Autonomous Vehicles to Evolve to a New Urban Experience

DELIVERABLE

D8.8 First report on Social Impact

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1. Introduction

1.1 Background

The AVENUE project aims at full-scale demonstration of urban road transport automation with particular focus on autonomous vehicles in public transportation systems. An important part of this project is the socio-economic and environmental evaluation (WP8)[1]: 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 . The aim of the social impact assessment is to study user experience, user acceptance and potential changes in mobility behavior in the use of public transport systems. The improved service and its benefits for all users will be examined: are the mobility needs of all users met; are users afraid to take a bus shuttle without driver; are there gender, age or disability specificities? Furthermore, we aim to assess what the relevant population (e.g. potential users) in general think, and what attitudes, expectations, fears, obstacles they have regarding autonomous e-minibuses. In this deliverable, we provide an overview of work of period October 2018 - July 2019. The majority of the empirical data collection has yet to be conducted. The first period (iteration) of this task has primarily been used to prepare for the studies to be conducted in 2019-2022. In general, the first year of the AVENUE project has been used to prepare for the deployment of autonomous vehicles in the public transportation system. Therefore, social impact studies will become more relevant in the second, third and fourth year of the project.

1.2 Research aim

In this social impact study, we focus on the (potential) users of the system. Public support is of crucial importance for a successful implementation of the 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. 2018a; Wicki and Bernauer 2018a; 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 2018a).

Other target groups such as governments, public transport operators, manufacturers, are of great importance for a social impact assessment. These target groups are, however, included in a separate work package within the AVENUE project (WP2.3 Stakeholder analysis) and will therefore not be included in this analysis. Both work packages do interact frequently, making sure that results from both analyses will be integrated at a later stage of the project. An overview of the various target groups and stakeholders and their allocation to WPs can be found in appendix I.

For this social impact study, we focus on the social impact of the deployment of autonomous e-minibuses in the four official AVENUE cities, Luxembourg, Copenhagen, Geneva and Lyon. The primary aim is to understand whether the introduction of autonomous e-minibuses in the public transport system will result in a changed mobility behavior, which corresponds to the following research question:

[1] For a complete overview of the work packages, please refer to the AVENUE proposal, which can be found on http://h2020-avenue.eu/

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

To change mobility behavior of residents in the four AVENUE cities by introducing autonomous e-minibuses requires social acceptance of this new technology by the society as well as a positive user experience of this new technology. These two 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 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).

Social acceptability is the acceptance of new technology by society. Following Shackel (2009), it comprises of four elements: Utility (the match between user needs and functionality), usability (ability to utilize functionality in practice) likeability (affective evaluation), and cost (both the financial costs and the social and organizational consequences of buying a product).

The second central concept is user experience. Whereas the term usability refers to the ability of the user to perform certain tasks, user experience takes a broader view; the entire interaction including thoughts, feelings, perceptions that result from the interaction. Albert and Tullis (2013) define three characteristics of 'user experience': 1) A user is involved; 2) the user in interaction with the system and; 3) The user's experience is of interest (Tullis, T. & Albert, A. 2013).

These concepts will be explained in more detail in chapter 2. Dividing into user experience and social acceptance, results in the following 3 sub-research questions:

- What is the user experience of autonomous shuttles in the four AVENUE test cities?
- What is the social acceptance of autonomous public transport systems in the four AVENUE test cities?
- What is the effect of the user experience and social acceptance of autonomous e-minibuses on the mobility behavior in the four AVENUE test cities?

A question that we aim to answer in addition to the three main research questions is:

- What is the accessibility of autonomous public transport systems for people with reduced mobility (PRM)?

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, as will be discussed in the next section.

1.3 Research approach

Autonomous driving is a very popular research and development field; in the last few years, there has been a large amount of pilot projects with autonomous vehicles and autonomous e-minibuses in particular (Bernauer and Wicki 2018; Kaan; Keolis Downer 2018; VINKHUYZEN and CEFKIN 2016; Woehr 2016; Wicki and Bernauer 2018b). These pilot projects also resulted in many valuable studies on the social acceptability of autonomous vehicles. Nevertheless, for the AVENUE project, additional empirical research has to be done to gain valid and reliable data, which are representative and comparable across all test sites. Problems with existing studies are, amongst others:

- Contents are not completely comparable, e.g. awareness and ethics are only included in some of the studies; also a differentiation between safety and security is not made consistently.
- Scales are not comparable, e.g. is an average acceptance of 4.2 (scale 1 to 7) higher or lower than the average of 3.3 (scale 1 to 6)?
- Changes in attitudes and behaviors can only be identified if exactly the same standards or at least approximate measurements are used across all countries and survey dates. Therefore zero

measurement[2] has to follow the same standards as control measurements across the four cities (Davidov et al. 2015).

Nonetheless, desktop research is an important first step to gain an overview of the state of the art. This can be found in chapter 2. Empirical research in this work package includes both qualitative and quantitative research methods. A combination of these two approaches leads to a deep understanding of social impact (see figure 1.1).

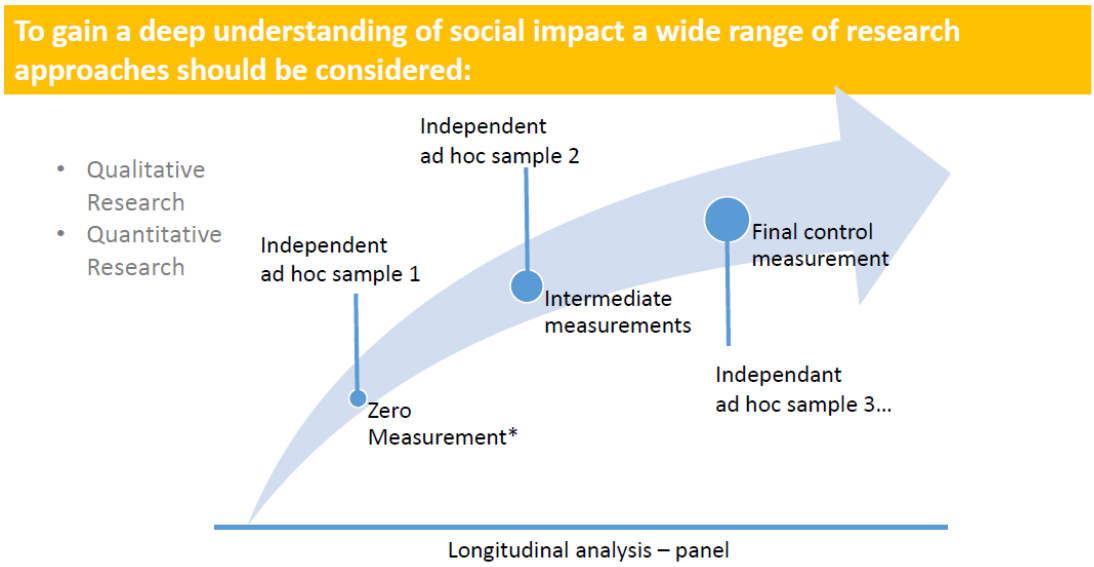

Figure 1.1: The need for method combination

Qualitative research approaches are often used for so-called preliminary studies. The idea is to identify relevant and valid indicators for quantitative main studies (e.g. to identify the most relevant and adequate indicators for social impact). As there already is a large amount of research on social impact and social acceptance of autonomous vehicles, the need for such a preliminary survey was not seen.

However, qualitative research approaches are also well-suited for basic studies that seek for deeper insights to develop explanatory models for phenomena observed in the market. In addition, they can help explain quantitative findings and uncover causes, especially when quantitative data raise questions rather than answering them. An example well known in consumer research on sustainability behavior is the so-called attitude-behavior gap. It might happen that the target groups of the AVENUE project mention positive attitudes towards the autonomous e-minibuses but are not willing to use them personally. Here, deeper qualitative insights to their emotions, motivations and attitudes may help. Therefore, an additional qualitative research part – the so-called qualitative longitudinal survey – is scheduled. In this respect, the qualitative research approaches will enormously expand the potential for deeper knowledge and understanding (translated and adapted from (Naderer 2011)).

Based on these considerations, we have defined four studies that together will answer the main research question: representative survey; user survey; longitudinal survey, ad-hoc qualitative research. A summary of these four studies is provided in table 1.1; each of these studies has a dedicated chapter to it.

Table 1.1: Overview of four empirical studies

2 A zero measurement is a reference measurement prior to the onset of expected changes. Subsequent control measurements or repeat measurements check whether changes actually occurred.

	REPRESENTATIVE SURVEY	USER SURVEY	LONGITUDINAL SURVEY	AD-HOC QUALITATIVE RESEARCH
T8.3 OBJECTIVE	Social acceptance	User experience	Social acceptance	Social acceptance and user experience
TARGET GROUP	Potential users	Users of the autonomous e-minibus	Households – general public	TBD; supervisors in bus (bus-drivers)
METHOD	Quantitative	Quantitative	Qualitative	Qualitative
SAMPLE SIZE	n= 500 per city (we strive for a sample of n=500 in every city)	n = 100 per city	n = 15 households per city	n = depends on research topic
FREQUENCY	At least twice*: ✓ Zero measurement ✓ Control measurement	At least twice*: ✓ Zero measurement ✓ Control measurement	At least twice*: ✓ Zero measurement ✓ Control measurement	At least twice: ✓ Zero measurement ✓ Control measurement
STATUS	Data collection	Awaiting data collection	In preparation	In preparation
CHAPTER IN DELIVERABLE	3	4	5	6

* If intermediate measurements are possible, we will conduct more measurements. However, this is not yet guaranteed due to practical and financial circumstances see also remarks to academic vs. empirical praxis – Table 3.1

1.4 Cooperation and distribution of responsibilities

Studying the social impact of the deployment of autonomous e-minibuses requires insights in the empirical reality in the four AVENUE cities. Therefore, the public transport operators (PTOs) in the four demonstrator cities (i.e. TPG, holo (formerly Amobility), Sales Lentz, Keolis Lyon) are partners in this work package, as they provide access to the demonstrators. For each of the studies, we identified the work division between HS Pforzheim and the PTOs (see table 1.2). Other partners that are involved in this work package are Siemens and the State of Geneva.

Table 1.2: Overview of responsibilities between HS Pforzheim and Public Transport Operators

	HS PF	PUBLIC TRANSPORT OPERATORS
REPRESENTATIVE SURVEY	✓ Develop questionnaire ✓ Provide the software ✓ Programming ✓ Data analysis ✓ Reporting	✓ Data collection e.g. via invitation on websites or in existing panels ✓ Input and feedback to the questionnaire ✓ Translate questionnaire
USER SURVEY	✓ Develop questionnaire ✓ Decide on software/app to be used ✓ Programming ✓ Data analysis	✓ Input and feedback to the questionnaire ✓ Translate questionnaire

	✓ Reporting	✓ Distribute invitations to the survey via post cards / flyers and supervisors
LONGITUDINAL (HOUSEHOLDS)	✓ Define sample structure and provide screener ✓ Develop questionnaires, online diary ✓ Support in data collection ✓ Data analysis ✓ Reporting	✓ Select & contact households, based on criteria for sample structure provided by HS-PF ✓ Translate questionnaire guidelines ✓ Regular contact to households ✓ Data collection: face to face, phone, online
AD HOC QUALITATIVE RESEARCH	✓ Identify issues and questions to study ✓ Develop questionnaire/topic list ✓ Organize interviews / focus groups ✓ Data analysis ✓ Reporting	✓ Suggest issues & questions to be studied ✓ Support with contact details if necessary

1.5 Reading guide

This deliverable provides an overview of the work that has been conducted in the first phase of WP8 and encompasses the period from October 2018 until July 2019. Chapter 2 starts with a literature review on existing studies in autonomous mobility. Hereafter, each of the studies introduced in this chapter will be discussed in more detail in chapters 3, 4, 5 and 6. These chapters follow a similar outline; objectives; methodology, survey preparation, data collection, data analysis; first results (only applicable in chapter 3) to close off with a section on planning and responsibilities. In the final chapter, we will present some conclusions, the planning for the coming period, and the research agenda.

2. State of the art

In this chapter, we will provide an overview of the state of the art in autonomous driving. We will start with an introduction to autonomous driving (section 2.1) explaining different levels of autonomous driving. These different levels influence the various impacts that this innovative technology can have on changed mobility behavior. In section 2.2 an overview on theoretical approaches will be provided.

2.1 Autonomous vehicles

The following taxonomy is used internationally for the degree of vehicle automation:

Level 1: Driver assistance: Human driver with technological assistance, monitoring the driving environment and assisted in a lateral motion.

Level 2: Partial driving automatization: Human driver with technological assistance, monitoring the driving environment and assisted in a longitudinal motion

Level 3: Conditional driving automatization: Automated driving system performs all dynamic tasks of driving (monitoring of the environment and motion control), but the human driver is expected to be available for occasional control of the vehicle.

Level 4: High driving automatization: The automated driving system controls the vehicle within a prescribed operational domain

Level 5: Full driving automatization: The automated driving system can operate the vehicle under all on-road conditions with no design-based restrictions.

In the context of AVENUE, level 4 is aimed for. This means that the autonomous e-minibuses will be monitored at a central location. Currently, all autonomous e-minibuses in operation have a supervisor on board, a requirement by the regulations in the four AVENUE cities.

In the literature, we see a difference between private autonomous vehicles and public (shared) autonomous vehicles. In the AVENUE project, the autonomous e-minibuses used for public transport are central. The general acceptance and social impact hereof is also influenced by autonomous private cars. Therefore, where applicable, this overview will include results from studies into private autonomous vehicles as well as public, shared autonomous vehicles.

A second differentiation we see in existing literature is a difference between theoretical/general studies and reports/studies based on real-life cases and pilot studies. To understand social acceptance and social impact of autonomous driving, both types of studies are relevant, hence, we have included both types of studies in this overview.

2.2 Changed mobility behavior

The modification of mobility behavior and our mobility system through the introduction of autonomous e-minibuses requires social acceptance of this new technology by society as well as a positive user experience of this new technology. These two aspects are interrelated, but should be distinguished, as citizens might be accepting the new technology in general but will not use it due to negative user experiences, or vice versa. Social acceptability is the acceptance of new technology by society.

Changing mobility behavior requires behavioral change. Understanding behavioral change is a well-researched topic; you can find a number of theories in literature that aim to explain this. Examples of such theories are; Theory of Interpersonal Behaviour (Triandis 1997); Theory of Planned behavior (Ajzen 1991); Theories of Social Practices (Mol & Spaargaren, 2006); Stages of Change model, also referred to as the Transtheoretical Model

(Prochaska 1979; Prochaska and DiClemente 1983; Prochaska et al. 1992) . According to the Theory of Interpersonal behavior, the intention to change behavior consists of a citizen´s attitude, social factors, and affect. Habits and routines, as well as contextual factors, also affect the new mobility behavior. Behavioral change is more probable if the change provides benefits that overcome the disadvantages (Triandis 1997).

