against the use?
 - Social aspects:
 - Safety – trust in AI, traffic accidents, AI intervention
 - Security - data protection, harassments, human component
 - Economic aspects:
 - Indirect consequences: Job loss (bus drivers)/ Job creation (operator/ IT), automotive industry, faster/more flexible → Efficiency
 - Costs: Assessment of price (more expensive/more cheap than conventional means of transport), willingness to pay, requests for a certain price
 - Environmental aspects:
 - What kind of benefits: Noise protection/nuisance, reduction of CO2 emissions, no fossil fuels
 - Importance of the environmental benefit of automated driving for the respondent

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B) Future Perspective:

- When you are thinking about the future: Do you plan to take the bus more often?

Checklist:

- Potential for future usage
- In what kind of mobility situations/occasions? (Mobility in leisure time/ Mobility to work/other Responsibilities)
- Substitution: Willingness to reduce another mode of transport due to the availability of the automated Minibus
- What must be given to integrate more the usage of the automated Minibus in your mobility/ increase the value on the scale?

C) Focus on Copenhagen

- Now that the automated Minibuses operates in Nordhavn: what do you think about the current operations there?
- Could it change your behavior regarding the mobility?
- Would you rather think it is a chance for you / the residents living in Copenhagen or a more barrier?

Checklist:

- Evaluation about the current integration/operation of the automated Minibuses
- (Possible) Changes due to the automated Minibus in mobility/life quality
- Automated Minibus in Copenhagen: future prospects?/ areas of application?/ opportunities and risks (competitive environment)
- Optimization proposals: What needs to be done to increase usage / attract more users in Copenhagen? What should be changed to increase the benefit for the residents (regarding their mobility/life quality)?

Conclusion **max. 5 Min**

- Remaining questions
- Comments to the project/ study etc.
- Thank you for your participation!
- Reminder: receiving mails with questionnaires in the next few weeks & follow-up Interview

EXAMPLE OF WEEKLY SURVEY

(programmed in Unipark/Questback)

General Questions

1. How would you describe your last week? (Single answer)
 - My week was a good combination of work and life
 - I had a few days off and enjoyed my days in Copenhagen
 - I had a few days off and went to another place
 - I had a lot of work to do
 - Other descriptions of my last week:

2. How often have you used the following means of transportation in the last week?

(**Categories:** Everyday on 6 to 4 days on 3 or 2 days on one day never)

Please click on the corresponding category for each mode of transport.

- ☐ Own car
- ☐ Bike
- ☐ Bus
- ☐ National Train
- ☐ Tram/ S-Train
- ☐ Taxi
- ☐ Automated minibus
- ☐ Car-Sharing
- ☐ Bike/ E-Bike
- ☐ Motorbike
- ☐ E-Scooter
- ☐ Walking

(Filter: Question Nr.2: only the means of transport > never)

3. When you think about the used means of transport in the last week: For how long have you used the certain mode of transport **total**?

(**Categories:** >5 hours 2-5 hours 1-2 hours about one hour less then one hour)

Please click on the corresponding category for each mode of transport:

- ☐ Own car
- ☐ Bike
- ☐ Bus
- ☐ National Train
- ☐ Tram/ S-Train
- ☐ Taxi
- ☐ Automated minibus
- ☐ Car-Sharing
- ☐ Bike/ E-Bike
- ☐ Motorbike
- ☐ E-Scooter
- ☐ Walking

(Filter: only the chosen means of transport)

4. For which occasions did you use the certain mode of transport in the last week? (Multiple answer possible)

- ☐ To got to my place of work
- ☐ As part of a leisure trip/ride

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- For a business trip
- To go shopping
- Fun, it is always a pleasure to use this mode of transport
- Other occasions: _____

The following few questions are referring to the automated minibuses, which are operating at the moment in the area Nordhavn in Copenhagen.



5. Have you heard minibuses since the

- Yes, I have minibuses

something about the automated Kick-off Interview?

