Listening to users' personal privacy concerns

The implications of trust and privacy concerns for users' adoption of a Mobility as a Service pilot in Norway

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Abstract

Mobility as a Service (MaaS) refers to the concept of integrating new mobility services electronically, thereby enabling users to access various public and private transport services via a single digital platform. Through MaaS, service providers aim at developing an integrated service that caters to various demands by mobility users. Personal data such as travel behavior is key in this context, because it allows the development, customization, and personalization of mobility services. Hence, for MaaS to become successful, service providers need to collect users' personal information, and users need to accept data collection. In turn, privacy concerns represent a potential hurdle for the success of MaaS. Therefore, understanding privacy concerns from the users' side can help MaaS providers to increase the users' willingness to share their information. This study aims to add on to earlier research findings on privacy concerns by shedding light on new dimensions emerging from the MaaS service. Understanding privacy concerns from the users' side is key in that regard, as it may enable improved service and system development. A sequential mixed-methods approach is used to collect, analyze, and "mix" both quantitative and qualitative research methods. The primary findings are as follows: (1) Privacy concerns specific to the mobility data collection context exist; (2) users are not necessarily personally worried about their privacy even though they claim privacy is an issue; (3) in contrast to traditional privacy thinking, users' trust in mobility service providers may override their privacy concerns. The study's results indicate trust is the key to MaaS adoption. Policy recommendations are explored in the end.

Keywords: Mobility as a service, Smart mobility, Privacy concern, Mobility Information, Technology acceptance, Trust

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I have completed this thesis entirely based on my genuine interest in the subject on my side. I wish this thesis would provide new insight to the academic community and stakeholders working with MaaS service development. In addition, I have to give my sincerest gratitude to all people involved.

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Stella Huang, June 2022

List of Glossary

Mobility as a Service :

Mobility as a Service (abbreviation: MaaS) is a concept that refers to carrying out an individual's mobility needs by combining different transport services. It offers users a range of simple mobile applications to access a wide choice of transport. Therefore, MaaS is considered a smart mobility solution since it offers an alternative to owning and using a private car. This mobility model will benefit users and smart cities significantly if implemented correctly.

Smart mobility:

Smart mobility refers to including modern technologies (e.g., ICT, IoT, see explanation under) into mobility networks. These technologies enable new modes of services like MaaS. Furthermore, smart mobility represents a sustainable solution because its main objective is to change the way people get around instead of private car ownership. Thereby, concerns around pollution and traffic congestion have made this idea gain attention in recent years.

Smart city

In the field of transport policy, the smart city refers to a digital transformation of traffic management. Integrating advanced communication technologies, data collection, automation, and high-speed networks makes it promising to change how cities approach mobility while reducing congestion on city streets. This current study is a case study of a MaaS-pilot in a smart city-Stavanger, Norway.

Internet of thing (IoT)

Internet of things (abbreviation: IoT) is a term over which many disciplines claim some intellectual ownership. It refers to the network where many computing devices are interconnected, enabling them to send and receive data. For example, the mobility system gathers data and information from devices embedded in everyday objects. IoT can transform urban mobility by altering how mobility systems gather data and information.

Internet communication technology (ICT)

Information and communication technologies (abbreviation: ICTs) have considerable importance for Mobility as a service, as they are the key to providing users access to travel information, such as travel planning tools, opportunities to share transport modes, compare costs, make payments, and to communicate travel patterns.

List of Figures

List of Tables

Table of content

Chapter 1. Introduction

This chapter presents the research background on Mobility as a Service (MaaS) and privacy concerns. First, it introduces the concept of MaaS, followed by the research problem, aims, and objectives. Finally, this chapter concludes with the delimitations and limitations of this study and a description of the thesis structure.

1.1. Background

MaaS integrates different forms of mobility, such as public transport, buses, ferries, and shared cars. Via a digital platform or interface, it enables users to plan, book, and pay for multiple types of mobility needs (Göran, 2020; Merus et al., 2020; Lyons et al., 2019). Ideally, to offer users-centric mobility services, MaaS allows for personalization and customization (Alyavina et al., 2020; Utriainen and Pöllänen, 2018; Jittrapirom et al., 2017). However, despite numerous potential benefits and advantages, progress from MaaS pilots to large-scale implementation has been relatively slow (Karlsson et al., 2020). Data-related issues are a key barrier to the adoption of new technologies (Rohunen and Markkula, 2019). In particular, users' technology acceptance largely determines the development of MaaS (Jittrapirom et al., 2017). To develop smart mobility systems that are responsive to end-user expectations, the underlying technologies and data platforms must be acceptable to users. In light of this requirement, information privacy is an area of particular relevance and interest to both end-users and service providers (Jittrapirom et al., 2018).

Information privacy has attracted attention in the domain of socio-technological research. However, there are gaps in the literature concerning information privacy, particularly in mobility. While existing information privacy research is extensive and covers various services that require personal data collection, studies conducted in the context of data-based mobility services are scarce (Rohunen and Markkula, 2019). The literature on privacy concerns has traditionally focused on e-commerce and social networking services (e.g., Nemec Zlatolas et al., 2022). This

area of privacy research mainly focuses on the perceived risk related to the disclosure of personal information while using websites or during transactions. The importance of privacy considerations in the MaaS context has been raised by scholars such as Jittrapirom et al. (2018). They identified privacy as a potential constraint to meeting MaaS objectives, but privacy concerns raised by end-users have not been addressed.

As Matemba and Li (2018) have argued, the adoption and use of services that require personal data disclosure depend on users' willingness to share data. Similarly, whether a MaaS system can become effective depends on users' willingness to disclose personal data (Rohunen and Markkula, 2019). While MaaS has the potential to develop mobility services to meet users' expectations, such development relies on users' personal information. However, users are not always willing to share their information with others; if that is the case, MaaS service providers may have difficulties developing optimized mobility systems. For example, regarding voluntary data disclosure related to data-based mobility services, privacy concerns can lead users to refuse to disclose information or to impose limitations on data collection (e.g., turning off data collection), resulting in non-adoption of MaaS solutions. Similarly, the perceived risk of private information being shared may cause users to provide false information or omit specific data, thus decreasing the quality of the data (e.g., Horne et al., 2007; Metzger, 2007; Son and Kim, 2008).