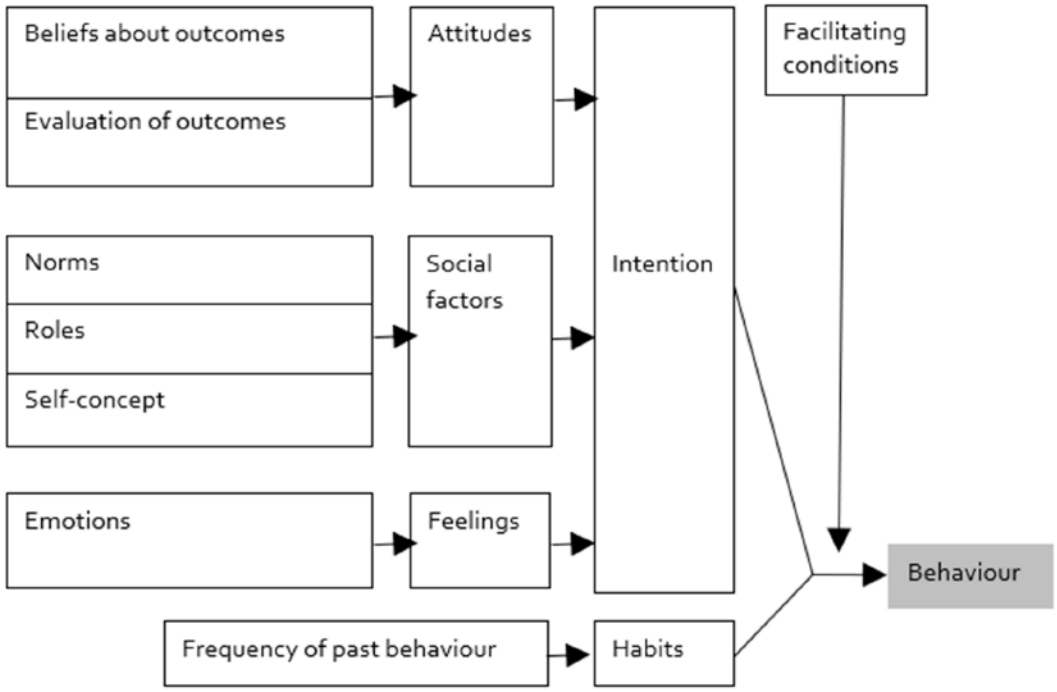

Figure 1. Triandis' (1977) Theory of Interpersonal Behaviour.

Figure 2.1 Theory of Interpersonal behavior (based on (Triandis 1997; Ajzen 1991)

Similar concepts are also central in the theory of planned behavior; behavior depends on intention and is influenced on perceived behavioral control (Ajzen, 1991, see also figure 2.2). The intention is influenced by attitude, subjective norm, and perceived behavioral control. The subjective impression of the extent to which one's own behavior works has a considerable influence on whether expressed intentions are actually translated into action. This is expressed in the so-called attitude-behavior gap.

A major difference between these two theories is that the one by Triandis (1997) adds habits and facilitating conditions as direct influencing factors.

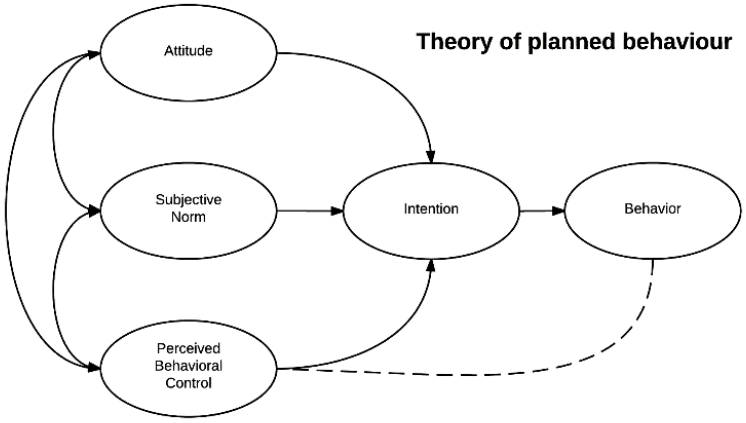

Figure 2.2: Theory of Planned behavior (based on Ajzen, 1991)

A different approach is taken in the theory of social practices (Mol et al. 2010). Central in this (sociological) theoretical approach is the idea that practices (i.e. behavior that people execute) are the result of the interplay

between structural assets of the system of provision and the individual agency of the actors (summarized as the 'lifestyles' of the actors). In this, Spaargaren takes the duality of structure, as coined by Giddens (Giddens 1991b, 1991a, 1997, 2013) as central theoretical paradigm. Structural assets such as the infrastructure and available transportation means influence decisions on mobility behavior (or 'travel' in figure 2.3). However, even though citizens might have the same options, their social practices differ. This is due to individual lifestyle choices. Hence, the understanding of mobility behavior and opportunities to alter mobility behavior depends on both individual lifestyles, attitudes, social factors, habits (Triandis 1997; Ajzen 1991) as well as structural systems of provision (Ajzen 1991; Mol et al. 2010)

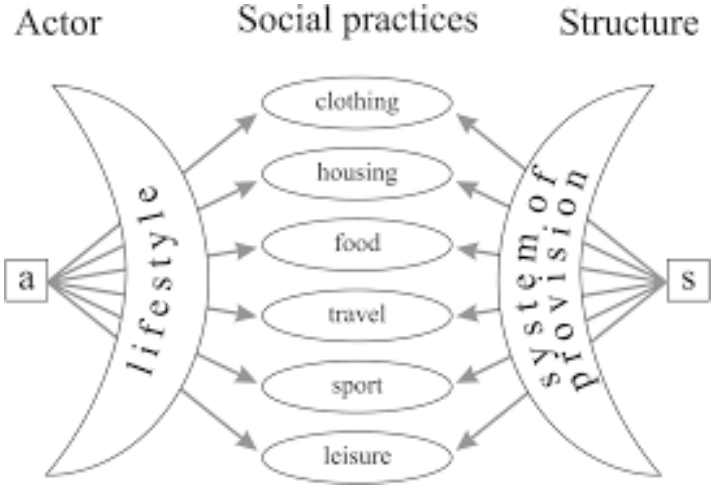

Figure 2.3: Social practices (Mol et al. 2010)

In this deliverable, we will not further discuss the theoretical frameworks and implications for behavioral mobility change. However, it does help to distinguish the main topics for this overview on social impact of autonomous driving. The main concepts that we will zoom into are: attitudes, social factors, intention and structural assets.

Several studies investigated the social acceptance of autonomous e-minibuses and in this respect also included attitudes towards cars. A study by Salonen & Haaviso (Salonen and Haavisto 2019) reveals that cars are necessary in society, and are used in those cases where public transport cannot fill people's mobility needs. Similar attitudes are also found in Boston, where families claim not to have a good mobility alternative to using their private car (World Economic Forum 2018). E-hailing fills a gap between public transport and personal mobility. Therefore, attitudes towards and adoption potential differ between neighborhoods and spatial geography (World Economic Forum 2018; van Acker et al. 2010). This gap between attitude and behavior could be explained by a lack of felt behavioral control (Ajzen 1991).

In addition to fulfilling mobility needs, owning and driving a car portrays a symbolic value, influencing the self-concept of a person. Immaterial motives to drive and own a car are increasing, and cars are used to express one's social position (Dittmar, 2011). Furthermore, a study from the World Economic Forum (2018) on autonomous and urban mobility in Boston concludes that driving manually is the most enjoyable mode and fully automated driving will be the least enjoyable.

Symbolic values and hedonistic aspects may fall away with the autonomous e-minibuses. The autonomous e-minibuses may have an exclusively instrumental value for the passengers or are only used for transport. Salonen & Haavisto therefore conclude that an optimal route network of autonomous e-minibuses that best meets the functional needs is a crucial factor for the success of autonomous e-minibuses (Salonen and Haavisto 2019).

In general, most studies into the attitudes on autonomous driving report positive views (Salonen and Haavisto 2019; World Economic Forum 2018; Kilian-Yasin et al. 2016; Nordhoff et al. 2018b). Elements that constitute this positive view are the expected amount and severity of accidents, time, traffic congestion, 'not having to look for a parking spot'. These positive attitudes are both apparent in general studies as well as in evaluations of pilot projects. Users of the Digibus, an autonomous e-minibus in Austria, report on three main positive

aspects: comfortable and safe driving experience, a simple way of user interaction, and a good maturity of the technology (Cornelia Zankl and Karl Rehrl). However, there is a high level (89%) of skepticism at fully automated vehicles (level 5) and a low interest of owning and paying for self-driving technology (World Economic Forum 2018).

Important attitudes regarding autonomous driving are concerns people have with the technology. Men seem less worried about fully automated driving than women; and primary concerns deal with misuse of the technology, data privacy and safety and security concerns (World Economic Forum 2018). A pilot project in Sion (Switzerland) revealed that people worry about the communication of the autonomous e-minibus with other road users; a concern that could be diminished with adapting the design of the autonomous e-minibus by adding larger signaling indicators, sounds or an electronic display mounted on the AV.

3. Representative survey

Studying user acceptance of autonomous e-minibuses requires insights into the mobility behavior of potential users. For the social impact assessment, we have therefore designed the 'representative survey'. This is a survey on mobility behavior in general and views on autonomous e-minibuses as public transport options in particular. In this first phase of the social impact assessment, we primarily focused on developing the survey and organizing the data collection campaign. So far, we have started data collection in three of the four AVENUE cities, Geneva, Lyon and Luxembourg. Data collection in Copenhagen is organized and will start soon after publication of this deliverable.

In the AVENUE project, there were some challenges the research team has to deal with. A first constraint is the financial structure of the AVENUE program; no financial resources are dedicated to support fieldwork. This does not only influence possibilities for researchers to visit 'the field', but has also implications for the range and structure of the representative survey. This is a point we will touch upon later on as well and which has tremendously influenced the data collection campaign.

A second challenge is the discrepancy between theory and practice. As a program aiming at demonstrating a new technology, AVENUE has a practical focus, with practice-oriented partners. This means that the goal is not to increase theoretical knowledge per se, but to develop practice-based knowledge that can be applied to improve business and to maximize business goals (also see table 3.1 for an overview). For this research component, it means a tightrope walk between theoretical claim and practicability. Consequently, we will not be able to meet all scientific theoretical claims, such as size of samples, representativeness of the sample structure.

Table 3.1 Differences between academic and practical/empirical research (Kleining 2011) (translated by authors)

RESEARCH PARADIGMS	ACADEMIC PARADIGM 'THEORY'	EMPIRICAL PARADIGM 'PRAXIS'
INSTITUTIONS	Academic teaching and research, psychology, social sciences, text and media sciences, academic research institutes	Private research institutes, research departments of advertising agencies, companies
GOALS	Methodologies and theories for knowledge development	Maximizing company goals
ADDITIONAL INTEREST OF RESEARCH PROFESSIONALS	Academic career, status through academic publications	Commercial interests, achievements in management, marketing and advertising
MAIN RESEARCH STYLE	Theoretical research	Applied research
REVIEWS	Academic colleagues, publications	Success of institute
PUBLICATIONS	Internal publication, grey literature, public scientific publications "Publish or perish"	Control by client based on political and competition. Large institutes have an interest in representation,

		public relations.
METHODS	Academically accepted, scientifically legitimized though publications	Applied oriented criteria; costs, availability, time
TRAINING	Scientific publications, workshops, conferences	Professional publications, workshops, conferences
ETHICS	General standards, public discussions on value	Professional criteria and codes, translation of laws and regulations.
CONTROL	Willingness of public clients/societies to sponsor research using own regulations and requirements	Willingness of private clients to sponsor research using own regulations and requirements.

3.1 Objectives

The objectives for the representative survey are to gain insights into the individual needs and life styles, mobility behavior, social and psychological well-being, experienced life-quality at test site, and perception and attractiveness of the concepts.

3.2 Methodology

Representative surveys can be conducted via telephone, online or using paper questionnaires. All three methods have pros and cons. As there is no budget available for fieldwork via CATI (computer assisted telephone interviews) or face-to-face interviews, the surveys will be conducted online. With one exception: in Lyon it was possible to integrate a small excerpt of the most important questions into a regular "barometer" (representative telephone survey).

For cost reasons, it is also not possible to draw a representative online sample - for example from an online panel. The invitation to the survey is made via Facebook, and alternatively it can be included in the web pages from the public transport operators in AVENUE. The representativeness of the sample thus obtained is reviewed retrospectively by comparing the sample structure with the population structure (Ramsey and Hewitt 2005). If necessary, weightings are made.

For this study, the total parent population are the four AVENUE cities. As we are interested in the population at large, the sample should represent a larger area than the direct surroundings of the pilot site. The geographical limit is within a radius of 30 to 50 kilometers (which will be checked via postcode areas, additional question). To ensure a high degree of reliability of the results, we aim for 500 respondents per city.

3.3 Survey preparation

For the development of the survey, we decided to use questions from existing surveys, where possible. Based on the literature review (see also chapter 2), we distilled a repository of questions used in previous questionnaires on autonomous driving. The questions were grouped according to our main parameters and indicators. When necessary, new questions were designed to fill in gaps in existing questions. After this first draft version of the questionnaire, we allowed all partners to provide feedback. A copy of the final questionnaire is added as Appendix III which does indicates the source of the questions.

The original English questionnaire was translated into French, German and Danish. This is an important step, as the four language versions should be compatible and consistent. In Copenhagen, respondents are able to choose between Danish (default language) and English. In Luxembourg and Geneva, respondents are able to choose between French (default language), German or English. In Lyon, the survey was only available in French.
The questionnaire was hereafter programmed using Questback/Unipark and pre-tested. As a preliminary check, some test participants were asked to complete the questionnaire. They were asked about understanding issues or missing answer options. They should also give their impression of the layout. Finally, they should document the time needed.

3.4 Data collection

As discussed in section 3.3, we had some constraints in creating the sample and data collection for the representative sample. This has resulted in different approaches in each of the four cities. Generally, we could say that random sampling was only partly (according to current state, only in Lyon) realizable because of budget restrictions. Table 3.1 provides an overview of the representativeness of the samples in each of the four cities. As these cities differ the number of citizens (the so-called parent population), they require different samples sizes to be representative. Representativeness will be checked via comparison between structure in the parent population and the structure of the net samples.

Table 3.2: overview of sample size

	Lyon		**Copenhagen**		**Geneva**		**Luxembourg**	
	Raw sample*	Adjusted sample	Raw sample	Adjusted sample	Raw sample	Adjusted sample	Raw sample	Adjusted sample
Population	654	654						
Female	347	347 (53%)						
Male	307	307 (47%)						
Age distribution								
5-14	0	0						
15-17	21	27 (4,2%)						
18-24	99	97 (14,9%)						
25-34	110	120 (18,3%)						
35-49	147	154 (23,6%)						
50-64	136	129 (19,7%)						
65-74	74	62 (9,4%)						
75 and elder	67	65 (9,9%)						

*Unweighted data (brut)

Copenhagen

In Copenhagen, the survey will be distributed through media-channels of holo (formerly Amobility) (their website, flyers, etc.) This sample will not be representative for the whole city but yield results on the suburb of Norhavn. In this respect, it is a self-recruitment that only partially guarantees the representativeness of the sample.

Lyon

Keolis regularly conducts a quantitative telephone survey (CATI) with the agency Enov Research – the so-called “Barometre Usages et Profils”. This survey focusses on means of transport and mobility behavior in the urban area of Lyon.

Keolis allowed the AVENUA team to include a specific set of questions in the barometer of 2019: “Barometre Usages et Profils 2019 – Questionaire de l’enquete”. The additional questions focus mainly on awareness, use and acceptance of the new service of electric e-minibuses. The barometer was conducted in May-June 2019. A total of 645 interviews were realized (first results are shown in chapter 3.6).