- No, I haven't heard anything about the automated minibuses since the Kick-off Interview

(Filter: if question nr. 5 = answer Nr. 1 –yes)

6. What was the source of information?

- Newspaper
- Radio/ TV
- Social Media
- Friends
- Seen on test side
- Word of mouth
- Internet
- Information brochure
- Formal information offered by employer
- Informal information by colleagues
- Other: _____

7. Have you seen the automated minibuses driving around in Copenhagen/Nordhavn? (single answer)

- Yes, I have seen them but haven't tried them yet
- Yes, I have seen them and used them already
- No, I have not seen them

(Filter: If Nr. 7 = answer nr. 2 – travel experience)

8. How satisfied were you with your last ride on the automated minibus?

Please tell us on a scale from 1 to 5, where 1 means very dissatisfied and 5 means very satisfied. With the other points on the scale you can grade your answer:

Very dissatisfied

1

2

3

4

5

Very satisfied

(Filter: If Nr. 7 = answer nr. 2 – travel experience)

9. How many times have you used the automated minibus the **last two weeks?** (single answer)

- ☐ 1 to 2 times
- ☐ 3 to 5 times
- ☐ 6 to 10 times
- ☐ 11 or more times
- ☐ I can not remember

(Filter: If Nr. 7 = answer nr. 2 – travel experience)

10. For what occasion did you use the automated minibus the last times? (Multiple answer possible)

- ☐ To go to my place of work or back home
- ☐ As part of a leisure trip/ride
- ☐ For a business trip
- ☐ To go shopping
- ☐ Especially for protecting myself from bad weather (rain/storm etc.) while moving to another place
- ☐ To show the automated minibus to a friend/someone else
- ☐ No specific occasion, just wanted to try the automated minibus
- ☐ No specific occasion, I just like the experience to use an automated vehicle
- ☐ Other occasion: _____

(Filter: If Nr. 7 = answer nr. 2 – travel experience)

11. Does the automated minibus affect your use of other means of transport?

- ☐ Yes, it has affected the use of other means of transport
- ☐ No, it has not affected the use of other means of transport

(Filter: if question nr. 11 = yes)

12. Which mode/means of transport did you substitute when using the automated minibus? Multiple answers possible

- ☐ Own car
- ☐ Bike
- ☐ Bus
- ☐ National Train
- ☐ Tram/ S-Train
- ☐ Taxi
- ☐ Automated Minibus
- ☐ Car-Sharing
- ☐ Bike/ E-Bike
- ☐ Motorbike
- ☐ E-Scooter
- ☐ Walking

(Filter: if question Nr. 7 = answer Nr. 1 – **no** travel experiences)

13. Even that you haven't travelled yet with the automated shuttle services, could you imagine to use such automated minibus?

- ☐ Yes, I can imagine to use them one day
- ☐ No, I can't imagine to use them one day

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(Filter: if question Nr. 7 = answer Nr. 3 – **no** travel experiences, **not** seen)

14. Even that you haven't seen yet the automated minibus, could you imagine to use such automated minibus?

- ☐ Yes, I can imagine to use them one day
- ☐ No, I can't imagine to use them one day

For all (except for question Nr. 13 and Nr. 14 = answer Nr. 2 – **can't imagine**)

15. For what occasion could you generally imagine to use the automated minibus?

- ☐ To go to my place of work or back home
- ☐ As part of a leisure trip/ride
- ☐ For a business trip
- ☐ To go shopping
- ☐ Especially for protecting myself from the bad weather (rain/storm etc.) while moving to another place
- ☐ No specific occasion, just like to try the automated minibus one day
- ☐ Other occasion: _____

For all (except for question Nr. 13 and Nr. 14 = answer Nr. 2 – **can't imagine**)

16. What mode of transport could you generally imagine to substitute with the automated minibus?

- ☐ Own car
- ☐ Bike
- ☐ Bus
- ☐ National Train
- ☐ Tram/ S-Train
- ☐ Taxi
- ☐ Automated Minibus
- ☐ Car-Sharing
- ☐ Bike/ E-Bike
- ☐ Motorbike
- ☐ E-Scooter
- ☐ Walking

(Filter: If Nr. 7 = answer nr. 2 – travel experience)

17. Now that you have tested the automated minibus, how willing are you to use it again?

Please tell us on a scale from 1 to 5, where 1 means unwilling and 5 means willing, with the other points on the scale you can grade your answer.