1.2. Problem formulation

As mentioned above, gaps in knowledge have been identified in the form of the lack of empirical research on privacy concerns in the MaaS context. However, privacy issues should not be ignored in MaaS development. Notably, users' personal data are essential for developing personalized and customized mobility services. Therefore, it is important to understand how the implications of privacy concerns can affect the development of MaaS.

The use of Maas In emerging services has received increasing attention as a sustainable solution for urban transport. Some studies mentioned that privacy concerns are an issue in MaaS development, but there is little effort in studying this. This gap provides a starting point for new

research opportunities, as privacy concerns have many dimensions, and it remains unclear how they relate to MaaS. On the one hand, recent studies have demonstrated that privacy concerns are context-specific (Donath, 2020; Padyab and Ståhlbröst, 2018; Kayhan and Davis, 2016; Li, 2011). On the other hand, existing studies have shown that in many cases, other factors also influence users' acceptance of services, for example, trust. However, the impact of different factors on users' acceptance of services can vary from case to case. Since many services require users' data, privacy concerns should receive more attention. Therefore, studying users' privacy concerns in the case of MaaS can expand the current understanding of this topic.

1.3. Objective

The purpose of this thesis is not to prove that MaaS is the only beneficial way to help urban mobility to become smart. However, due to the emerging interest in the concept, it is important to understand the impact of the technology used in MaaS concerning the future endeavors of MaaS development.

In response to the previously mentioned gap in the literature, the objective of the proposed thesis is *to explore privacy concerns around MaaS and their impact on users' intention to use it.*

1.4. Research questions

Against this background, the aim of this study is to explore the impact of privacy concerns on users' adoption of MaaS. It begins by exploring which dimensions of MaaS could be related to privacy concerns. Thereafter, the arguments in support of MaaS adoption are made.

Two research questions guide the design of this study:

RQ1. What are the dimensions of MaaS users' privacy concerns?

RQ2. What explains users' intention to use MaaS?

Two sub-questions are presented to answer the main research question. The first sub-question asks whether privacy concerns are related to MaaS per se:

RQ 1.1. Is there a difference between mobility service users' privacy concerns depending on the service's spatial context and the ownership of the device used to access the service?

The second sub-question is concerned with the underlying factors that support or reduce user's intention to use MaaS:

RQ 2.1. Which factors have implications on a user's intention to use MaaS services?

1.5. Limitation and delimitations

With the objective of this study in mind, certain limitations and delimitations are defined.

First, the study focuses on one case, namely a MaaS pilot in a city, which can be considered both a delimitation and a limitation. The limitation of a case study is its generalizability; however, this is an explorative study, and the intention is not to make generalizations. The case here should be capable of offering useful information. Further, because this is an independent work conducted with limited resources, it was important to focus only on one case. Finally, because this study had no funding and was affected by the COVID-19 pandemic, the possibilities for interviews or other extensive investments in the data collection phase were limited.

These limitations imply that the results are confined to the specific context of the study, but the focus on this work allows for an in-depth understanding of the issue in that context. On the one hand, since the pilot case was one of the first initiatives to adopt the MaaS concept in the city of Stavanger, it can be regarded as a unique case. On the other hand, the MaaS concept is still relatively novel in this region, and there were no other known MaaS pilot projects in this region when this study was conducted.

Since this study focuses solely on the initial understanding of the impact of users' privacy concerns on their intention to use MaaS, it is not possible to spell out and study all the possible factors that could impact the user's intention. Therefore, many other indirectly relevant factors are omitted from the study.

Further, this study does not aim to generalize the results, which is its main limitation. Hence, it will not be possible to confirm some of the results without conducting a large-scale survey. The selection of participants is also a limitation. As only participants considered capable of completing the survey were recruited, the survey data were collected from a specific group; this also affected the size of the data collected.

1.6. Outline

This thesis is designed in accordance with the suggestions from the "Guidelines for Master Theses in Energy, Environment and Society 2022." The present work is divided into six chapters, all of which are both essential and distinct. Essentially, these chapters provide a clear structure, which makes it easier for the reader to follow and understand the research presented in this thesis.

Chapter 1 introduces the research problem and presents some background information on the relevance of the topic in the specific context. Then, based on this backdrop and problem formulation, the study's objective is presented alongside the research questions, which help to achieve the objective. Finally, this chapter ends with a discussion of delimitations and limitations, which explain the scope of this study.

Chapter 2 is the literature review. It begins with the literature on MaaS, followed by the existing literature on privacy concerns related to MaaS; this review is intended to familiarize readers with the topic. Further, relevant models and constructs that are often used for studying privacy concerns are discussed.

Chapter 3 presents the research design. It describes the methods, and methodology to gather primary data. Since there was no instrument available for such proposes, the development of the instrument used for data collection is described. Further, the approach of this study, which involved different evaluations of the collected data sets, is discussed.

Chapter 4 reports the results and analysis of the case study. This chapter intends to both achieve the research objective and answer the research questions.

Chapter 5 discusses the extent to which this study contributes to scientific knowledge.

Chapter 6 concludes and notes this study's implications. Additionally, suggestions for future research are made.

Chapter 2. Literature review

MaaS-related research involves multiple aspects. This chapter begins with the main research areas regarding MaaS. Further, privacy research related to MaaS is presented, namely (a) privacy concerns related to MaaS, (b) information privacy concerns related to personal data disclosure in MaaS, and (c) relevant models for studying privacy concerns in users' acceptance of services. The relevant literature for each of these three areas is presented.