Luxembourg

In Luxembourg, the representative survey is distributed using the media channels of Sales Lentz. The survey is online. In this respect, this is a self-recruitment that only partially guarantees the representativeness of the sample. Further distribution options, for example via the city's official website, are currently being examined.

Geneva

In Geneva, the survey will be distributed through media channels as Facebook. In this respect, it is a self-recruitment that only partially guarantees the representativeness of the sample.

3.5 Data analysis

The evaluation of the quantitative data is done with the statistics tool SPSS. The data are initially evaluated descriptively (frequencies, positional dimensions, and crosstabs). Significance tests and further structure-discovering and structure-testing procedures are used for specific questions or to test specific hypotheses.

3.6 First results

So far, the only results that are available are the first results from Lyon. Specific questions from the representative survey were included on the barometer addressing transportation questions in the city, and it was conducted by Keolis and Enov research. We will present some preliminary findings here. Full analysis will be conducted in the next phase and will be presented in Deliverable 8.7 second iteration Social Impact Assessment.

The survey in Lyon comprised a total of 654 participants, with a proportion of 47% men and 53% women, taking into account all age groups (see also table 3.2). Some first findings:

- 55% of respondents stated that they knew about the autonomous shuttles before participating in the survey;
- Newspapers, radio/television and the internet are the main sources of information (72%) through which they became aware about the autonomous shuttles;
- 9.5% stated that they have already travelled in an autonomous shuttle;
- 74% think that autonomous shuttles will be an important mode of transport in the future. This coincides with results from the studies mentioned above addressing positive views and attitudes about autonomous driving (Salonen and Haavisto 2019; World Economic Forum 2018; Kilian-Yasin et al. 2016; Nordhoff et al. 2018b)
- The graph below (Figure 3.1) illustrates the level of awareness about existing or planned experiments with autonomous shuttles in Lyon area. Hence, 44.2% stated to be aware of the Lyon experiments;

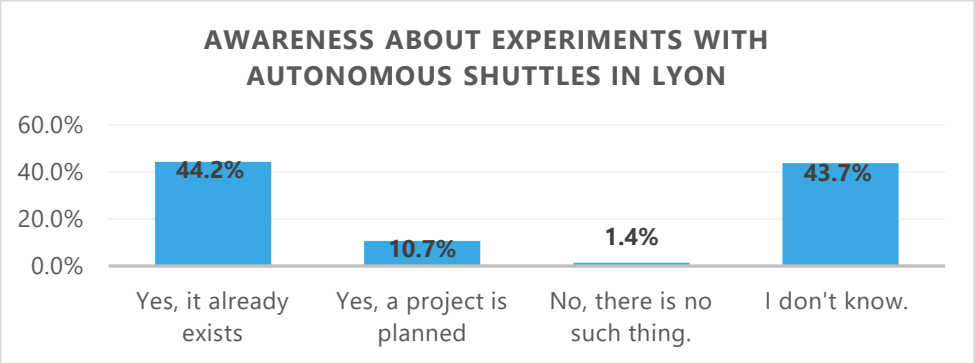

Figure 3.1: Level of awareness about the current experiments with autonomous shuttles in Lyon

- When asked about the willingness to use the autonomous shuttles, 43% of the participants declared be "not willing at all" or "not willing" to use the autonomous shuttles, 31% declared to be "willing" or "very willing"; 22% stated a neutral positioning. 4% of the participants had no opinion at all. Hence, the final willingness to use the autonomous shuttles is distributed according to different willingness levels and points a potential polarization of opinion (figure 3.2).
  In addition, the behavioural change is more probable if the advantages to use the autonomous shuttles are strongly dominating, as addressed previously according to Triandis model (1997);

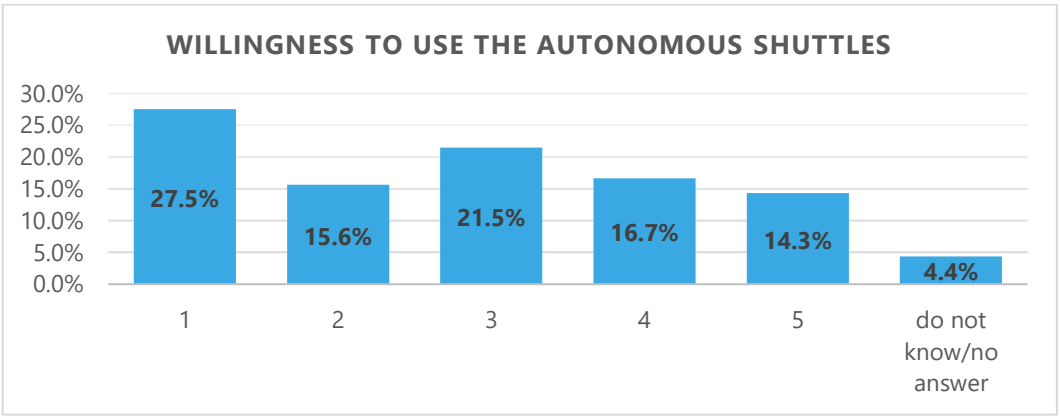

Figure 3.2: Willingness to use the autonomous shuttles as transport means, 5-point scale, 1 means not willing at all, 5 means absolutely willing

- Regarding the participants' motivation to reduce the use of their personal car, 56% have pointed out to be "motivated" or "highly motivated". However, it is worth to analyse such statements from the perspective of Fishbein and Ajzen (1991) theoretical models, in the sense that it cannot be expected that the attitude of reducing the use car will totally fit to the real behaviour.

  Other variables may influence this reduction or mobility shift, for instance behaviour control, service affordability, as well as how far the mobility service will correspond to the needs of potential users (figure 3.3);

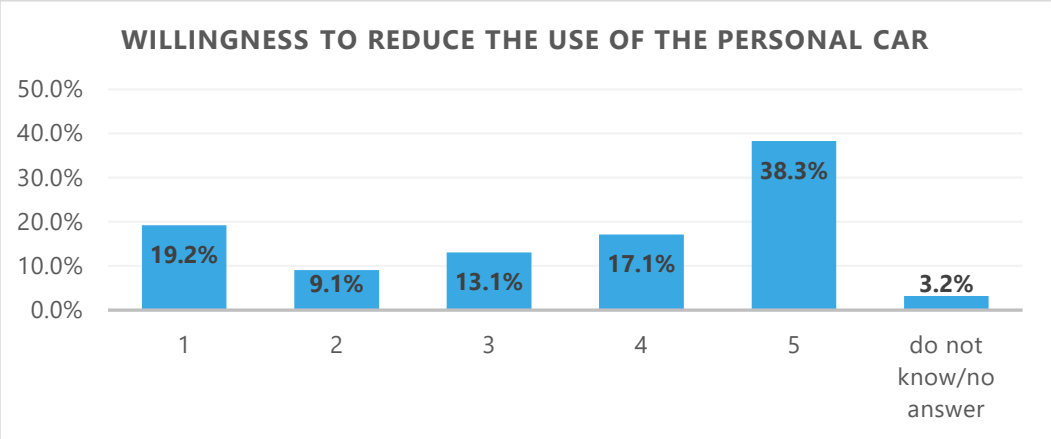

Figure 3.3: Willingness to reduce the use of the private cars considering the deployment of autonomous shuttles, 5-point scale, 1 means not willing at all, 5 means absolutely willing

- When asked about the willingness to pay to use autonomous vehicles, 18% affirmed to be willing to pay a superior price in comparison to the current price of public transport, 46% affirmed to be willing to pay the same amount of public transport; and 36% stated to be willing only to pay less than for public transport or nothing at all.

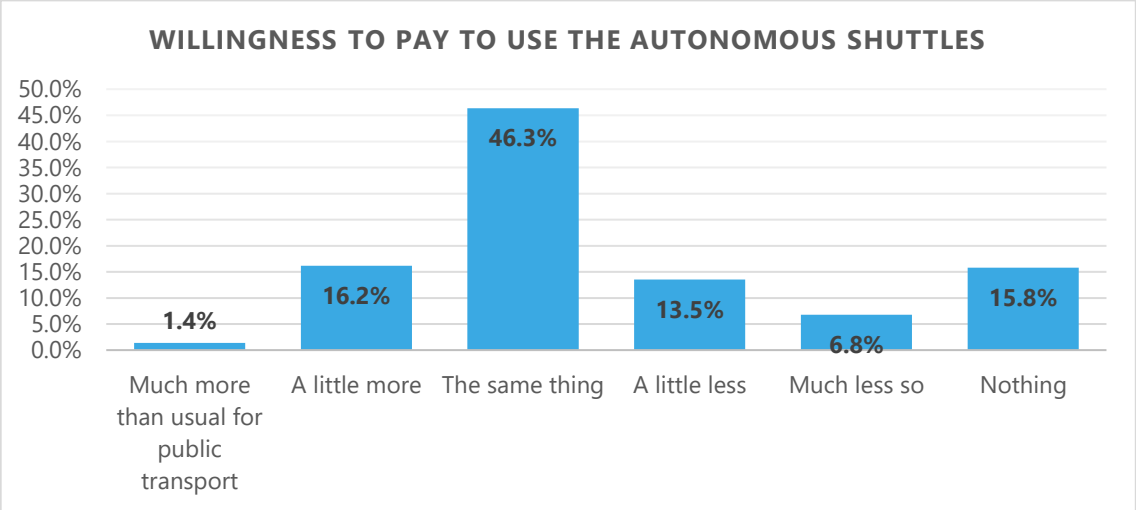

Figure 3.4: Willingness to pay to use the autonomous shuttles in Lyon

Figure 3.5 illustrates the perceptions about potential benefits concerning the deployment of autonomous shuttles.

From the raised points, the most attracting advantages by deploying autonomous shuttles are a higher flexibility (provide more opportunities, a higher level of freedom of choice), reduced environmental impacts and the hope that such shuttles could be booked on demand in the future.

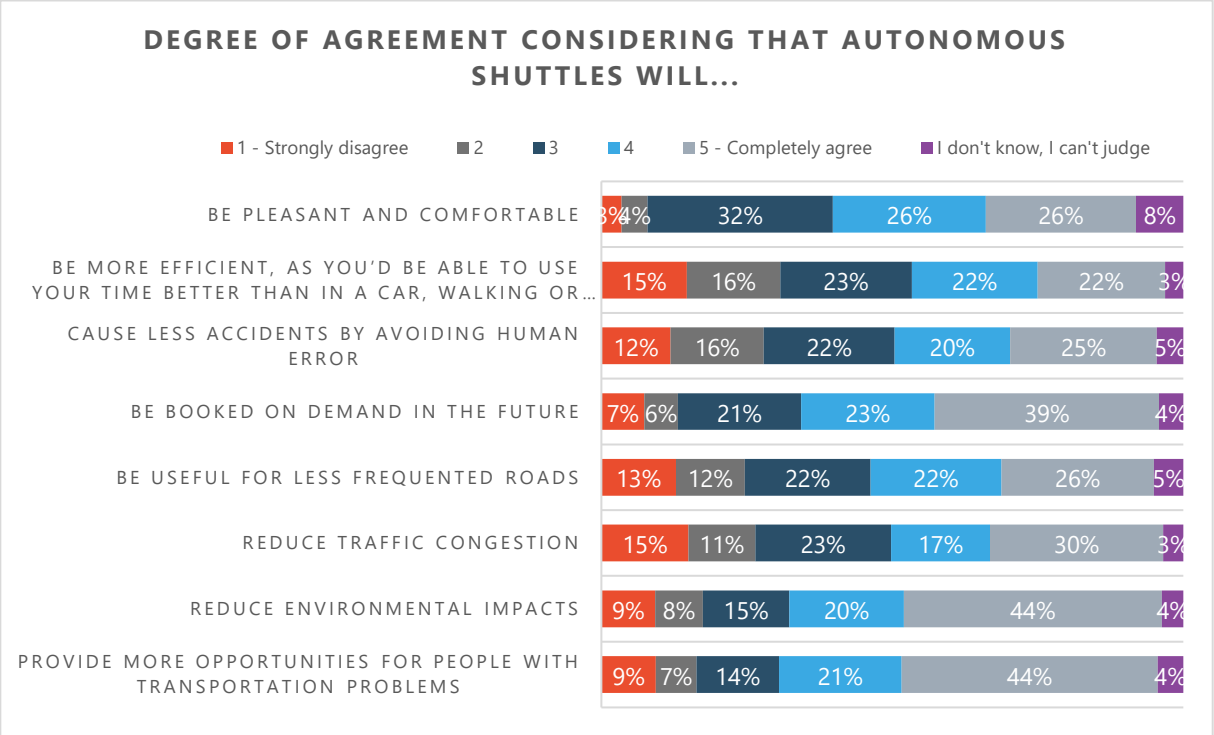

Figure 3.5: Potential benefits concerning the deployment of autonomous shuttles

❖ Figure 3.6 illustrates the perceptions about potential concerns by deploying autonomous shuttles. From the mentioned points, the most significant concerns involve the liability of the autonomous shuttles in case of an accident; loss of jobs; uncertainties about how autonomous vehicles interact with traditional vehicles and non-motorized vehicle on the road; and the risk of program hacking. Nonetheless, data privacy does not seem to be a main concern.

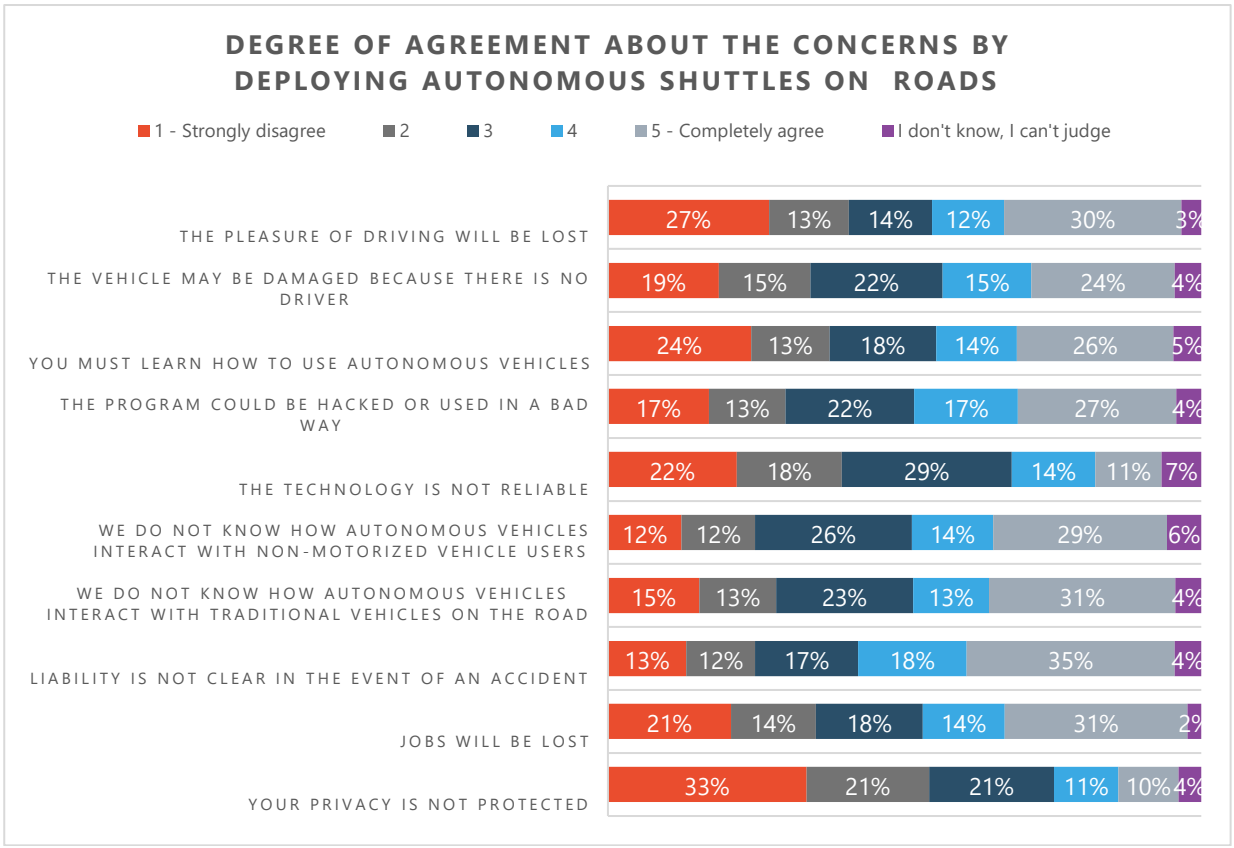

Figure 3.6: Potential concerns considering the deployment of autonomous shuttles

3.7 Planning and responsibilities

A crucial activity in the remaining part of 2019 is the distribution of the online survey. The responsibility of this distribution is in hands of the TPOs: holo (formerly Amobility), Sales Lentz, and TPG. All three partners have confirmed their willingness to distribute the survey, among their clients and networks. We are therefore confident that the surveys will be distributed, and that data analysis can start in 2019. HS PF is responsible for the analysis of the survey results and will report on these in a subsequent deliverable (Deliverable 8.7_Second iteration Social Impact Assessment).