Not willing at all

1

2

3

4

5

Very willing

(Filter: If Nr. 7 = answer nr. 2 – travel experience)

18. What did you like the most about the automated minibus when you think about your travel experiences with it? (You can answer spontaneously in terms or phrases)

- ☐ _____

(Filter: If Nr. 7 = answer nr. 2 – travel experience)

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19. Is there something you would criticize about the automated minibus, when you think about your travel experiences?

- ☐ Yes
- ☐ No

(Filter: if Question Nr. 19 = yes)

20. What do you criticize about the automated e-minibus? (You can answer spontaneously in terms or phrases)

- ☐ _____

For all:

21. Do you think that automated minibuses are going to be an important mode of transportation in the future?

- ☐ Yes, why? _____
- ☐ No, why? _____

(Filter: If Nr. 7 = answer nr. 2 – travel experience)

22. Would you promote the use of the minibus among your friends and family?

- ☐ Yes
- ☐ No

COMMENTS

Do you have any additional comments to your mobility or any questions regarding the automated Minibus/ the AVENUE project?

If yes, you are welcome to write them down in the following text field:

Thanks for participating in the first questionnaire!

Have a good week and I wish you all the best!

FINAL INTERVIEW

AVENUE – **Automated Minibus**
'Does the operation of the automated minibus influence mobility behavior and the perception on the automated minibus?'

General Introduction

5 Min.

- Welcome and thanks for participating
- Incentive?
- Data protection declarations
 - ☐ Request for audio recording
 - ☐ Use of citations for reporting
- Rules of the Interview
 - ☐ Again: Open Discussion, spontaneous and honest answers, limited English skills
- Short introduction of interviewer

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Warm-Up: Corona - Changes

5 min.

- How is the current situation in Copenhagen with Corona?

Checklist:

- Current Situation Corona
- Corona: developed more or less strict within the last weeks (more measures for restrictions)
- Changes in Life general: different values, priorities, activities
- Feelings due to Corona: restrictions in certain life aspects, which are important to the respondent (like traveling/ going out/ sport activities)
- Changes in mobility due to Corona: switch to other means of transports/more or less transport

Opinion on Survey

5 min.

- How did you experience the study in the last week?

Checklist:

- Opinion on online surveys and total study
 - Preferences: what was good? What did you like?
 - Dislikes during the survey? What and why?
- Opinion on topic “automated Minibus/ vehicles”
 - Interest towards automated vehicles/Minibuses:
 - already interested towards the topic before the study/
 - became interested due the to study/ → Why?
 - still not interested also after the study → Why?
 - Relevant topic for the future in general and for itself? (Imagine having more discussions and higher involvement regarding automated vehicles than before)

Mobility Behavior

15 min.

A) Mobility behavior last six weeks

- How did you experience mobility during the last six weeks? Different or as before?

Instructions: Refer to the mobility behavior analyzed in the Kick-Off interview

- I can remember that you mentioned in the first interview that is an important mode of transport for you - would you still agree?

Checklist:

- Mobility behavior in the last six weeks – any changes:
 - If changes: what kind of changes? more/less public transport, switch to other mode of transport due to some problems

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- Possible reasons or the changes: due to weather condition? (now December, Kick-off Interview in the mid of October)
- **Comparison:** Most preferred mode of transport at the time of the kick-off Interview and at the moment (if change: why?)
- Special changes in times of Corona in the last months
 - Is mobility behavior and preference different to the time before Corona?
 - If yes: what is different?
 - What mobility aspects became more important due to Corona?