2.1. Research on MaaS

Research on MaaS solutions started around 2016, and the relevant literature has subsequently grown continuously (Esztergár-Kiss et al., 2020, p.4). This literature has covered various subjects, including definitions and concepts such as MaaS ecosystem construction (Kamargianni et al, 2017; Datson, 2016) and MaaS benefit evaluation (Kamargianni et al., 2016; Zhao et al., 2021). To explore the possibilities of MaaS development, some studies have covered subjects such as business model exploration (Callegati et al., 2016) and function design (Sochor et al., 2016; Arnaoutaki et al., 2019). Further, other studies have focused on barriers to MaaS development, such as data sharing and security (Cottrill, 2020; Chondrogiannis et al., 2016) and MaaS impact assessment (Li and Voege, 2017). Among these topics, barriers to MaaS implementation are among the most discussed. The barriers that have been identified include i) legislation and regulatory frameworks (König et al., 2016), ii) taxation (Karlsson, 2020), iii) a lack of appropriate business models (Li and Voege, 2017), iv) uncertainties regarding market potential (Karlsson, 2020; Kamargianni et al., 2017), and v) a lack of sources of fundings and investors (König et al., 2016). Zhao et al. (2020) have provided a helpful review of the critical barriers to MaaS development and implementation. However, these studies were predominantly based on the perspectives of experts and stakeholders.

A few studies have focused on users and considered users' perspectives on the technical features and other relevant functionalities of MaaS applications. For example, Arnaoutaki et al.

(2019) have discussed designing and offering suggestions for an optimal MaaS plan that matches users' personal needs. However, the study by Arnaoutaki et al. was focused only on designing a number of mobility services under one or more service packages and did not include the user experience. Schikofsky et al. (2020) have focused on motivation in MaaS adoption, for example in relation to efficiency and performance, ease of use, choices based on preferences, feelings of control, and anticipated enjoyment. However, they overlooked the technical features of MaaS applications. A lack of research on users' perspectives on MaaS can thus be identified in the literature. However, this subject is of great importance to the implementation of MaaS solutions.

Existing research has enriched the academic understanding of how MaaS can develop and change urban mobility. However, research on the willingness of users to accept MaaS has been insufficient. The ultimate goal of MaaS is to meet the needs and expectations of users, and all other elements (such as technology, policy, business model, and land use) are merely enabling factors. Existing research has focused mainly on the possibilities for MaaS' development; however, it has ignored the fact that user data (e.g., mobility information [MI], regarding which user may have privacy concerns) serve as the design material for MaaS products and systems. Therefore, the current study attempts to fill this gap by exploring the factors that explain users' intention to use MaaSs, with the results being used to provide suggestions for the promotion of MaaS in the future.

The following subsections explore existing literature focused on users' perspectives and privacy concerns relevant to MaaS and technical features.

2.2. Privacy concerns related to MaaS

The existing literature has studied the impact of privacy concerns on users' acceptance of various services, such as e-commerce, smart homes, and e-health. However, little attention has been devoted to MaaS. In considering ways by which to fill this knowledge gap, the author noted that privacy concerns could be related to the spatial context of different types of MaaS

applications and the ownership of the device used to access the services; these topics are discussed in the following section.

2.2.1. Privacy concerns related to the spatial context of MaaS applications

Various authors (e.g., Donath, 2020: Clark and Greenleaf,2017) have identified the spatial dimension as being relevant to privacy concerns. Donath (2020) noted that privacy is contextual and differs from place to place. For example, one may feel more secure making a phone call in a private space than in a shared space. When it comes to mobility services, when one travels in a car, they move in a "private space" that separates themselves from the public space; in contrast, those who use public transport travel without separating themselves from the public space. According to Finn and Wright (2010), privacy can also be regarded as including the rights to be alone in a personal space (i.e., a car) and to move freely in a public space without being tracked. From this perspective, individuals' privacy concerns refer to whether they can avoid interactions with the public while traveling from point A to B. Alternatively, privacy concerns refer to traveling from point A to point B without being identified, monitored, or tracked. Now that private space is connected to public space by technology (e.g., the Internet of Things), car users can remove themselves from public observation while on the road. The private space they enjoy in the vehicle distinguishes them from bus users, who move among the public. Therefore, privacy concerns related to space may lead users to choose different mobility services.

2.2.2. Privacy concerns related to the ownership of the device used to access MaaS applications

The ownership of the device used to access mobility services is also relevant to privacy concerns. For example, Derek (2017) has identified different attitudes towards tracking related to whether one owns the car being tracked. He found empirical evidence showing that car owners are less willing to be tracked than shared car users. Further, Acheampong (2020) found that car ownership is related to privacy concerns, which affect one's choice when a number of different mobility services are available.

2.3. Information privacy concerns related to MaaS

MaaS provides users with all the necessary services for their trips, such as trip planning, booking, ticketing, and payment features and real-time information, through a single digital platform, meaning that users do not have to rely on multiple ticketing and payment operations (Merus et al., 2020). To utilize the full potential of MasS, a user needs to share a significant amount of personal information. Providing efficient MaaS requires the combined time- and location-specific travel behavior data of individual users. In some cases (e.g., car sharing), service providers may require more targeted information (such as preferred travel modes and habits, access to a vehicle, and the presence or absence of a driving license), which contributes to developing personalized and customized mobility services. At the same time, a user's ability to schedule payments through the service will also necessitate that the user share their financial information, adding another layer of data to the profile. These examples entail the creation of a detailed individual profile for these mobility services.

Further, MaaS platforms include various mobility services where users can access multiple services. This service development means that actors in the mobility domain increasingly combine data sets to increase service provision (Zhao et al., 2015; Cottrill and Derrible, 2015; Çolak et al., 2015). That those providers need specific user profile information to offer the customized mobility service also raises questions concerning user data and privacy concerns.