A second activity is the final measurement of the representative survey. The planning hereof can be found in chapter 7 of this deliverable.

4. User Survey

To gain insights into the experiences of people that use the autonomous e-minibuses and to examine the usability of the new services, a well-recognized instrument is a user survey (see also chapter 2). In a user survey, people reflect on their experience in the shuttle and evaluate their usability. At this stage, we have been primarily concerned with the development of the survey, but have not yet started data collection, as the shuttles are not in operation in all four cities yet. However, the surveys are ready, and data collection can start as soon as the service is available everywhere.

This user survey especially focusses on the aim to study the user experience and the user acceptance as well as the potential changes in mobility behavior in the use of public transport systems based on this user experience. Thus, the influence of the user experience and the usability on the acceptance of the new transport systems as well as on the willingness to change mobility behavior can be understood and explained (see chapters 1.1 and 1.2).

4.1 Objectives

The goal of the user survey is to understand;

- Information behaviour, used references
- experience and satisfaction with the autonomous e-minibuses
- frequency of use, motivation for use, occasions for use
- perception and evaluation of the transport service regarding relevant features
- willingness to use in the future, willingness to recommend
- demographic data

4.2 Methodology: Online Survey

To fully meet the needs of users of the autonomous e-minibuses, it is necessary to understand their needs and experiences. Therefore, users shall be asked regarding their motivation for using the buses and to what extent the expectations are fulfilled in order to understand whether and why they may be willing to use the autonomous e-minibuses again or even to recommend them to others.

As the service will be improved during the project, it is important to understand which improvements can be expected to support attractiveness and acceptance of the e-minibuses. Therefore, a zero measurement at the beginning of the test phases is scheduled, plus at least one control measurement after a period of about one to two years to prove potential changes in attractiveness and acceptance. Control measurements will be conducted after significant improvements have been realized.

With the survey, the experiences with the autonomous e-minibuses as well as their evaluation from the point of view of the users should be recorded. The questionnaire covers points such as comfort, security in and out of the bus, punctuality, frequency of the autonomous e-minibus service, atmosphere in the bus, acceptance, willingness to use and to pay in the future, and others (see Appendix IV).

4.3 Survey preparation

For the development of the user survey, we followed a similar procedure as in the development of the representative survey. Hence, we started with collecting questions and topics from existing surveys (such as (Cornelia Zankl and Karl Rehrl) as we decided to use questions from existing surveys where possible. Based on the literature review (see also chapter 2), we distilled a repository of questions used in previous questionnaires

on autonomous driving. The questions were grouped according to our main parameters and indicators. Wherever necessary, new questions were designed to fill in gaps in existing questions. After this first draft version of the questionnaire, we allowed all partners to provide feedback. A copy of the final questionnaire is added as Appendix III which also indicates the source of the questions.
The original English questionnaire was translated into French, German and Danish. This is an important step, as the four language versions should be compatible and consistent. In Copenhagen, respondents were able to choose between Danish (default language) and English. In Luxembourg and Geneva, respondents were able to choose between French (default language), German or English. In Lyon, the survey was only available in French. The questionnaire was hereafter programmed using Questback/Unipark, and has been pre-tested. As a preliminary check, some test participants were asked to complete the questionnaire. They were asked about understanding issues or missing answer options. They should also give their impression of the layout. Finally, they should document the time needed.

4.4 Data collection

The user survey will be conducted online. During their ride passengers will receive a leaflet with brief information and with a link to the online survey. As the questionnaire can also be fulfilled via mobile devices passengers can choose whether they want to fulfil the questionnaire during their ride or later on after their ride. The link to the user survey will be distributed in a time-period of about four weeks, with the aim to have at least 200 interviews per test site.
The exact time frames are not yet fixed for the four cities, this depends on the schedules of the test sites.
The e-minibuses start at different times in the cities participating in the Avenue project. Accordingly, the survey periods will vary between the different cities. Currently the field time for the first wave is planned as follows:

- *Copenhagen in winter 2019*
- *Geneva in autumn 2019*
- *Luxembourg in calendar week 44, 2019*
- *Lyon latest in autumn 2019*

4.5 Data analysis

The evaluation of the quantitative data is done with the statistics tool SPSS. The data are initially evaluated descriptively (frequencies, positional dimensions, and crosstabs). Significance tests and further structure-discovering and structure-testing procedures are used for specific questions or to test specific hypotheses.

4.6 Planning and responsibilities

The current status of the user survey is that the survey is prepared, translated and all partners have been given the opportunity to provide feedback. The next step is to distribute the user survey among the users of the autonomous e-minibuses. The aim is to start with distributing the user survey in September/October, latest in winter 2019 (Copenhagen), in all four pilot project sites.
All partners are involved in this task. HS PF is responsible for the development of the questionnaire, the programming of the questionnaire, data analysis and reporting. The PTOs are responsible for providing feedback on a draft version of the survey, for translation of the survey, and for the distribution of the invitations (through the operators in the autonomous e-minibuses).

5. Longitudinal Qualitative Survey

AVENUE aims to show the possibilities for a new mobility system. A key research question is how individual lives will be changed by the AVENUE outcomes. Understanding and demonstrating these (possible) changes requires in-depth insights. To gather these in-depth insights, we focus on qualitative research methods[3]. In addition to selecting a qualitative research approach, understanding changes on an individual level, means accompanying respondents over a longer period, a period in which the individuals are exposed to the innovation - in our case the autonomous e-minibuses. Therefore, we will conduct a longitudinal qualitative survey (Calman et al., 2013). The unit of analysis of this study are households.

In this chapter, we will present the research proposal for this longitudinal qualitative survey. We will start with the objectives of the study. Hereafter, we will discuss the three-step research methodology: sampling (selecting the households), data collection and data analysis.

5.1 Objectives

The objectives for the longitudinal survey are comparable to those for the representative survey and the user survey. One difference is that the long-term study provides deeper insights into these goals, more complex and comprehensive information. Another difference is that, in the long-term study, dependent data of the same individuals are generated over different survey dates (single source approach).

- Individual needs and life styles, lived values
- Mobility behavior in different situations – daily commuting, leisure, holidays
- Social and Psychological well-being
- Experienced life-quality at test site
- Perception, attractiveness of the concepts
- Changes in behavior and attitudes over the test period
- Demographic data

5.2 Methodology

In qualitative market research, objectives other than statistical representativeness take the center stage. Therefore, other types of sampling are used for qualitative research as well. Instead of collecting samples at random, the criteria for collection are clearly defined. The main aim is to select cases containing information that are particularly significant and informative in relation to the question. For example, people with handicaps are explicitly relevant for the qualitative longitudinal survey. So, the aim is not the statistical generalizability of the sample to a population. Rather, the random sample should be used instead of analytical generalizability: the sample should provide as detailed information as possible about a phenomenon which should map it as comprehensively and in all its facets as possible (Merkens 2005 p. 291). In addition to the general objective of qualitative research, this purpose of intentional sampling is to provide a more in-depth analysis of the complexity of the phenomenon of interest (Mason 2002, Quinn Patton 2002, Chapter 2). The decisive factor here is not the number of cases involved but their information content in relation to the phenomenon itself. A qualitative

[3] Qualitative research methods focus on understanding phenomenon in detail, answering how & why questions. This in comparison with quantitative research methods (such as used in the representative survey and the user survey) where the focus is on measuring the amount of change.

sampling plan follows (see (Naderer 2011) five steps:

1. Determine the scope of the investigation
2. Identify relevant features in the subject area
3. Definition of the feature combinations / "cells" of the plan
4. Determination of the number of cases per feature combination
5. Case selection

Sample design

An important step in the design of the study is the selection of the households that will be included in the study: the sample design. In this study, we selected a theoretical sampling method, which means that we have selected participant for the study based on criteria defined in advance[4].

We will select **16 households** per test side. A minimum of 7 participants is necessary to get reliable results. In longitudinal research, we can expect a 'mortality' of 30%, i.e. 30% of the participants will not continue to participate in the study until the end. To be on the safe side, we will select 16 households per city. If we lose all participants representing an important criterion, these participants will be substituted.

Table 5.1: Sampling scheme (n=16)

Restrictive, strong opponent of AV		**Enthusiastic, strong proponent of AV**	
Couples with kids	n=2	Couples with kids	n=2
Couples without kids	n=2	Couples without kids	n=2
Elderly people (65 years and older)	n=1	Elderly people (65 years and older)	n=1
Students (24 years and younger, no kids)	n=1	Students (24 years and younger, no kids)	n=1
Employees, not living in the area, but commuting on a daily basis	n=1	Employees, not living in the area, but commuting on a daily basis	n=1
People with reduced mobility	n=1	People with reduced mobility	n=1
Total	**n=8**	**Total**	**n=8**

Table 5.1 reflects the basis for the sample selection. However, depending on the specific demands of the PTOs and contextual settings of the cities, specific test-sites and routes of the autonomous e-minibuses, other criteria could be considered. These criteria will be brought in by the four TPOs. Most criteria require a sufficient distribution over the sample – such as age / income / education level. Some criteria are very specific (such as a family that has children that go to school using public transportation systems), these criteria require a minimum of two respondents per item. Possible criteria to select these households are:

- Gender
- Age
- Income
- Openness to new experiences
- Car ownership
- Current mobility behaviour (using own car, public transport systems, bike, walking, etc)

[4] The opposite of theoretical sampling is data-driven sampling

- Values regarding sustainability in general
- Education level
- Children that go to school using public transport systems
- Opinions on sustainability & environmental problems
- Experience with Autonomous bus driving
- Experience with autonomous car driving
- Specific needs and opinions on public transport (e.g. cheap, able to bring luggage/baby carrier etc)
- Involvement to public transport
- Other specific criteria important for the respective city

To select the right participants for our study, based on the criteria selected, we will conduct a 'screener questionnaire'. This is a short questionnaire for the selection of participants based on the criteria mentioned above. An example of such a screener questionnaire is added as Appendix VI.

5.3 Survey design

The longitudinal qualitative survey consists of two main parts; in-depth interviews and online diaries.

In-depth interviews / mini group interviews

Data collection will start with an extensive diagnostic interview. Topics in this interview are the biography of participants (and household members), mobility behavior, insights in technology acceptance, etc. The interview will last for about 2 hours. It is important that it is conducted at the participant's place of residence (as it will include observations). During this first interview, the online diary is explained and a first task is completed together with the participant.

The interview guideline is developed by HS PF, and is added to this report as Appendix V.

Online diaries

Throughout the test period, the households will be followed through an online diary. Tasks will be defined for participants to report on mobility behavior (such as a daily commute and a holiday/short stay). Participants do not have to work on their diary on a daily basis but will report once a week on their mobility behavior. This reporting is done by assigning small tasks; every member of the household should complete these tasks.

As a first task, we will ask the participants to fill in a personality test to get insights in personality traits, using the Big Five Personality Traits Model[5].

5.4 Data Collection

Data collection will be a combination of in-depth qualitative interviews conducted either face to face or by phone or online and an online diary.

After this first interview, the qualitative interviews are conducted twice a year:

- Autumn 2019: First interview *face-to-face*
- Spring 2020: Face-to-face *OR Skype*
- Autumn 2020: Face-to-face *OR Skype*
- Spring 2021: Face-to-face

The online diaries will start after the first interviews. The participants will be asked to participate in the online diaries for 1 to 1 ½ years.

[5] We will use the model of 'the Big Five Personality Traits Model' to measure the five key dimensions of people's personalities: Openness, Conscientiousness, extraversion/introversion, Agreeableness, and natural reactions.

5.5 Data analysis

Data analysis follows the concept of qualitative content analysis according to Mayring (2015e). The qualitative content analysis is a common form for the evaluation of qualitative data.

Qualitative content analysis is a systematic, data-reducing method for comparative analysis of meaningful material. The interview transcripts usually contain much more information than is necessary to answer the research question. The amount of information must be reduced and processed for further analysis and interpretation.

The qualitative content analysis aims to develop a category system, which, like a "search grid", serves to filter out from the abundance of interview material those aspects that are relevant for answering the research question. The analysis is performed by assigning pieces of material (segments) to the categories of a content-analytic category system.

This assignment is usually made by two independent coders.

5.6 Responsibilities and Planning

The longitudinal survey is still in the preparatory phase. Currently, the primary activity is the selection of specific criteria for the sample design and the subsequent selection of participants.

Similar to the representative survey and the user survey, responsibilities are shared between HS PF and the PTOs. In general, HS PF is responsible for the design of the study. This includes the development of the sample design (based on attributes) and the screener questionnaire to select the appropriate participants. The PTOs are responsible for practical support and contextualizing general designs and guidelines, such as the selection of specific criteria for the sample design and the subsequent selection of participants.

Table 5.2: Tasks, responsibilities and planning

HS Pforzheim			**PTOs**		
Task	**Status**	**Time-frame**	**Task**	**Status**	**Time-frame**
Preparation / Sample design					
Theoretical sampling scheme	Done	X	Select specific criteria for sample design	holo (formerly Amobility): Done	Autumn 2019
Screener survey	Done	X	Selecting households to participate	-	Autumn 2019
Data collection					
Interview guideline	Done	X	Supply interviewers for qualitative interviews (diagnostic & follow-up interviews)	-	To be defined

Training interview techniques		Sept-Dec 2019	Translation of interviews (if necessary)	-	
Diagnostic interviews	No participants yet	ASAP	Diagnostic interviews	No participants yet	To be defined
Follow-up interviews	No participants yet		**Follow-up interviews**	No participants yet	
Definition of tasks online		Sept – Dec 2019	X		
Keeping track of participants		Sept 2019 – June 2021	Keeping track of participants	-	Sept 2019 – June 2021
Provide support to participants		Sept 2019 – June 2021	Provide support to participants		Sept 2019 – June 2021
Data analysis					
Analysis of diagnostic interview	-	Sept 2019	X		
Analysis of tasks in online diaries	-	Ongoing until Dec 2021	X		

6. Ad-hoc qualitative research

In addition to the three planned surveys as discussed in chapters 3, 4, and 5, some extra space is reserved for the collection of additional data over the next years. These 'ad-hoc qualitative research methods' can counter unexpected events and allow for additional interviews with specific target groups.
In this scope, it is planned that we will conduct interviews with the supervisors on board the shuttles, identified as an important target group in the second phase of the Social Impact Assessment. They are considered key actors once they are working daily on the operational implementation of the autonomous shuttles. Therefore, the supervisors can provide valuable inputs about the ongoing tests as well as to report their impressions and experiences regarding the human and autonomous driving interaction, user behavior and experience, technical obstacles and consequences on the service user and acceptance and so on.