B) Mobility behavior in general and analysis of different means of transport

- When you think generally about all your used means of transport in Copenhagen what is your most preferred mode of transport?

Checklist:

- Advantages and reasons for using the most preferred mode of transport
- In general important mobility aspects, needs (especially in Copenhagen?)
- What is fulfilled by the preferred mode of transport? Satisfaction of mobility needs? (Mobility aspects/mobility needs)
- Analysis of other used means of transport:
 - What about... ? Is this mode of transport fulfilling the mobility aspect...?
 - Problems when using other mode of transport; satisfaction of the mobility needs
- Observation of changes in the last times (compared to Kick-Off interview)

*Important aspects during mobility: Mobility needs (Time saving, flexibility, convenience, costs, environment, fun): depends on different scenarios/situations?

Focus: Mobility in Copenhagen

10 min.

- When you think about the mobility situation in Copenhagen: How satisfied are you on a scale from 1 to 10, when 1 means “not satisfied at all” and 10 means “very satisfied”?

Checkliste:

- Satisfaction with the mobility: once with the public transport and on the other side with the private vehicles/ walking etc. – Justification of the value: Why this value?
 - Satisfaction of the mobility needs and important mobility aspects in Copenhagen with the offered and available means of transport
 - Problems while moving from one to another place **in the last times**
 - What kind of problems*
 - With which mode of transport
 - Any limitations of mobility in the last times
- *(Unpunctuality, inconvenience, frequent changes, long walk to the stop, waiting times, inappropriate departure times, parking situation, traffic jams, other road users, road layout, construction sites, lack of bicycle paths)

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- Dissatisfaction of the important motives and mobility needs
- **Any positive/negative changes** in the mobility situation within Copenhagen in the **last 2 months?**

*(f. e.: unpunctuality, inconvenience, frequent changes, long walk to the stop, waiting times, inappropriate departure times, parking situation, traffic jams, other road users, road layout, construction sites, lack of bicycle paths)

Automated Driving

7 Min.

- Can you remember that automated driving has been an issue for you in recent weeks? Have you had some experience or touch points with it?

Instructions: Comparison to the perception of the automated driving in the Kick-Off interview

Checklist:

- Deal with automated driving **in the last time**: read articles/ TV shows/ discussed with friends
 - What kind of information? (source)
 - Opinion towards the information
- Experience in the last time
- Feelings and thoughts: **acceptance** (preferences, well-being, hopes) or **rejection** (fears, worries, barriers)
- Advantages and Disadvantages in implementing automated driving
- In which areas: public transport VS. privat transport
- Comparison to the perception of the Kick-Off Interview: positive/negative change → why?

Automated Minibus

25 Min.

A) Knowledge about automated Minibus

- Besides the online surveys, have you heard/ read or seen something about the automated Minibus in the last weeks?

Checklist:

- Source of information
- What kind of information, topics, discussion points etc.
- Discussion with friends?
- Feelings and opinions regarding the information (relevant, trustworthy, convincing – reasons for the opinion)
- Perception of the automated Minibus based on the information: positive or negative

B) User Experience

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- Have you used the automated Minibus in the last weeks?

A1) Instruction: Ask questions to respondents with user experience(s)

First impression: "What are the first 3 terms coming to your mind spontaneously when you are thinking about your experience with the automated minibus?"

A2) Instruction: Ask questions to respondents with non user experience.