2.3.1. Perceived risk of secondary use of information

Perceive risk is among the privacy concerns associated with the MaaS providers collecting users' personal information. Perceived risk refers to the degree to which individuals believe that if they disclose their personal information, they will suffer losses due to losing control over that information (Nemati and Van Dyke, 2009). For example, the secondary use of the information refers to a situation where "the information collected from individuals for one purpose is used for another" (Smith et al., 1996, p.171). As noted by Solove (2006, p.520), "[t]he potential for secondary use generates fear and uncertainty over how one's information will be used in the future, creating a sense of powerlessness and vulnerability."

In addition, perceived risk may be associated with users having less control over how others may use their personal information or for what purposes. Empirical cases have revealed public suspicions regarding the secondary use of information, which has resulted in users abandoning services (see Van Gaal, 2014; Dominiczak, 2015). Given that MaaS providers need to use users' information to develop their mobility services, the perceived risk of the secondary use of MaaS users' personal information is assumed to be relevant to privacy concerns in this context.

2.3.2. Perceived risk of mobility information

MI is a specific type of information that can reveal one's location or mobility history, which is highly relevant to privacy concerns. Mobility data include a wide range of information, such as one's travel route, time, transportation tools, and travel behavior (De Mattos et al., 2022). Developing businesses are increasingly collecting such a variety of data, which can even be made publicly available as open data (Rohunen and Markkula, 2019). However, the increasing availability of such data increases the possibilities in terms of identifying a particular individual based on this data, which creates privacy concerns in the current MaaS context (Paiva et al., 2020). For example, cars' tracking data, such as that concerning speed and fuel consumption, can serve as a rich source of information.

Personal mobility data of this type would be helpful for future MaaS concepts that aim to optimize travel time or costs by combining different transportation modes (e.g., Kolumbus travel planner). The current trend with regard to user mobility data collection in MaaS is through a mandatory application that can be complemented with voluntarily disclosed data. Users explicitly consent to have their data used; the voluntarily disclosed data can be used to produce additional services. However, given that one cannot access MaaS if they do not agree to provide mobility data, this is merely a passive form of voluntary data disclosure. In addition, there is uncertainty about the possible use of users' mobility data. Therefore, the perceived risk of sharing mobility data is also assumed to be relevant to privacy concerns.

2.4. Relevant models in MaaS adoption

2.4.1. Technology acceptance model

To understand why people accept or reject new services due to privacy concerns, different methods have been proposed (e.g., Alberto Castañeda et al., 2007; Dinev and Hart, 2004; Malhotra et al., 2004; Stewart and Segars, 2002; Smith et al., 1996; Culnan, 1993, Ajzen, 1991). Among the theories, the technology acceptance model (TAM) has proven to be one of the most useful in explaining users' service adoption (Venkatesh, 2000). The TAM is derived from the theory of reasoned action (TRA) by Fishbein and Ajzen (1975) and is widely used for testing user acceptance of information technology (Davis et al., 1989).

Davis (1989) hypothesizes that system use is directly determined by behavioral intention to use (BI), which is in turn influenced by perceived usefulness (PU) and perceived ease of use (PEU). PEU refers to the individual's perception of effortless use of a service (Davis, 1989; Taylor and Todd, 1995). Previous studies have found that ease of use is vital for acceptance, as familiarity with technology and the skills needed to use technology are likely to be significant for various services (Park et al., 2017; Kim et al., 2017). In addition, many earlier works have provided empirical and theoretical evidence that PEU directly and positively influences BI (Dabholkar and Bagozzi, 2002; Dabholkar, 2002; Venkatesh, 1999; Szajna, 1996; Davis, 1989).

The appeal of TAM is that it is specific, efficient, and easy to modify. Researchers have often augmented TAM by adding new constructs to fit specific conditions in various services, thus improving the explanatory ability of the model. These constructs are also easy to understand for system developers and can be considered during system development stages. Therefore, this model has been widely applied to solve the acceptance problem (Taylor and Todd, 1995).

2.4.2. Trust and the TAM

Trust is an essential element of the economic framework of social exchange (Kelley, 1982; Kelley and Thibaut, 1978). Business transactions are usually carried out during social exchange without an explicit contract or control mechanism against opportunistic behavior. In that sense, the parties involved in these activities expose themselves to a complicated social environment

characterized by mass uncertainty. To ensure better rewards from economic activities, people make efforts to reduce this uncertainty and avoid the risk of being exploited (Wrightsman, 1972). Therefore, trust is seen as key to reducing the perceived risk of a transaction, which increases the perceived certainty regarding the expectation of the trustee (Grabner-Kraeuter, 2002; Gefen, 2004). For an online environment, In the absence of mechanisms intended to reduce the perceived risk of undesirable opportunistic behavior on the part of an e-vendor, only short-term transactions would be possible (Kim et al., 2004; Pavlou and Gefen, 2004). Accordingly, trust is an essential determinant in e-commerce, including public services.

The connections between trust and the TAM have been widely discussed in the literature, such as in online business settings (Gefen, 2004; Gefen et al., 2003a, Gefen et al., 2003b; Pavlou, 2003; Saeed et al., 2003; McKnight and Chervany, 2002), e-health (Pai and Huang, 2011; Holden and Karsh, 2010), online gaming (Wu and Liu, 2007), and e-banking (Suh and Han, 2002). However, studies have yielded different results. For example, Hsu and Lin (2008) found that trust positively influences attitudes towards blogs. In contrast, the relationship between trust and attitudes towards online purchases was not found to be significant in a study conducted by Heijden et al. (2003). In addition, the impact of trust on intention to use has been found to be insignificant in mobile applications (Watzdorf et al., 2010), while negative correlations have been found between trust, perceived usefulness, and actual usage (Chen et al., 2004). While MaaS is considered a particular type of e-service, the trust and TAM model is partially applicable to the MaaS setting. However, there are additional variables, as discussed below, that should be included in this context.