6.1 Objectives

The qualitative interviews aim to explore:

- The responsibilities, roles and tasks of the shuttle supervisor;
- The perception on autonomous e-minibuses and test sites;
- The description of the autonomous e-minibuses in practice;
- The identification of operational main challenges;
- Special focus on the description of the users' profile, experience, behaviors, questions and conversations, critical situations.

6.2 Methodology: Qualitative interviews

Exploration is a non-standardised, oral questioning under psychological expertise of individual people by a single interviewer, aiming at getting information about the individual and his/her world.

- Comprehensive and most thorough questioning technique:
  Preferably survey everything about what an individual thinks or knows about something, what he associates with it, how he evaluates it, what meaning it has for him, and what he relates to it.
- "Small" explorations as a part of so-called "semi-structured interviews":
  i.e. single, open questions within the scope of the interviews, related to neutral requests and follow-up questions that contribute to get full transparency of a limited issue.
- Sophisticated form of exploration: Interview based on a topic guideline

  - Topics instead of pre-formulated questions,

  - Essential questions are to be formulated throughout the interview

Exploratory interviews are characterized by

- avoiding direct, concrete questions about such matters that could be irrelevant to the respondent
- focusing on content that is meaningful and relevant to the interviewee
- following a course of conversation that develops naturally and individually
- flexible timekeeping, the interview is concluded when the interviewee has nothing more to add to the research topic.

Qualitative psychological interviews or expert interviews are always used when it comes to generating a deeper, comprehensive and exhaustive picture of the impressions, experiences, attitudes and opinions of the target persons.

The choice for qualitative semi-structured interviews relies on the flexible design, free manifestation of subjects and spontaneity during the conversation. Therefore, main topics and questions guide the dialogue, and the order and priorities of subjects are adjustable.

In addition, the semi-structured interview allows that secondary issues could be explored according to the stakeholders' priorities and interests. It creates a comfortable environment, enabling the participants to grasp informal information, underlying interests and conflicts, not explicit in the desk research material.

Sample design

Considering that the supervisors on board the shuttles have similar responsibilities and tasks, they can be seen as a 'homogeneous sample' according to Schreier in (Naderer 2011), which is made up of similar cases.
Hence, the sample size may vary between n=5 and n=10, in which:

- N=5, if test sites and infrastructure are considered similar, or
- N=10, in case test sites are not comparable (e.g. private living area vs. industrial area, center area vs. banlieues)

6.3 Survey preparation

A guideline for the in-depth semi-structured interviews has been prepared based on the main topics of interest (refer to the draft version on Appendix VII) concerning the target group of supervisors on board the shuttles in the Avenue test sites.
The guideline has been designed to provide the respondent a maximum level of openness; it determines the topics in detail but does not determine accurate direct questions.
The duration of the interview is projected to last about one hour, and it depends on the extent of knowledge and experience the respondents will have.
The key topics of interest that will be explored concern: description of the supervisors' responsibilities and tasks; perception on autonomous e-minibuses and test sites; the roles of the shuttle operator; description of the autonomous e-minibuses in practice; identifying the operational main challenges, description of the users' profile, behaviors and interactions.

6.4 Data collection

According to Schreier (2011), 5 interviews per cell of homogeneous cases are sufficient. If we expect that supervisors across all cities have comparable tasks but are working in different test areas (e.g. with a comparable or homogeneous user structure between different test areas, then n = 10 in total and n = 5 per homogeneous user structure (e.g. private living area vs. industrial area) should be sufficient. We will nevertheless try to realize 10 interviews across all test areas.
The interviews will be conducted by researchers trained in qualitative interview techniques. They will be held face-to-face ideally, or alternatively carried out by Skype or by phone, if a direct conversation is not possible for pragmatic reasons (see table 3.1). The talks will be conducted based on a topic guide, thread-centered or semi-structured.
The interviews with the supervisors are estimated to be conducted in the four AVENUE cities – Copenhagen, Geneva, Luxembourg and Lyon – between winter/2019 and spring/2020.

6.5 Data analysis

Data from the interview will be audio recorded, and the qualitative analysis will consist of reporting the interviews, in order to register detailed information and contents. Further, specific categories will be chosen in order to compress, analyze the data, findings and reporting.

6.6 Planning and responsibilities

For the ad hoc qualitative research HS PF is responsible for identifying the study question to be addressed, to elaborate the guidelines and topic list for the interviews, conduct the interviews, data analysis and reporting. The PTO's contributions are welcome by integrating their feedbacks and investigation issues of interest in the scope of the ad hoc qualitative research. In addition, the PTO's support is required to provide the contact with the shuttles supervisors.

7. Conclusion and Research agenda

This deliverable provides an overview of work conducted in the first phase of T8.3 Social Impact Assessment. The first phase took from October 2018 until July 2019. In the previous chapters, four studies were discussed that together will result in the social impact assessment of integrating AVENUE's autonomous e-minibuses into the public transport system. With the results of these four studies, we will be able to answer our main research question:

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

At this stage of the project, we are not yet able to provide an answer to this question. However, based on the literature review (chapter 2), the first results of the representative survey (Lyon, chapter 3), the experiences with developing the user survey (chapter 4), the longitudinal survey (chapter 5) and the ad-hoc qualitative interviews (chapter 6), we are confident that this research question will be answered at the end of the AVENUE project (April 2022).

Each chapter concludes with a short note on planning. To avoid duplication and repetition, the research agenda that we provide in this chapter is based on time periods rather than on the four central studies. Two important points in time are the deadlines for the forthcoming deliverables:

- D8.7 Second Iteration Social Impact Assessment, which is due on 28-02-2021;
- D8.9 Final Social Impact Assessment, which is due on 31-12-2021

We will discuss the research agenda and our planning according to three phases.

Activities autumn 2019

The remaining months in 2019 will be especially used for field work as well as the evaluation of the collected data. This means that the representative survey will be distributed in all four cities. Households to participate in the longitudinal survey will be selected, and first interviews will be conducted. Furthermore, we will conduct qualitative interviews with supervisors of the autonomous e-minibuses. Descriptive and multivariate analyses in SPSS will be performed.

Activities before Deliverable D8.7

The aim for Deliverable 8.7 second iteration social impact is to report on the empirical results of the four studies; on the zero measurements of the representative and the user survey, the qualitative interviews with households participating in the longitudinal survey and the qualitative interviews with the shuttle supervisors. This requires data analysis and reporting.

Activities before Deliverable D8.9

The aim for Deliverable 8.9 final social impact is to report on all four studies. This includes final control measurements of both the representative and the user survey.

T8.3 Social Impact Assessment	850 Tage	Mon 1-10-1
Representative survey Zero measurement	196 Tage	Mon 1-10-18
Preparation and analysis	176 Tage	Mon 1-10-1
Copenhagen (representative survey)	46 Tage	Mon 1-4-19
Luxembourg (representative survey)	46 Tage	Mon 1-4-19
Geneva (representative survey)	46 Tage	Mon 1-4-19
Lyon (representative survey)	46 Tage	Mon 1-4-19
Representative survey Final measurement	196 Tage	Fre 1-1-21
Preparation	120 Tage	
Survey design	30 Tage	
Programming	30 Tage	
Data analysis	89 Tage	Die 1-6-21
Copenhagen (representative final measurement)	44 Tage	Don 1-4-21
Luxembourg (representative final measurement)	44 Tage	Don 1-4-21
Geneva (representative final measurement)	44 Tage	Don 1-4-21
Lyon (representative final measurement)	44 Tage	Don 1-4-21
User survey: Zero measurement	262 Tage	Die 1-1-19
Preparation and analysis	240 Tage	Die 1-1-19
Copenhagen (user survey)	46 Tage	Son 1-9-19
Luxembourg (User survey_	45 Tage	Sam 1-6-19
Geneva (User survey)	46 Tage	Son 1-9-19
Lyon (User survey)	45 Tage	Sam 1-6-19
User survey: Final measurement	196 Tage	Fre 1-1-21
<Neuer Vorgang>		
Preparation		
Survey design		
Programming		
Copenhagen (user survey)	45 Tage	Don 1-7-21
Luxembourg (User survey_	44 Tage	Sam 1-5-21
Geneva (User survey)	45 Tage	Don 1-7-21
Lyon (User survey)	44 Tage	Sam 1-5-21
Longitudinal qualitative survey	524 Tage	Die 1-1-19

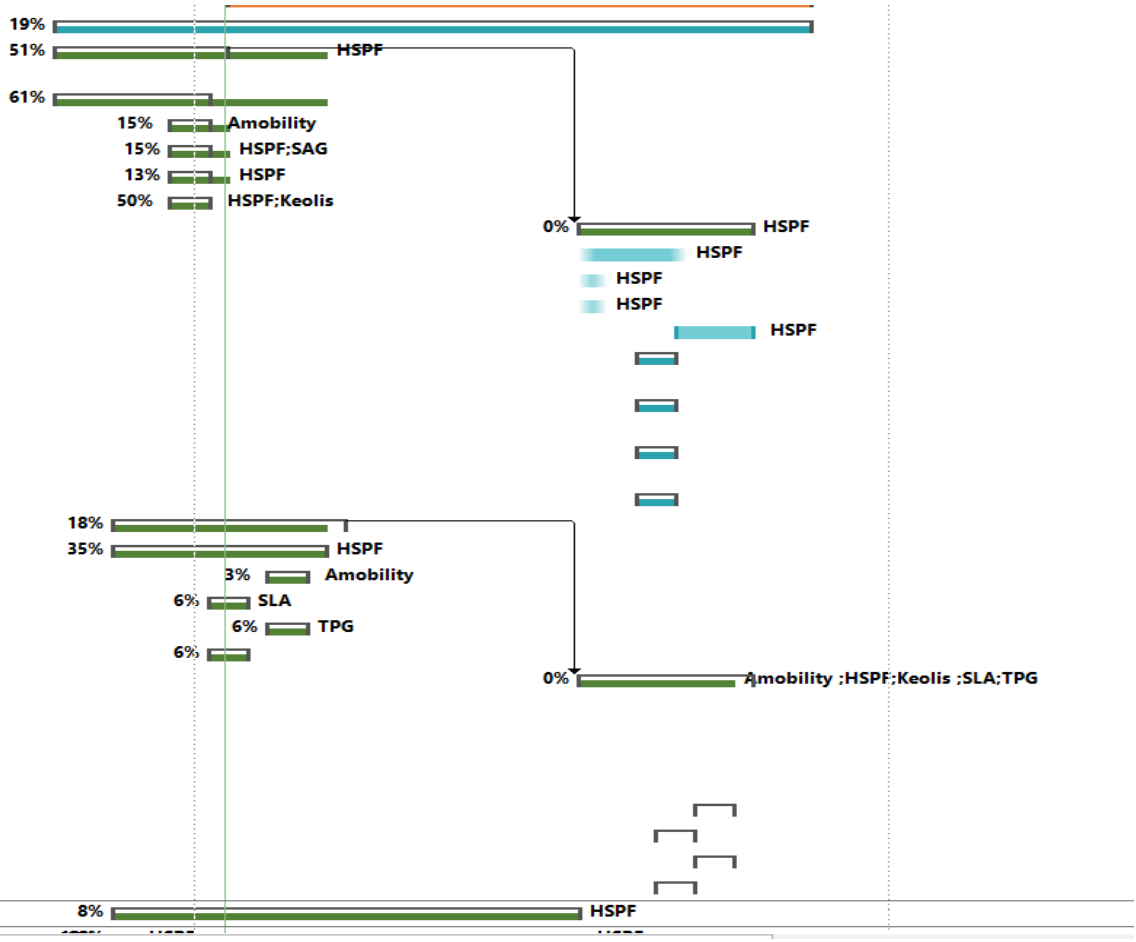

Figure 7.1: Planning of activities

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Appendix I: Target groups

Target groups	Representative survey	user survey	Longitudinal survey	Qualitative interviews	Stakeholder analysis (WP2) qualitative interviews	To be decided
Private users	■	■	■			
Business users		■				
Tourists		■				
First users		■				
Loyal users		■				
Families		■	■			
Non-users	■		■			
General public	■					
Transport operators					■	
Software developers					■	
Local governments					■	
Regulatory actors					■	
Legislators					■	
Technology providers					■	
Assessment agencies					■	
Environmental NGOs					■	
Citizen associations					■	
Driver associations					■	
New competitors					■	
Other road users (motorized)					■	
Other road users (not motorized)					■	
Supervisors (in shuttle)					■	

Appendix II: Overview state of the art

Name	City/country	Aims	Methodology	Main results/findings	Recommendations for future research	Reference
Autonomous vehicles – general acceptance / social impact						
User Acceptance Of Autonomous Vehicles: Factors And Implications. Jens Kaan, 14.06.2017	Delft, Netherlands.	Factors and Implications for User Acceptance	Unified Theory of Acceptance And Technology Use (UTAUT)	Grouping 70% of the user acceptance's **variance.**	Some models such as Technology Acceptance Framework and some others interesting models could be used.	Page 13-14, J. Kaan. User Acceptance Of Autonomous Vehicles: Factors And Implications
			Interviews with potential users	-UTAUT suggest 4 important criteria for technology acceptance in interviews; age, gender, experience	Conduct similar strategy with different target audience if is	Page 29-43, J. Kaan. User Acceptance Of Autonomous Vehicles: Factors And Implications Page 47 summary of results.

				and voluntariness of use. -**Results**: Safety, Traffic decongestion, ability of consuming time in other activities and comfort with technology. Most important factors for potential users.	not already done (out of Netherlands)	
			Interviews with experts	Out of the most important factors for potential users, experts expressed their opinion (not documented)	AVENUE already has its experts on each topic, identify and address them when necessary.	
Reshaping Urban Mobility with autonomous vehicles	Worldwide	Social acceptance	Survey	Most important aspect of AV is 'not having to look for a parking spot' hence mobility system is important Broad acceptance (60% would likely ride in an AV)		
			Focus groups on mobility	• E-hailing fills a gap		

	Boston, USA		and autonomous vehicles	between public transport and personal mobility • Families do not have good mobility alternatives to using their private car Sharing a ride is not the preferred travel mode for most Bostonians		
			Conjoint analysis	• AV adoption potential differs between neighborhoods (geography) Age and income are significant drivers for AV adoption		
Sustainable Cities Mobility Index 2017 Bold	North America, Europe	Evaluation of most	-	A score based on the city's performance in 23 individual	Indictors very accurate to	ARCADIS_2017_SUSTAINABLE CITIES MOBILITY INDEX 2017

Moves. A focus on Europe. ARCADIS	and Asia.	sustainable cities.	Overall Index Rating	indicators. **People** (social aspects), **Planet** (Environmental Impacts) and **Profit** (Efficiency and Reliability) of each mobility system.	find the adequate replicator city.	BOLD MOVES. A FOCUS ON EUROPE
What's ahead for fully autonomous driving Consumer opinions on advanced vehicle technology Perspectives from **Deloitte's** Global Automotive Consumer Study	United States, Germany, Japan, South Korea, China and India	Comparison between countries po tential users' opinions.	Survey	Not specified how the surveys were addressed but a lot of useful information and statistical approach of how Germany's potential users' point of view is.	Perfect to generate conclusions and have an overview of Germany in comparison with other first world countries.	(Deloitte_2017_ What's ahead for fully autonomous driving_consumer-opinions-on-advanced-vehicle-technology)
Public opinion on automated driving: Results			Surveys via CrowdFlower	Learning platform that transforms unstructured texts, images, audios, or videos into customized training data.	Interesting tool for interviews or surveys without leaving office.	Link

of an international questionnaire among 5000 respondents	Delft, Netherlands	Public opinion on high or fully automated vehicles.	Analyses at the individual level	- **Manually driving** is the most enjoyable mode. F**ully automated driving** will be the lest enjoyable. - Fully automating driving will be easier than manual driving but not agree on removing steering wheel. - Majority agreed to allow their vehicle to transmit data for safety and efficiency purposes - Men seems less worried about fully automated driving than women. - Most noticeable worries of respondents: Worry misuse, worry legal and worry safety.		(Kyriakidis et al_2015_Public opinion on automated driving_results of an international questionaire among 5000 respondents)
			Analyses at the international level	- People of higher-income countries are less comfortable about data transmition.		