- First impression: "What are the first 3 terms coming to your mind spontaneously when you are looking at those pictures/ thinking about the moment when you have seen it driving around in Copenhagen?"
→ Instruction: Explore those terms detailed

Checkliste:

- **For users:**
 - Experience using the automated Minibus: preferences and criticism
 - Frequency (how many times of using the bus)
 - Occasions/ situations of using the automated Minibus in the past
 - Any problems during the ride?
 - Expectations like reality? (Satisfaction of the expected attributes)
 - Feelings during using the automated Minibus
 - Comparison of the different time of usage (first time of use vs. second time of use)
 - Experience regarding: preferences or criticism?
 - Automated Minibus appearance (easy to recognize, find the stop easily, easy enter and stop, door opening and closing)
 - Inside the bus (comfort: interior of the bus, enough place to sit/stand, enough handles, stop request button, SOS button)
- **For non-users:**
 - Reasons against using it – why not?
 - Imagine to use it
 - Yes: Potential occasions/ Situations of using the bus
 - No: What are the arguments against using it? What has to be given to use it?

C) Future Perspective and Perception of the automated Minibus

Instruction: Show scale - 1 means "no way" and 5 means "definitely"

- How is your willingness to integrate the use of the automated minibus in your typical mobility? How do you rate yourself on this scale?

Checkliste:

- Willingness to use it in future
- In what kind of mobility situations/ occasions the integration of automated Minibus? (Mobility in leisure time/ Mobility to work/ other responsibilities)
- Substitution: Willingness to reduce another mode of transport due to the availability of the automated Minibus? Which one?

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- **Referring to Kick-Off Interview:** change of perception/willingness (more acceptance/more rejection, positive/negative user-experience)
 - If yes, why?
- What are the arguments for its use? What are the arguments against the use?
 - Social aspects:
 - Safety – trust in AI, traffic accidents, AI intervention
 - Security - data protection, harassments, human component
 - Economic aspects:
 - Indirect consequences: Job loss (bus drivers)/ Job creation (operator/ IT), automotive industry, faster/more flexible → Efficiency
 - Costs: Assessment of price (more expensive/more cheap than conventional means of transport), willingness to pay, requests for a certain price
 - Environmental aspects:
 - What kind of benefits: Noise protection/nuisance, reduction of CO2 emissions, no fossil fuels
 - Importance of the environmental benefit of automated driving for the respondent

Automated Minibus Concept & Mobility needs

15 min

- Do you think that the automated Minibus become an important mode of transport in the future? Why?

(In case of big change compared to the Kick-Off Interview: explore this more detailed → what are the reasons?)

Checkliste:

- Role of the automated Minibus in the future (once for the city in general and especially for the respondent)
- Comparison to the evaluation in the kick-off Interview: more rejection/acceptance for the future → why?
- Satisfaction of the mobility needs/important aspects regarding mobility
- What must be given to integrate more the usage of the automated Minibus in your mobility/ increase the value on the scale? When does it offer a benefit/added value for you?

Instruction: (ranking of different aspect***, which are important for the Minibus to integrate it more in the future mobility)
& explore the most important aspects for the automated Minibus more detailed

- Why is this important; how can this be satisfied by the bus (through which attributes)
- Expectations and Requirements of the automated Minibus for the certain aspect
- Obstacles/barriers of the automated Minibus regarding the certain aspect

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- All in all, how could the ideal concept of the automated e-mini-bus look like in Copenhagen? (Optimal for the city and optimal for the participant and his mobility)
 - Location: Where should the automated Minibuses be implemented? Which routes should it take?
 - Usage: more as last mile or as a whole substitution for a often used mode of transport like bus system, bicycle, s-train
 - Importance of on-demand: how could it work? (via application?)
- Importance of local/temporal Flexibility
- Economical: Pricing and ticketing

Conclusion **max. 5 Min**

- Remaining questions
 - Comments or questions to the project/ study etc.
 - Thank you for your participation!
- Incentive?

- High Comfort inside the bus
- High flexibility (local/ temporal → what is more important)
- Order via application
- Accessibility for everyone (f.e. with wheelchair)
- High speed and travel time
- Safety and trust feeling
- Pleasure and joy
- Punctuality and Reliable
- Justified Price
- Environmental friendly (f.e. green electricity)