2.4.3. Intention to use MaaS

The theory of planned behavior (TPB) underlying the effort of TRA has been proven successful in predicting and explaining human behavior related to using various information technologies (Ajzen, 2002). According to the TPB, a person's actual behavior is directly influenced by their behavioral intention, which is in turn jointly determined by attitude toward performing the behavior, perceived behavior control over that behavior, and relevant social norms (Ajzen, 1991). Norms refer to the shared understandings of obligatory, permitted, or forbidden actions

in a group of people or a larger cultural context (Cummins, 1996). In this sense, any unexpected use of one's information by a third party is regarded as a form of privacy violation. Several studies (Abrahamse and Steg, 2009; Guagnano et al., 1995) have discussed the positive correlation between norms and behavioral intentions in other contexts. For example, Culnan (1993) found that people who are less sensitive to unauthorized secondary uses of information have a more positive attitude towards behavior intention. In that sense, under the TPB and the TAM, behavioral intention measures the strength of one's willingness to try MaaS. Within MaaS, it is also possible that a positive attitude on the part of a user towards a service will increase the likelihood that that user will provide personal information in exchange for a specific mobility service, and a less positive attitude will lead to a lower likelihood of sharing personal information. Given that many factors can affect one's intention to use a service, behavior intention is used to represent one's willingness to adopt MaaS.

Chapter 3. Methodology and research design

This chapter presents the methodology and the design of this study. It begins with the case study, followed by the methodology and the research design and strategy.

3.1. Case study

According to the literature review and the introduction to the TAM model, users' privacy concerns related to MaaS have multiple dimensions. All these dimensions may have implications for a user's intention to use MaaS. As mentioned in Chapter 1, two research questions serve to illuminate this complex issue.

To answer these questions, a case study was conducted. The selected case helped to illuminate privacy concerns associated with MaaS applications. The case selected for this study was a MaaS pilot launched in "Innovation park" in Stavanger, a city in southeast Norway, in November 2019. In this pilot project, Kolumbus, a regional public transport operator, and Hyre, a car-sharing service provider, developed mobility services in line with MaaS. As a result, users pay the same price to access multiple transport services via a single digital channel. This pilot offered a unique opportunity to study users' perspective on the adoption of MaaS and was therefore chosen as a case study for this project.

The selected case is instrumental; this approach is helpful in that it allows for answering research questions that concern broader issues than this particular case. Therefore, this inquiry takes the form of an instrumental case study. Instrumental cases such as this have very limited generalizability (Stake, 1995). The intent is mainly to illuminate a complex issue or concern with helpful insights.

As mentioned in Sections 2.2.1 and 2.2.2, the two identified dimensions guided the selection of four groups of MaaS users from this selected case, as presented in Section 3.4.1.

The following section presents the methodology and the research design of this case study.

3.2. Methodology and research approach

According to Della Porta and Keating (2008), methodology refers to the instruments and techniques used to acquire knowledge. The objective of this study is to identify explanations for the assumptions of a cause-effect relationship between variables. Achieving this goal starts with theories, which are then used to generate hypotheses, and the empirical world is then explored, where data are collected to test these hypotheses. This process is similar to the hypothetico-deductive method in natural science (Crossman, 2020), in which the study of social reality utilizes scientific reasoning to generate and test proposed hypotheses in the real world (Corbetta, 2003). This method reflects the positivist tradition, which aims to derive useful knowledge in the sense that certain outcomes of future events can be explained (Lawson, 2015), which is in line with the objective of this study.

Because it is more difficult to conduct experiments in social reality than in a laboratory, data sets and statistical analysis are used to identify causes and effects and arrive at a single explanation. This is not to say that only the quantitative method can be used in this study; however, whether other (qualitative) methods are used, they follow the same logic of inference.

When no instrument is available , which is the case for the present study, many scholars suggest using a mixed methods approach for exploratory instrument design (Bryman, 2006, Creswell and Plano Clark, 2018; Collins et al., 2006; Crede & Borrego, 2013; Durham et al., 2011, Hitchcock et al., 2006; Nastasi et al., 2007). Therefore, the research approach adopted in this study is exploratory sequential mixed methods. It begins with a qualitative method, where the qualitative data contribute to developing an instrument with which to collect quantitative data. It is worth noting that, even though both qualitative and quantitative methods are used, the logic of inference follows the positivist tradition. The research design is presented in the next section.