				- Higher-income countries have more sophisticated compute r infrastructure for data misuse		
Name	**City/cou ntry**	**Aims**	**Methodolog y**	**Main results/findings**	**Recommend ations for future research**	**Reference**
Autonomous vehicles – Pilot projects and tests						
On the Road with an Autonomous Passenger Shuttle: Integration in Public Spaces	Sion, Switzerl and	Investigate the impact of one of the first placements of AV. The *Sion*	Interviews with potential and current users	- A lot of positive opinions due to "Generates image of innovation". - Majority of interviewed are **skeptical** because technology might fail. - Communication for other road users with		(Eden etal_2016_On the Road with an Autonomous Passenger Shuttle_ Integration in Public Spaces)

		SmartShuttle.		the AV such as larger signaling indicators, sounds, or an electronic display mounted on the AV		
			Trial ride and participant-observation	- A relation between real time human interaction and AV mechanisms could be implemented to avoid collisions. - In 'mobile encounters' people rely upon mutual gaze, gesture and movements to communicate with one another. - AVs should have algorithms and sensors that take into consideration the norms of conduct between different types of people who share the roads at any given time and AVs.	Important to analyze people's reactions and level of acceptance via "trial rides".	
				- Most of test drives had been done in ideal		

Digibus: results from the first self-driving shuttle trial on a public road in Austria	Koppl, Austria	Real-world evaluation of a self-driving shuttle for bridging the first/last mile in public transport	Test drives	weather conditions (sunny weather). - Very different study focus because it was realized in rural area. - Role of digital infrastructure - The interaction with other road users was the biggest challenge presented - How will passenger feel if operators are not within the ride?	Most important conclusion of report. Important to take to consideration at the moment of generating our report.	
			Passenger surveys	With post-ride quick questions, it was able to identify some positive (+) and negative (-) experiences from passengers. Negative aspects were quite low (around 8% or less) but important to mention. (+) comfortable and safe driving experience (+) Simple way of user interaction		(Rehrl_Zankl_2018_Digibus results from the first self driving shuttle trial on a public road in Austria)

				(+) Good state of development of the technology (-) Lack of driving comfort (-) High braking intensity (-) Insecure feeling.		
			Observed vehicle behaviors.	- Shuttle complete stop due to obstacles. Force to manually overpass obstacle and automatic mode re-set. - Shuttle complete stop for no apparent reason. Automatic mode on and off to let the vehicle complete ride. - No detection of other road users. Manual control required. - Unclear interaction with other road users. Not able to predict what will the AV will do.		

Towards Autonomous Transportation. Passengers' Experiences, Perceptions and Feelings in a Driverless Shuttle Bus in Finland	Helsinki, Finland	Real-life user experiences of a driverless shuttle bus	Theory of Interpersonal Behavior (TIB)	- According to the TIB, the intention to change mobility behavior consists of a citizen´s attitude, social factors, and affect. - Habits and routines, as well as contextual factors, also affect the new mobility behavior - Personalized services are required, as transportation designed for the masses rarely meet the exact needs of an individual citizen	Take this theory in consideration for finding next replicator cities.	Link for TIB diagram
			Interviews	Questions divided into 4 segments: A) **Imminent reaction**: Thoughts, observations or feelings of the ride. Very positive responses. Human driver as an instrumental value. Drivers absence unnoticed.		(Salonen_Haavisto_2019_Towards_autonomoust_ransportation_Passengers' Experiences, Perceptions and Feelings in a Driverless Shuttle Bus in Finland)

				B) **Attitudes**: Thoughts and observations of the self-driving mobility. Decreasing necessity of a private car. Losing experience of driving C) **Social factors**: Expectations of users in the future. Future of AV technology. Convenience, Flexible on-demand service. Accessibility (price focus). D) **Affections**: Factor that decreased(-) or increased (+) safety. + Positive impact of real-life experience + no more human error, advanced technology can be trusted - Skepticism when trusting new technology - Skepticism for traffic adaptation		

			Vehicle behaviors	- Snowflakes, heavy rain, dust, and flying leaves can cause emergency stops for the bus because it often recognizes these things as obstacles. - Lack of human driver was not a problem for the passengers		
Public Opinion on Route 12. Interim report on the first survey on the pilot experiment of an automated bus service in Neuhausen am Rheinfall	Zurich, Switzerland	Public Opinion on Route 12	Survey (1,408)	Results have been separated in 4 main categories. - **Attitude towards AV**. Participants were asked to rate their concern relating AV. Biggest concerns: Software misuse, loss of driving enjoyment, job loss, interaction with other road users and reaction in unforeseen situation. - **Status of information**. Majority of people were familiarized with other		(Wicki_Bernauer_2018_Public Opinion on Route 12)

				self-driving systems in Switzerland. - Agreement with the test on R12. Very positive acceptance for AV-technology and tests. - **Public perception**. Majority of people didn't have a lot of knowledge over project on Route 12.		
Name	**City/country**	**Aims**	**Methodology**	**Main results/findings**	**Recommendations for future research**	**Reference**
ARTS – general acceptance / social impact						
			Expert interviews (4) and participant observations	Important aspects to take into consideration to fulfill social acceptance. - **Awareness**: Peoples' identification with public mobility systems - **Security**: Increasing security by decreasing overcrowding in	5 very important aspects to take into	(Kilian Yasin et al_2016_Social acceptance of alternative mobility systems in Tunis)

Social acceptance of alternative mobility systems in Tunis	Tunis, Tunisia	Social acceptance of innovative forms of mobility		buses and metros. - **Intramodality**: Developing an intermodal approach by improving connections between individual and collective transportation systems - **Common vision and cooperation**: Cooperation of the governorates on mobility issues - **Electronic information system**: Electronic information system to analyse mobility behavior.	consideration.	
			Social acceptance Surveys (155)	*A) Mobility behavior*. Principal attractiveness for Tunisian mobility are **Car, taxi, metro/train**. Setting **Bus and bicycle** as less attractive mobility alternative.		

				- metro, train and bus mobility systems cannot offer attributes like comfort, speed/time, reliability and safety *B) Alternative Mobility.* Speed, Time and Safety most important criteria to choose between mobility systems. *c) E-Mini bus social acceptance*. Majority (more than 75%) of interviewers (car owners also) could use E-mobility.		
A SURVEY OF PUBLIC OPINION ABOUT AUTONOMOUS AND SELF-	United States, China, India, Japan, United Kingdo	Examine public opinion regarding self-driving-	Survey (1,533)	- Majority of responders have a positive point of view. - Positive points of view regarding suppositions of AV such as: amounted and severity of accidents,	This study also shows positive opinions over AV but expressed hi gh levels of	*In this study, all data provided was divided for each country, but for this report, overall responses had been used* (Schoettle_sivak_2014_A survey of public opinion about autonomous and self-driving vehicles in the US, UK and australia)

DRIVING VEHICLES	m and Australia	vehicle technology.		time, traffic congestion. - High level of skepticism at fully automated vehicles. (89%) - Responders concerned about: Legal aspects, data privacy, System and vehicle security (from hackers), interaction with other road users. - Low interest of owning and paying for self-driving technology (58% not interested) - Respondents who had previously heard of AV were more likely to expect crash-reduction benefits and better fuel economy.	concern about riding in AV due to security issues, vehicles without drivers controls and self-driving vehicle not performing as well as actual drivers.	
Methodology and indicator calculation method for sustainable urban mobility.					22 indicators Indicator set: understand the natural evolution of	(WBCSD_2015_Methodology and indicator calculation method for sustainable urban mobility

					sustainable mobility	
Policy and society related implications of automated driving: A review of literature and directions for future research	Delft, Netherlands	Discuss potential effects of AV that are relevant to policy and society	Ripple effect concept (implication of AV)	**First-order:** Implications of automated driving on traffic, travel cost, travel choices. -Travel comfort: Has been incorporated in trajectory planning and ACC algorithms as the optimizing metric. - Fixed cost of AV: Current automated vehicle applications cost several times the price of a conventional vehicle, but the price could be gradually reduced with mass production - Road capacity: The higher the level of automation, cooperation and		Link for image Ripple effect concept

				penetration rate, and the higher the positive impact on road capacity.		
				Second-order: Implications of automated driving with respect to vehicle ownership and sharing, location choices and land use, and transport infrastructure. - Vehicle ownership: Shared automated vehicles could replace from about 67% up to over 90% of conventional vehicles delivering equal mobility levels. - Location choices and land use: Automated vehicles could enhance accessibility citywide, especially in remote rural areas, triggering further urban expansion.		(Milakis et al_2017_Policy and society related implications of automated driving A review of literature and directions)

				- Transport infrastructure: Shared automated vehicles could significantly reduce parking space requirements up to over 90%. The overall reduction of parking spaces could vary according to the automated mode (vehicle-sharing, ride-sharing, shared electric vehicle		
				Third-order (energy consumption, air pollution, safety, social equity, economy, and public health): Benefits on safety, economy, public health and social equity - Fuel efficiency: Higher level of automation, cooperation, and penetration rate could lead to higher fuel savings		

				- Emissions: Vehicle automation can lead to lower emissions of NOx, CO, and CO2. Higher level of automation, cooperation and penetration rates could lead to even lower emissions. - Safety: Advanced driver assistance systems and higher levels of automation (level 3 or higher) can enhance traffic safety. - Social equality: Automated vehicles could induce up to 14% additional travel demand from the non-driving, elderly, and people with travel-restrictive medical conditions - Economy: Jobs in the transportation and logistics sectors have a high probability of		

				being replaced by computer		
Acceptance of Driverless Vehicles: Results from a Large Cross-National Questionnaire Study	Delft, Netherlands	Acceptance of driverless shuttles in large cross-national samples	Surveys via CrowdFlower (10,000)	Study's results divided in 2 mayor outcomes. - **Individual level**: High acceptance on AV technology but highs skepticism over responsibility and safety matters. - **National level**: The countries' mean general acceptance score was negatively correlated with national GDP per capita. Study also revealed differences between within-country and across-countries correlations. For example, the correlation between gender and the general acceptance scores was stronger for males across countries than within countries.	Surveys showed that respondents believe that driverless shuttles are easy to use and convenient. Study also revealed cross-national differences and found that lower-income countries were more accepting of driverless vehicles than higher-income countries	(Nordhoff etal_2018_Acceptance of driverless vehicles Results from a large cross national questionnaire study)

WHEN TRANSPORT GEOGRAPHY MEETS SOCIAL	Ghent, Belgium	Develop a conceptual model for travel behavior.	Why travel behavior is part of a decision hierarchy	**- Short-term activity decisions and implications for travel behavior.** Researcher should focus on the spatial aspects of the individual's activity pattern as well as the temporal aspects of it. Therefore, focus should focus on constraints that influence time-space paths and prisms. The contains are as follows: (i) *Capability constraints:* refer to limitations because of physiological necessities such as sleeping, eating and personal care. (ii) *Coupling constraints*: define where, when and for how long an individual can interact with other individuals.		(Van Acker Van Acker, V., van Wee, B. & Witlox, F. (2010). When Transport Geography Meets Social Psychology: Toward a Conceptual Model of Travel Behaviour. Transport Reviews 30(2), 219-240)

PSYCHOLOGY: TOWARD A CONCEPTUAL MODEL OF TRAVEL BEHAVIOUR				(iii) *Authority constraints*: limit access to either space locations or time locations (e.g., business hours of a shop). **- Medium-term location decisions and implications for travel behavior.** More significant location choices such as residence and workplace influence daily travel behavior. - **Long-term lifestyle decisions and implications for travel behavior.** The concept of lifestyle refers to an individual's way of living and is influenced by his or her outlook of life and motivations, including beliefs, interests and general attitudes. Nevertheless, the		

				influence of objective socio-economic and demographic characteristics exceeds the influence of subjective lifestyles.		
			Why homogeneous groups behave differently	Due to individual perceptions, attitudes and preferences toward location, activity and travel behavior. Theories argue that behavior is not always well-reasoned through perceptions, attitudes and preferences. Therefore, behavior has a reasoned component as well as an unreasoned component (i) **Reasoned behavior**: refers to a positive, negative or mixed evaluative response to some issues, objects or		

				people (*stimuli*) which influences the individual's behavior A) Cognitive aspect: perceptions and knowledge of *stimuli* B) Affective aspect: feelings, emotions and values C) behavioral aspect: Acting in response to A) and B) (ii) **Unreasoned behavior:** behavior results from rational decisions, but individuals are not constantly conscious of their behavior		
			Interdependencies, opportunities and constraints	External factors such as the social environment and the spatial environment are generally ignored in studies on travel attitudes and habits. (i) **Interdependencies due to the social environment:**		

				relationships between behavior, personal characteristics, and the environment as interacting determinants of each other. (ii) **Interdependencies due to the spatial context:** focuses on the social environment, ecological psychology and environmental psychology stress the influence of the spatial environment. (iii) **Individual, social and spatial opportunities and constraints:** Refers to how the individual's reasoning determines travel behavior. Habits as well as subjective characteristics, such as perceptions and attitudes, are important factors		

			Conceptual and modelling implications	Theories in transport geography justify the incorporation of a spatial component (and even a spatiotemporal component) and a socioeconomic compo nent, where theories in social psychology validate the incorporation of a personality component. In order to create a conceptual map: a) Consider travel behavior as derived from short-term activity decisions, medium-term location decisions and long-term lifestyle decisions. b) Behavioral decisions are regarded as the result of an assessment between reasoned and		Link to conceptual model of travel behaivor

				unreasoned influences.		

Appendix III: Representative questionnaire

Thanks for participating in our survey.
We are collecting your data for a European Union's Horizon 2020 research and innovation program under grant agreement No. 769033.

When you have read this data protection statement and agree with the storage of your data, you can click 'continue' to start with the survey

If you would like to obtain more information about the processing of your personal data, please click here.