3.3. Research design

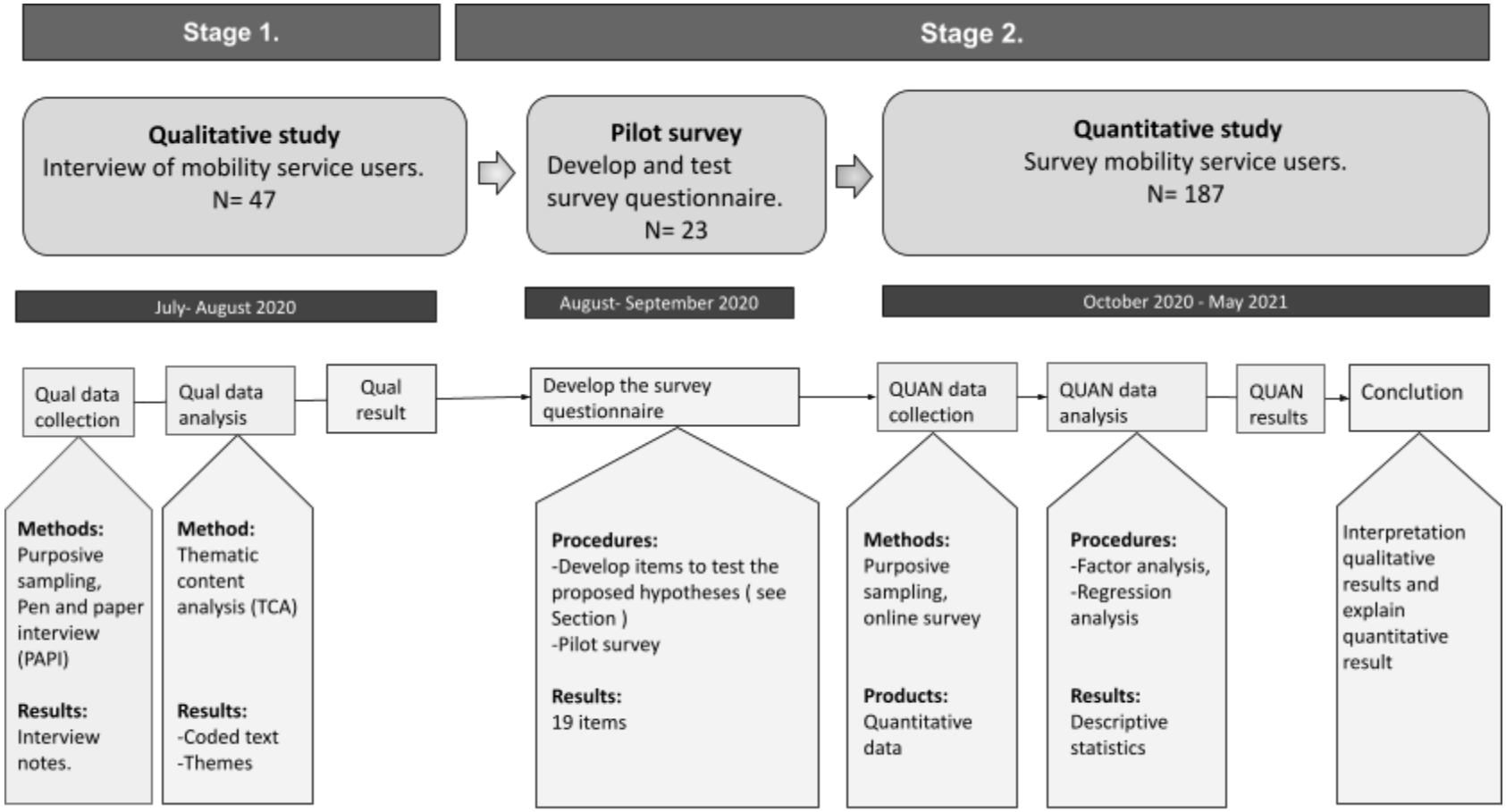
In this case study, privacy concerns related to MaaS were investigated. Particular attention was given to factors that may explain users' MaaS adoption. The emphasis is on quantitative data

collection and analysis. The research design includes a two-stage process that begins with qualitative data collection and analysis and moves to quantitative instrument design and testing (see Figure 1).

The research design follows a sequential mixed methods approach (Creswell and Plano Clark, 2018). First, qualitative data were used to answer the first research question. In this stage of the research process, differences between user groups regarding their privacy concerns were studied. In the literature review, it was found that the spatial context and ownership of the device used to access mobility services were relevant to privacy concerns. Hence, these two dimensions were helpful in identifying four groups of MaaS users from the selected MaaS pilot as participants for this study (see Section 3.4.1). Then, in a second stage, quantitative data were used to answer the second research question. Since the existing literature does not explain which factors have implications for MaaS users' adoption (see Chapter 2), the second stage aimed at empirically identifying factors that could explain the users' intention to adopt MaaS.

The integration between these two stages occurred where qualitative data were analyzed and used to develop an instrument for quantitative data collection. The intention was to develop an instrument grounded in participants' views (e.g., MaaS users) rather than use an existing instrument that may not accurately reflect their views. The evaluation of these data using qualitative and quantitative methods (thematic content analysis, survey, and factor analysis, regression analysis) allowed conclusions to be drawn regarding the validity of the hypotheses.

Figure 1. Stages of the research



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CLICK HERE to List of Figures

3.4. Stage 1: MaaS user interview

3.4.1. Participants

In Stage 1, 47 semi-structured interviews were conducted between July and August 2020. The qualitative data were used for initial exploration and to determine whether MaaS users' privacy concerns differ in relation to the spatial context of the MaaS platform and the ownership of the device used to access mobility services. Participants were MaaS users recruited from a MaaS pilot in Stavanager. Thus, four groups of users were selected:

1. Public transport users who use mobile apps (spatial context of the service: not private; ownership of the device used to access mobility services: yes);
2. Public transport users who use bus cards (spatial context of the service: not private; ownership of the device used to access the mobility service: no);
3. Shared car users (spatial context of the service: private; ownership of the device to access the service: no); and
4. Tesla owners (spatial context of the service: private; ownership of the device to access the service: yes).

Accordingly, a purposive sampling technique was used. The interviews consisted of questions in three parts. The first part was related to the respondents' experience of using MaaS mobility services in general. In the second part, the respondents were asked about their perceptions of information privacy. Finally, the interview participants' demographic information was gathered, including age, education, civil status, and IT competence. Those with IT competence were excluded because they typically have a much higher sensitivity to information privacy than the general public.

3.4.2. Qualitative data collection process

These interview questions were designed as an online survey where participants scanned a QR code or followed a link to access the interview questions through their mobile phones. The interviews were conducted in paper-and-pen form, with the participants reading the interview questions and the researcher taking notes on the interviewees' responses, while some participants entered their answers directly as text. Further, each interview result was numbered, allowing all participants to remain anonymous. If quoted in the research results, they were coded as P1–P47 in place of their actual names. The questions were designed to help participants think about their experiences of using smart mobility services and what their perceptions were regarding the personal information collected by service providers (see Appendix B for the interview guideline). These questions were divided into three stages. Part one contained demographic questions. Part two featured questions related to the use of smart mobility services in general (e.g., how did the participants start to use the specific smart mobility service, how often did they use it, how did they know of the service, what was their first impression, and did they like it). In part three, respondents were asked about their perceptions of information privacy. The first two questions in part three asked whether they thought sharing personal information contributes to ease of use or convenience. The respondents were then asked to actively identify these issues related to personal information (Part 3, # 3-6). For question #7, participants were asked whether they trust service providers to handle their information appropriately. Questions #8 and #9 concerned the secondary use of personal data and perceptions of the risks associated with sharing MI. These questions helped identify specific dimensions of privacy concerns related to MaaS, particularly in relation to the uncertainty arising from the environment of the internet and personal data flow, which may have affected the respondents' intention to use MaaS.