Please select your language and press 'continue' to start the survey
English
French
German

1. **Overall, how satisfied are you with your life these days?**[6]

Please tell us on a scale from 1 to 10, where 1 means very dissatisfied and 10 means very satisfied. With the other points on the scale you can grade your answer.

Very dissatisfied									Very satisfied
1	2	3	4	5	6	7	8	9	10
o	o	o	o	o	o	o	o	o	o

2. **How satisfied are you with each of the following items:**[7]

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 present standard of living	o	o	o	o	o
Your accommodation	o	o	o	o	o
Your family life	o	o	o	o	o

[6] European Quality of Life Survey, https://www.eurofound.europa.eu/surveys/european-quality-of-life-surveys/european-quality-of-life-survey-2016/questionnaire

[7] European Quality of Life Survey, https://www.eurofound.europa.eu/surveys/european-quality-of-life-surveys/european-quality-of-life-survey-2016/questionnaire

Your local area as a place to live	o	o	o	o	o
Traffic situation in and around your city	o	o	o	o	o
Public transport offer	o	o	o	o	o
Environmental situation in your city	o	o	o	o	o

3. How important each of the following items are in your life[8]

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 1	2	3	4	Very important 5
Work	o	o	o	o	o
Family	o	o	o	o	o
Friends	o	o	o	o	o
Making new experiences	o	o	o	o	o
Politics	o	o	o	o	o
Climate protection	o	o	o	o	o
Health	o	o	o	o	o

4. Would you consider the area in which you live to be:[9]

Please choose only one.

- The open countryside please fill in your postal code _____
- A village/small town please fill in your postal code _____
- A medium to large town please fill in your postal code _____
- A city or city suburb please fill in your postal code _____
- Don't wish to disclose

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:[10]

Please tell us on a scale from 1 to 5, where 1 means major problems and 5 means no problems. With the other points on the scale you can grade your answer.

	Major problems 1	2	3	4	No problems 5
Noise	o	o	o	o	o
Air quality	o	o	o	o	o

[8] European Value Study

[9] European Quality of Life Survey, https://www.eurofound.europa.eu/surveys/european-quality-of-life-surveys/european-quality-of-life-survey-2016/questionnaire

[10] European Quality of Life Survey, https://www.eurofound.europa.eu/surveys/european-quality-of-life-surveys/european-quality-of-life-survey-2016/questionnaire

Litter or rubbish	o	o	o	o	o
Heavy traffic	o	o	o	o	o
Safety /security	o	o	o	o	o
Nature/green space	o	o	o	o	o
Public transport	o	o	o	o	o
Access to supermarket	o	o	o	o	o

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

6. 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

7. Could you indicate what aspects are important in selecting your preferred means of transport?[11]

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

Item	Ranking
Comfort	
Accessibility, meaning the bus can be used by all people	
Safety and trust feeling	
Speed /travel time	
Pleasure and joy	
Punctuality	
Price	

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

- Own car
- Motorbike

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

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

9. Are there differences in your means of transport depending on good or bad weather conditions?

- No
- Yes: could you please indicate the changes in case of bad weather:

9.1 Could you please indicate the changes in case of bad weather:

I use this means of transport...

- 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

10. Which means of transport do you mainly use when commuting between:[12]

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

	Option 1	Option 2	Option 3	Option 4
your home and the place you work / study	o	o	o	o
your home and the supermarket	o	o	o	o
Your home and family/friends	o	o	o	o

* Option 1, option 2, refers to the means of transport from question 8, we will only include those options that the respondents uses on a daily/weekly basis.

11. Regarding one way transport, how much time do you on average travel between:

	<30 min	30min-1h	1h-2h	>2h	km

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

your home and the place you work / study	o	o	o	o	
your home and the supermarket	o	o	o	o	
Your home and family/friends	o	o	o	o	

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

	km
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?

	Yes	No	Don't know
Information	o	o	
Accessibility, i.e. the bus can be used by all people	o	o	
Price	o	o	
Safety	o	o	
Speed / travel time	o	o	
Environmental friendliness	o	o	
Mobility on demand	o	o	
Entertainment	o	o	

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

14. Have you ever heard of autonomous e-minibuses before participating in this survey?[13]

- Yes, source of information
    - Newspaper
    - Radio/tv
    - Social Media
    - Friends
    - See on on test side
    - Word of mouth
    - Internet
    - Information brochure
    - Formal information offered by employer
    - Informal information by colleagues
    - Other
- No

15. Have you ever travelled with an autonomous e-minibus?

Yes, I have travelled with an autonomous e-minibus

No, I have not travelled with an autonomous e-minibus before

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

16. Do you know whether tests with autonomous e-minibuses are planned or already taking place in your city?[14]

- No test are planned in my city
- Tests are planned, but are not in operation
- Test are in operation in my city
- I don't know

16.1 What was the source of information?

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

17. Do you think that autonomous e-minibuses are going to be an important mode of transportation in the future?[15]

- Yes, why?
- No, why?

18. How willing are you to use autonomous e-minibuses?[16]

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
o	o	o	o	o

19. Imagine that autonomous e-minibusses 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?

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

20. Imagine that autonomous e-minibusses 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?

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

[14] 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.

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

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

o o o o o o o

22. Imagine that your private car could be autonomous but the car would be much more expensive, would you prefer the cheaper autonomous e-minibus, the expensive autonomous private car or an none autonomous private car?

o cheaper autonomous E-minibus
o much more expensive autonomous private vehicle
o a traditional private car o wouldn't use any of these options o do not know

22. How important is it to you that there is a supervisor on board the autonomous e-minibus?[17]

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
o	o	o	o	o

23. In your opinion, is the current technology ready to have autonomous e-minibuses on the public road?

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

Not ready at all				Completely ready
1	2	3	4	5
o	o	o	o	o

24. How much do you agree with the following statements? Autonomous e-minibuses will…[18]

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.	O	o	o	o	o	
… reduce the negative impact on the environment.	O	o	o	o	o	
… reduce congestion	O	o	o	o	o	
… be used for routes that are less popular	O	o	o	o	o	
… be booked on demand in the future	O	o	o	o	o	
… cause fewer accidents, as they avoid human errors	O	o	o	o	o	
… be more efficient, as you'd be able to use your time better than in a car, walking or cycling	O	o	o	o	o	
… be pleasant and comfortable	O	o	o	o	o	

[17] Adapted from amobility

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

25. To what extend do you agree with the following statements? The idea that autonomous e-minibuses will be introduced everywhere worries me, because…[19]

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	O	o	o	o	o	
… jobs get lost	O	o	o	o	o	
… it is not clear who is liable in the event of an accident	O	o	o	o	o	
… it is not clear how autonomous e-minibuses interact with motorized road users	O	o	o	o	o	
… it is not clear how autonomous e-minibuses interact with non-motorized road users	O	o	o	o	o	
… the systems are not reliable	O	o	o	o	o	
… the software may be hacked or otherwise misused	O	o	o	o	o	
… I have to learn how to use an autonomous e-minibus	O	o	o	o	o	
... The systems are not secure	O	o	o	o	o	
… the pleasure of driving gets lost	O	o	o	o	o	
… it is not clear how autonomous e-buses react in unforeseen situations	O	o	o	o	o	

26. You have thought about concerns and benefits of autonomous e-minibuses, considering all; what would you be willing to pay to use autonomous e-minibuses in general?[20]

- 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

27. Do you have any further thoughts on autonomous e-minibusses?

Yes, namely...

No

Finally, a few questions regarding statistics:

28. Which age group do you belong to?

- 16 to 25 years
- 26 to 35 years
- 36 to 45 years

[19] Adapted from: Swiss Federal Institute of Technology Zurich - ETH (2019). User Survey on autonomous shuttles in Neuhausen am Rheinfall.

[20] Adapted from Amobility

- 46 to 55 years
- 56 to 65 years
- 66 to 75 years
- 76 years and older

29. Do you have children in your household?

- Yes
- No
- Refuse to answer

30. Sex

- Female o male o other/unknown

31. Do you have mobility issues?

No
Yes, visually impaired
Yes, hard of hearing
Reduced Mobility: Walking frame
Reduced Mobility: Wheelchair
Reduced Mobility: Guide dog
Reduced Mobility: Walking stick / aid

32. Level of education?

No education
Primary education
Secondary education
Tertiary education

33. What is your main occupation?

- Student
- Employee
- Self-employed
- On maternity or parental leave
- On sick leave
- Retired
- Other
-

34. How many cars do you have in your household?

- None
- One
- More than one

35. Do you have a drivers licence?

- Yes
- No

Thank you very much for participating in this questionnaire.

Appendix IV: User survey

Thanks for participating in our survey.
We are collecting your data for a European Union's Horizon 2020 research and innovation program under grant agreement No. 769033.

When you have read this data protection statement and agree with the storage of your data, you can click 'continue' to start with the survey.
If you would like to obtain more information about the processing of your personal data, please click here.

Please select your language and press 'continue' to start the survey
English
French
German
Danish

1. **How did you experience your last ride on the autonomous e-minibus today?**[21]

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	No answer
General	O	O	O	o	o	o

2. **Was this your first autonomous e-minibus experience?**[22]

Yes, this was my first experience
No, this is not my first experience

2.1 If yes: How many more times have you used the autonomous e-minibus?[23]

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

3. **For what occasion did you use the autonomous e-minibus?**[24]

[21] Adapted from: Swiss Federal Institute of Technology Zurich - ETH (2019). User Survey on autonomous shuttles in Neuhausen am Rheinfall.
[22] Adapted from: Keolis Lyon (2018). Enquête de la perception de la navette autonome Navly. Rapport d'étude. Lyon.
[23] Adapted from: Keolis Lyon (2018). Enquête de la perception de la navette autonome Navly. Rapport d'étude. Lyon.
[24] Adapted from: Keolis Lyon (2018). Enquête de la perception de la navette autonome Navly. Rapport d'étude. Lyon.

- To go to my place of work
- As part of a leisure trip / ride
- For a business trip
- To show the autonomous e-minibus to someone else
- No specific occasion, just wanted to try the autonomous e-minibus
- Other, which?

4. Why did you use the autonomous e-minibus for this trip?[25]

One answer only, please

- Bad weather
- Was waiting for another bus, but the autonomous e-minibus 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
- Only public transport system on this route
- Routine, use the autonomous e-minibus on a regular basis
- Other, which?…

5. How did you become aware of the autonomous e-minibus service?[26]

One answer only, please

- Newspapers
- Radio/TV
- Internet
- Friends
- Social media
- Seen on test site
- Information brochure
- Formal information offered by employer
- Informal information by colleagues
- Word of mouth
- Other

6. What transport system would you have used if there had not been an autonomous e-minibus-service?

One answer only, please.

- Own car
- Motorbike
- Scooter
- Bus
- Train
- Metro
- Tram
- Taxi
- Shared taxi
- Taxi on demand (Uber, Grab, etc)

[25] Adapted from: Keolis Lyon (2018). Enquête de la perception de la navette autonome Navly. Rapport d'étude. Lyon.

[26] Adapted from: Keolis Lyon (2018). Enquête de la perception de la navette autonome Navly. Rapport d'étude. Lyon

- Car-sharing
- Bike/e-bike_e-scooter
- Walking

7. Did you take any of the following items with you on your last ride with the autonomous e-minibus
Allow for more answers

- No
- Yes:
  - Baby carriage/stroller
  - Luggage
  - Shopping trolley
  - Other

8. What were you doing during your last ride with the autonomous e-minibus?
Allow for more answers

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

9. How satisfied were you with the following aspects of your last ride?
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	No answer
Comfort	o	o	o	O	o	O
Cleanliness	o	o	o	O	o	O
Safety in the bus	o	o	o	o	o	O
Security from outside the bus	o	o	o	o	o	O
Accessibility, i.e. the bus can be used by all people	o	o	o	o	o	O
Speed/travel time	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	o	o	o	o	o	O
Frequency of autonomous e-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						

Information online	o	o	o	o	o	O
Easy access to information to plan my whole journey	o	o	o	o	o	O
Atmosphere in the bus	o	o	o	o	o	O
Waiting time	o	o	o	o	o	O
Location of stops	o	o	o	o	o	O

10. Now that you have tested the autonomous e-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				Very willing
O	O	O	o	o

11. What would you be willing to pay to use autonomous e-minibuses in general?[27]

- 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

We would now like to ask you some general questions about autonomous e-minibuses. Hence, these questions are not directly related to your last ride on the autonomous e-minibus.

12. Do you think that autonomous e-minibuses are going to be an important mode of transportation in the future?

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

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

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

14. How important are the following items for you in deciding to use the autonomous e-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 important at all				Very important	No answer
Comfort	o	o	o	O	o	O

[27] Adapted from Amobility

Cleanliness	o	o	o	o	O
Safety in the bus	o	o	o	o	O
Security from outside the bus	o	o	o	o	O
Accessibility, i.e. the bus can be used by all people	o	o	o	o	O
Speed/travel time	o	o	o	o	O
Punctuality	o	o	o	o	O
Temperature	o	o	o	o	O
Reliability	o	o	o	o	O
Noise level	o	o	o	o	O
Frequency of autonomous e-minibus service	o	o	o	o	O
Connection to other transport means	o	o	o	o	O
Information on time table	o	o	o	o	O
Information at the bus stop	o	o	o	o	O
Information in the bus					
Information online	o	o	o	o	O
Easy access to information to plan my whole journey	o	o	o	o	O
Atmosphere in the bus	o	o	o	o	O
Waiting time	o	o	o	o	O
Location of stops	o	o	o	o	O

15. How important is it to you that there is a supervisor on board the autonomous e-minibus?

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

Not important at all				Very important
O	o	o	o	o

16. In your opinion, is the current technology ready to have autonomous e-minibuses on the public road?

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

Not ready at all				Completely ready
1	2	3	4	5
o	o	o	o	o

17. Imagine that autonomous e-minibuses were to become on demand, 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.

Not willing at all				Very willing

1	2	3	4	5
o	o	o	o	o

18. How much do you agree with the following statements? Autonomous e-minibuses will…[28]

Please tell us on a scale from 1 to 5, where 1 means fully disagree and 5 means fully agree.

	Fully disagree				Fully agree
	1	2	3	4	5
… provide enhanced freedom for people with mobility issues.	O	o	o	o	o
… reduce the negative impact on the environment.	O	o	o	o	o
… reduce congestion	O	o	o	o	o
… be used for routes that are less popular	O	o	o	o	o
… be booked on demand in the future	O	o	o	o	o
… cause fewer accidents, as they avoid human errors	O	o	o	o	o
… be more efficient, as you'd be able to use your time better than in a car, walking or cycling	O	o	o	o	o
… be pleasant and comfortable	O	o	o	o	o

19. To what extend do you agree with the following statements? The idea that autonomous e-minibuses will be introduced everywhere worries me, because…[29]

Please tell us on a scale from 1 to 5, where 1 means fully disagree and 5 means fully agree.

	Fully disagree				Fully agree
	1	2	3	4	5
… privacy is not protected	O	o	o	O	o
… jobs get lost	O	o	o	O	o
… it is not clear who is liable in the event of an accident	O	o	o	O	o
… it is not clear how autonomous e-minibuses interact with motorized road users	O	o	o	O	o
… it is not clear how autonomous e-minibuses interact with non-motorized road users	O	o	o	O	o
… the systems are not reliable	O	o	o	O	o
… the software may be hacked or otherwise misused	O	o	o	O	o
… I have to learn how to use an autonomous e-minibus	O	o	o	O	o
… The systems are not secure	O	o	o	O	o
… the pleasure of driving gets lost	O	o	o	O	o
… it is not clear how autonomous e-buses react in unforeseen situations	O	o	o	O	o

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

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

[29] Adapted from: Swiss Federal Institute of Technology Zurich - ETH (2019). User Survey on autonomous shuttles in Neuhausen am Rheinfall.