3.4.3. Qualitative data analysis

Thematic content analysis (TCA) was chosen in this process, as this study adopted an interpretive approach (Braun and Clarke, 2006). This study followed the six steps suggested by Braun and Clarke (2006) (see Table 1). This process was completed in several iterations. First,

transcriptions were read repeatedly to obtain an overall view of the interviewee's responses, followed by coding, searching, previewing, providing definitions of, and finally naming the themes (see Table D-I in Appendix A). In addition to the six-step process, the software Nvivo 12 was also used to generate word clouds to obtain an overview of the qualitative data.

Table 1.
Braun and Clarke's (2006) six phases of thematic analysis

Phases	Description of the process
1. Familiarization with data	Transcribing, reading, and re-reading the data, noting initial ideas.
2. Generating initial codes	Coding interesting features of the data in a systematic fashion across the entire data set, collating data relevant to each code.
3. Searching for themes	Collating codes into potential themes, gathering all data relevant to each potential theme.
4. Reviewing potential themes	Checking the theme work in relation to the coded extract (Level 1) and entire data set (Level 2), generating a thematic "map" of the analysis.
5. Defining and naming themes	Ongoing analysis to refine the specifics of each theme and the overall story the analysis tells, generating clear definitions and names for each theme.
6. Producing the report	The final opportunity for analysis. Selecting vivid and compelling extract examples, final analysis of selected extracts, relating back of the analysis to the research question and literature, producing a scholarly report of the analysis.

The qualitative data resulted in interview summaries, which served two purposes: First, they offered material with which to determine whether there were differences in privacy concerns among the mentioned user groups. Second, these qualitative data were used to develop items to test proposed hypotheses 1–5 (see Section 3.5.1).

3.5. Stage of mixing survey development

3.5.1. Hypotheses

According to the literature review and the TAM, several factors influence MaaS adoption. On the one hand, PEU and trust may positively influence users' intention to use these services, which would support MaaS adoption. However, on the other hand, factors such as PU, perceived risk of the use and sharing of user's personal information (SI), and MI may negatively influence users' intention to use these services, which would decrease the likelihood of MaaS adoption.

Two variables from original models, perceived usefulness (PU) and attitude, were not included. PU is not included because mobility services are useful in most people's everyday lives (Kowatsch and Maass, 2012); otherwise, no one will use these services . Further, the variable "privacy concerns" replaces the attitude variable. It represents an attitude towards MaaS, focusing on privacy risks.

These identified variables that may influence the user's intention are considered independent variables in this study. These independent variables measure one dependent variable - intention to use MaaS. Accordingly, based on these assumptions, the following hypotheses were formulated:

Hypothesis 1

PEU is positively associated with the intention to use (IU) MaaS.

Hypothesis 2

Perceived privacy concerns (PCs) are negatively associated with IU for MaaS.

Hypothesis 3

Perceived risk of secondary use of information (SU) is negatively associated with IU in MaaS.

Hypothesis 4

MI is negatively associated with IU in MaaS.

Hypothesis 5

Trust is positively associated with IU in MaaS.

An online survey was conducted to collect quantitative data with which to test hypotheses 1–5. The survey was designed based on the existing literature and this study's stage one results. Nineteen items from previous studies were selected and explicitly formulated to capture the context of this research and test the proposed hypotheses (see Table C in Appendix A).

Each of the concepts was tested by three to four items, with all items being measured on a seven-point Likert scale (ranging from 1, strongly disagree, to 7, strongly agree). The development of these items is described in Section 3.5.2. Although all the items were adapted from previous empirical studies, they were explicitly formulated to match the context of the current study, particularly the items used to measure the concept of trust; which were adapted from Lee (2005) and Pavlou (2003). Further, since three MaaS providers were included in the scope of this study (i.e., bus, shared car, and electric car), three scenario-based questions were developed to capture the respective contexts in which these services are used. Participants were asked to indicate to what extent they thought that each service provider was handling user information appropriately.

The items used to measure the concept of perceived ease of use were adapted from the scales developed to measure PEU in the study by Park et al. (2017). Further, the items used to measure the concepts of privacy concerns were developed from the scales used to measure PCs in the study by Hsu and Lin (2016). Moreover, the items used to measure the perceived risk of secondary use of information were adapted from scales that were initially created to measure

SU in the study by Stewart and Segard (2002). Further, the items used to measure one's perceived risk of MI were adapted from the work of Pavlou and Gefen (2004). Finally, all these items were used to test the impact of the independent variables on the dependent variable IU. Three items were used to capture IU: two were based on the TAM and measured IU (Lee, 2005), and one standard item captured the level of one's willingness to exchange their personal information with a MaaS provider (i.e., bus, shared car, electric car).

Section 3.5.2 describes the process of developing these items.

3.5.2. Scale development

The questionnaire items were developed from two sources: the items from prior studies and interview data. As mentioned in Section 2.4, the measurements used in this study can be divided into five independent constructs and one dependent variable. The following section describes how each variable was developed.