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
Traffic situation in and around the city	O	o	o	o	o
Public transport offer	O	o	o	o	o
Environmental situation in the city	O	o	o	o	o

Finally, a few questions regarding statistics:

21. Which age group do you belong to?

- 16 to 25 years
- 26 to 35 years
- 36 to 45 years
- 46 to 55 years
- 56 to 65 years
- 66 to 75 years
- 76 years and older

22. Do you have children in your household?

- Yes
- No
- Refuse to answer

23. Sex

- Female o male o other/unknown

24. Do you have mobility issues?

No
Yes, visually impaired
Yes, hard of hearing
Reduced Mobility: Walking frame
Reduced Mobility: Wheelchair
Reduced Mobility: Guide dog
Reduced Mobility: Walking stick / aid

25. Level of education?

No education
Primary education
Secondary education
Tertiary education

26. What is your main occupation?

- Student
- Employee
- Self-employed
- On maternity or parental leave
- On sick leave

- Retired
- Other
-

27. How many cars do you have in your household?

- None
- One
- More than one

28. Do you have a drivers licence?

- Yes
- No

Thank you very much for participating in this questionnaire.

Appendix V: Household interview guideline (for longitudinal survey)

Topic Guide

Methodology n=15 in-depths (twice per year)
duration determined by interviewee
(at least 60 minutes, max. 2 hours)

Sample structure:

1.1.1.1.1.1.1.1 n=15 households
• **7 to 8 fans of autonomous e-minibuses** **7 to 8 refusers**
• **Additional criteria to be added**
• **…**

Key questions:

- Life-situation
- Specific interests, values, needs
- Mobility Behavior
- Attitudes towards
  - mobility
  - social aspects
  - environmental aspects
  - …
- Explanation and introduction into the following steps

To provide respondents a maximum level of openness the guidelines determines the topics in detail but does not determine accurate direct questions.

General Remarks **about 5 min.**

- Data protection declarations
- Request for audio recording
- Use of citations for reporting
- Introduction oft the interviewer

I. Warm-Up **about 15 min.**

Introduction of the respondents, the family, the couple… (current life-situation)
First I'd like to introduce yourself, the members of your household!

- Age, short characterization
  "How would others describe each member of the household in a few key words?"
- Short biography
  - main steps of own biography beginning as child
  - professional background, professional career
  - family situation, living alone, with partner, children, others
- Motivation to take part in the survey, expectations

II. Specific interests, values, needs **about 20 to 30 min.**

Aim: Identifying which interests, values, social or individual norms, wishes, life goals are characteristic for the household

Now I'd like to understand more detailed what are your general interests, wishes, needs, norms, life goals?

- Most important interests, values, needs, life goals
- Additional interests, values, needs, life goals
- Why are some more important and others less?
- I: Do not ask directly!
  Are questions of social responsibility, environmental aspects, health, mobility and public transport, new technologies of specific interest? If yes: Why?

I: Collect needs and use laddering questions for deeper understanding!

II. Mobility Behavior **about 20 to 30 min.**

Aim: Identify reasons, motivation for current mobility behavior

We have to move on a variety of occasions. Could you please give me a short overview about typical occasions in your household, e.g. going to work, to school, holidays, shopping etc.?

- Which transport systems are used for different occasions?
- What motivates these preferences?
- For what reasons does one change typical mobility behaviors? In what situations?
- I: Do not ask directly!
  Are questions of social responsibility, environmental aspects, health, openness for new technologies of relevance? If yes: Why?

I: Collect reasons (features, triggers for preference or refusal) and use laddering questions for deeper understanding!

III. General Knowledge and Attitudes towards Autonomous E-Minibuses **about 15 min.**

Aim: Identify how familiar households are already with the topic and which general attitudes do members of the household have

Now we'd like to talk especially about autonomous driving and autonomous e-minibuses.

Please let me know what spontaneously comes up when you think about autonomous driving and/or autonomous e-minibuses!

- Which systems, technologies for autonomous driving are mentioned?
- What do the respondents think about the different systems?
- Which strengths, weaknesses to the different systems (autonomous cars, autonomous e-minibuses etc.) have from the perspective of the respondents?
- What do they know in detail? By which sources?
- Do the already have any concrete experiences?
- Are they interested in using such systems? Why? Why not?
- What information would they need to accept or to be more interested in using such systems, especially autonomous e-minibuses?
- Would they be willing to substitute their own car? Under what conditions? What would influence their decision?

CHECKLIST

Thoughts about…

- main Trends (Individuals, Society, Markets, Technologies, Ecology, Politics/Legislation) driving an AVENUE Concept
- public vs. private mobility
- security
- sustainability
- expected target groups
- political aspects
- economic aspects
- social, psychological aspects
- …….

IV. Future Projection **about 15 min.**

Aim: Identify how far respondents can imagine autonomous e-minibuses a part of daily life, daily mobility behavior, self-evident part of public transport

Please imagine it is 2025. How does public transport look like? What remained, what has changed? Are autonomous e-minibuses a self-evident part of public transport or not? Why?

MANY THANKS FOR THIS INTERVIEW!

Now I'd like to explain to you how we will go on. In the next months we will ask you to answer additional questions and to fulfill some tasks. Some of these tasks are done very shortly – no longer than 10 to 15 minutes. Others will need more time. But you will have enough time to fulfill the tasks and you can decide when you will do this.

We will send you the tasks via Mail (or perhaps via App) – introduction into the app.

First tasks, spread over the first 6 months

1. All household members (14 years and elder) should fulfill the representative questionnaire as well

2. All household members (14 years and elder) should fulfill a questionnaire about the big 5 (personality inventory)

3. Documentation of typical routes the household members have to overcome
   - description of the route, characteristics, lengths, duration, routine, rarely
   - mobility behavior on this route and reasons for this behavior
   - experiences – what is experienced to be very good, what is disturbing, missing

   (Tasks for daily routes, typical weekend, typical evening, typical holiday journey)

4. Identification of needs, wishes about improved services

Appendix VI: Screener survey for selection households (longitudinal survey)

Developed for: holo (formerly Amobility) Copenhagen

Sampling scheme:

Restrictive, strong opponent of AV		Enthusiastic, strong proponent of AV	
Couples with kids	n=2	Couples with kids	n=2
Couples without kids	n=2	Couples without kids	n=2
Elderly people (65 years and older)	n=1	Elderly people (65 years and older)	n=1
Students (24 years and younger, no kids)	n=1	Students (24 years and younger, no kids)	n=1
Employees, not living in the area, but commuting on a daily basis	n=1	Employees, not living in the area, but commuting on a daily basis	n=1
People with reduced mobility	n=1	People with reduced mobility	n=1
Total	n=8	Total	n=8

Introduction

Int: Read aloud

Hallo, my name is _____ vom HS Pforzheim [ADJUST]. We are currently conducting a study into the social acceptability and impact of autonomous e-minibusses. (or more general; mobility in your city). I would like to ask you a few questions. I am not trying to sell you anything. I am only interested in your opinions. Can I ask you a few questions?

Q1. Do you live in Nordhavn?

Yes		➔ Continue with Q3
No		➔ Continue with Q2

Q2. Do you commute to Nordhavn?

Yes		➔ Continue with Q3
No		➔ END

Q3. Which age group do you belong to?

Under 18		➔ END
18-24		➔ Continue to Q4 (but we only need 2 persons in this age group)
24-64		➔ Continue to Q4
65 and older		➔ Continue to Q4 (but we only need 2 persons in this age group)

Q4. Do you have children in your household?

Yes		➔ Continue with Q5 (but we only need 4 persons with children)
No		➔ Continue with Q5
Refuse to answer		➔ ENDE

Q5. Have you ever heard of autonomous e-minibuses before participating in this survey?

Yes		➔ Continue with Q5
No		➔ ENDE

Q6. We will ask you to repond to a few questions. Please answer on a scale from 1 to 5 whether you agree to these statements, where 1 means totally disagree and 5 means totally agree.

Statement	1	2	3	4	5	Don't know
I am very familiar with autonomous buses			Ende			Ende
Autonomous E-minibuses are going to be an important mode of transport in the future			Ende			Ende

Autonomous e-minibuses could be a solution for traffic problems in the cities			Ende			Ende
I am willing to use an autonomous e-minibus			Ende			Ende

🔔 ***If respondent selects both 1/2 as well as 4/5 → END***

Q7. Do you have mobility issues?

Yes		→ Continue with Q8 (but we only need 2 persons with Mobility issues)
No		Continue with Q9

Q8. What resources / aid are you using?

- wheelchair
- walker
- walking stick, walking aid
- Guide dog
- Large/heavy luggage
- Stroller
- Bicycle

In case the respondent fulfills all relevant criteria, please check whether we this respondent falls into a category that is still open;

Restrictive, strong opponent of AV			Enthusiastic, strong proponent of AV		
Category	Desired	Already selected	Category	Desired	Already selected
Couples with kids	n=2		Couples with kids	n=2	
Couples without kids	n=2		Couples without kids	n=2	
Elderly people (65 years and older)	n=1		Elderly people (65 years and older)	n=1	
Students (24 years and younger, no kids)	n=1		Students (24 years and younger, no kids)	n=1	
Employees, not living in the area, but commuting on a daily basis	n=1		Employees, not living in the area, but commuting on a daily basis	n=1	
People with reduced mobility	n=1		People with reduced mobility	n=1	
Total	n=8		Total	n=8	

In case the respondent belongs to a category for which we are still looking for participants, explain to the respondent what we are interested in and what the longitudinal study does entail. Ask whether they would like to contribute and ask to set up an appointment.

Int: Read aloud

Thank you very much for your answers. We would like to invite you to participate in a longitudinal study about your mobility behavior and autonomous e-minibuses. This means that we would like to ask you questions on your mobility behavior over a period of 2 years. You will for instance be asked to document typical routes you take to work, to report on your mobility behavior and your experiences. A first task would be an in-depth interview with you and your family members. This interview will take about 60-120 minutes. Can we make an appointment for this?

Name:	
Adresse:	
E-Mail-Adresse	
Possible dates for an appointment: 1. XXX 2. XXX	

Appendix VII: (Draft version) Interview guidelines for the autonomous e-minibuses' supervisors

Methodology **n=3 to 5 in-depth interviews**
duration determined by interviewee 40min-60min
Languages: English, French, German

Target group
• **Shuttle supervisors from Lyon, Luxembourg, Geneva, Copenhagen/ Oslo**

***Key topics*:**

- Description of the interviewees' responsibilities and tasks
- Perception of the supervisors on autonomous e-minibuses and test sites
- The roles of the supervisors
- Description of the autonomous e-minibuses in practice from the supervisors' perspectives
- Description of the autonomous e-minibuses in practice from the passengers' perspectives
- Wrap Up – Final Self-Reflection

Guideline:

- To provide respondents a maximum level of openness the guidelines determines the topics in detail but does not determine accurate direct questions.
- At the start of the interview, we ask for personal introduction & attitudes, in the remaining of the interview, we are interested in the perceptions, daily operations, challenges in practice, user's profile and behaviours.

General Introduction **about 5 min.**

- Introduction to AVENUE (EU project, aim to demonstrate the usefulness of integrating autonomous e-minibuses in public transport, role of HS-PF, goal of stakeholder analysis, methodology of qualitative interviews)
- Data protection declarations
- Request for audio recording
- Use of citations for reporting
- Introduction of the interviewer

I. Warm-Up **about 5 min.**

Aim: Introduction of the interviewee.

- Professional background, professional career
- Description of his/her responsibilities and tasks

II. Perception of the supervisors on autonomous e-minibuses and test sites
about 10 min.

Aim : Identifying the interviewee's perception on autonomous e-minibuses and pilot tests in the respective cities.

Now I'd like to know what do you think about:

- *The new transport system in general*
- *The test in the city of Lyon, Luxembourg, Geneva, Copenhagen/ Oslo*
- *Relevance for the company in which supervisor is working for*

CHECKLIST

- Supervisors' short and long term perceptions and positioning (open-minded, neutral, enthusiastic or sceptical)

III. The roles of the supervisor **about 10 min.**

Aim : Understanding the role and importance of having an supervisor on board of the autonomous e-minibus.

- *What do you think in general about the role of an operator?*

CHECKLIST

- When the supervisor is needed? Why: for which tasks or typical situations?
- What would you expect for the future: the supervisor remains necessary or not? It depends on what?

IV. Description of the autonomous e-minibuses in practice from the supervisors' perspectives about 10 min.

Aim: Understanding daily operations and specific situations on board the autonomous e-minibus in the test sites.

Please, could you describe:

- *how the daily operations with the autonomous e-minibus occurs?*
- *Which specific situations you have experienced/observed?*
- *Main challenges*

CHECKLIST

- Description of a normal working day / bus service
- Autonomous e-minibus performance (hours of work, occupancy, possible interruptions, causes of interruptions)
- Description of specific situations
- Main challenges: Maturity of the technology, necessary improvements; Frequent errors; Necessary human interventions, frequency of interventions; Risks of accidents/incidents.

IV. Description of the autonomous e-minibuses in practice from the passengers' perspectives about 10 min.

Aim: Projective question - understanding the passengers' perceptions and experience on board the autonomous e-minibus.

Considering the passengers' perspective, please, could you describe:

- *the users' public/profile (*aged people, young people, PRM, businessman, tourists, family, etc)
- *the users' behaviours during the ride (main activities during the ride, questions, comments, reactions, perceptions on trust feeling)*

CHECKLIST

- Estimate: what percentage of passengers use the shuttle to get to a specific destination and what percentage just want to take a ride and try the shuttle?
- Are there occasions when more people use the shuttle, e.g. depending on time, weather, ...?
- How do passengers react to technical problems of the shuttle?
- What was your funniest experience on the shuttle?
- To be commented

	Not satisfied				Very satisfied	No answer
Comfort	o	o	o	O	o	O
Cleanliness	o	o	o	O	o	O

Safety[30]	o	o	o	o	o	O
Security[31]	o	o	o	o	o	O
Accessibility	o	o	o	o	o	O
Speed/travel time	o	o	o	o	o	O
Punctuality	o	o	o	o	o	O
Price	o	o	o	o	o	O
Temperature	o	o	o	o	o	O
Reliability	o	o	o	o	o	O
Noise level	o	o	o	o	o	O
Frequency of autonomous e-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
Easy access to information to plan my whole journey	o	o	o	o	o	O
Atmosphere in the bus	o	o	o	o	o	O
Waiting time	o	o	o	o	o	O
Location of stops	o	o	o	o	o	O
Substitution of own car	o	o	o	o	o	O
Substitution of walking/biking	o	o	o	o	o	O
Pick up at my location on demand	o	o	o	o	o	O
Environmental friendliness	o	o	o	o	o	O

VII. Wrap Up – Final Self-Reflection — about 5 to 10 min.

Aim: Invite interviewee to address to topics that we have not yet touched upon

Thanks for you time and the information provided. Are there any themes/issues regarding autonomous public transport that you would like to discuss with us?

MANY THANKS FOR THIS INTERVIEW!

[30] Definition: the condition of being protected from or unlikely to cause danger, risk, or injury.

[31] Definition: the state of being free from danger or threat.