PEU was defined as the extent to which users believe that using a service is effortless (Pavlou, 2003). Many interview respondents claimed they experienced convenient, comfortable, effortless, and cheap use of MaaS in the interview. However, half of the respondents noted that the procedure used to lease a car was not clear or understandable for shared car users. They explained that the registration process and the process for ending the lease were confusing and complicated, as opposed to effortless. In other words, the respondents emphasized that providing a large amount of personal information was a complicated but necessary requirement to enable the shared car. In this sense, ease of use refers to the interaction between users and the app or interface that enables users to access the service. Therefore, the questionnaire showed the app or interface of the bus, shared car, and electric car alongside the closed-ended questions below to assess how the respondents experienced using the interface. The respondent answered the three questions using a seven-point Likert scale (see Table 2):

- Using such apps/interfaces does not take much effort.

- These apps/interfaces are easy to use.

- The instructions for using such apps/interfaces are, in general, clear.

Table 2. *Scale of measurement I*

1	2	3	4	5	6	7
Strongly disagree	disagree	Somewhat disagree	neutral	Somewhat agree	agree	Strongly agree

Trust was the center of the third part of the questionnaire, and three scenarios were designed to measure it. In each scenario, the participants were asked to imagine themselves as an electric car owner, shared car user, or bus user, respectively (see Appendix C). At the beginning of each scenario, participants were informed of what types of personal information each service provider required from them to enable them to use these services. Then, the participants were asked whether they believed that a service provider would handle personal user information in a secure manner. Finally, the participants were asked about their intention to use these mobility services at the end of each scenario.

- The service provider is trustworthy in handling its consumers' information.

- I trust that the service provider takes measures to protect the information provided by consumers.

- I trust that the service provider devotes time and effort to prevent unauthorized access to its database.

After the question concerning trust in the service provider, the second question asked whether participants still wanted to use the service after considering these privacy concerns. The scale of measurement is presented in Table 3.

- Considering the data collected/used/stored by the service provider, how likely are you to be willing to provide personal information so that you can use this service?

Table 3. *Scale of measurement II*

1	2	3	4	5	6	7
Very unlikely	Unlikely	Somewhat unlikely	Neutral	Somewhat likely	Likely	Very likely

Perceived privacy concerns (PCs) focus on one's perception of the use of personal information in exchange for using MaaS. As mentioned in Section 2.2, privacy concerns are a vague concept for many; therefore, PCs is used to capture one's sense of losing one's privacy once one uses MaaS. Three closed-end questions adapted from Pavlou and Gefen (2004) were modified according to the responses from the interviews to ask about participants' perceived concerns in general:

- There may be privacy risks involved in using MaaS mobility services.

- Accessing "MaaS" exposes you to privacy risks.

- Using MaaS involves a loss of privacy.

The respondents used the same seven-point Likert scale mentioned previously to respond to the three questions (see Table 2).

SU is considered a construct, as several interview respondents expressed that their privacy was highly relevant to their uncertainty as to how their personal information might be used. These responses did not appear in a specific statement but were rather inferred based on the co-occurrence of other responses. For example, several respondents mentioned they thought it was unacceptable to use users' data for commercial purposes. Some mentioned that the service providers should inform the users when the latter's information is used. These conceptual co-occurrences suggested how some individuals may react to the uncertainty concerning the usage of their information. As a theme, SU helps to tie various accounts and responses together.

In this phase, the objective was to develop items to form a scale with which to measure this theme. Users had to consent to allow MaaS providers to use and store their data; otherwise, the users could not use the service. In this sense, the users were passive in their privacy choices because they had to exchange their personal information for using the service even if the service providers could use their personal information for other purposes. Therefore, these questions were designed across three conditions, with respondents being able to select their preferences. In addition, these questions reflected social norms around the degree to which users react to the use of their information and the potential violation of their privacy.

The two sets of closed-end questions were as follows:

Social norms regarding the secondary use of information

- The service provider must not use the user's personal information for any other purpose.

- The service provider should not use personal information for any other purpose unless authorized by the person who provided the information.

Social norms regarding storage and sharing of information

- The service provider must not share personal information in its database with any other company unless authorized by the individual who provided the information.

- The service provider must not share personal information in the database with any other company.

The wording of the measurements is the same as in Table 2.

Perceived risk of secondary use of information is considered a construct because several interview respondents expressed that their privacy was highly relevant to the uncertainty of how their personal information might be used. These responses did not appear in a specific statement but appeared as a concept suggested by other responses' co-occurrence. For example, several respondents mentioned they thought it was unacceptable to use users' data for commercial purposes. Some mentioned that the service providers should inform the users

when their information is used. These conceptual co-occurrences suggest how some individuals react to the uncertainty of usage of their information. As a theme, it helps to tie various accounts and responses together. In this phase, the objective is to develop items to form a scale to measure this theme. Users have to consent to let MaaS mobility service providers use and store their data; otherwise, they cannot use it. In this sense, the users are passive in their privacy choices, even if the service providers may use it for a not favorite purpose. Therefore, these questions are designed across three conditions, allowing respondents to select their preferences. In addition, they reflect social norms to what degree users react to their information privacy about use and storage.

Two sets of closed-end questions are as follows:

Social norms regarding the secondary use of information

-The service provider must not use the user's personal information for any other purposes.

-The service provider should not use personal information for any other purposes unless authorized by the person who provided the information.

Social norms regarding storage and sharing of information

-The service provider must not share personal information in the database with any other company unless authorized by the individual who provided the information.

-The service provider must not share personal information in the database with any other company

The wording of the measurements is the same as in Table 2.

Perceived risk of sharing MI is highly relevant to all types of MaaS. In principle, the service providers need to obtain users' location information to improve their services (e.g., recording an individual’s favorite route and offering real-time traffic information). Notably, issues regarding

location-based information are directly related to privacy concerns among MaaS users. For example,

"…. the (location information) is highly sensitive; it can be problematic for me.” (EV owner, female, 40–49)

Several studies have focused on services based on location information (e.g., Poikela, 2020; Zhou, 2011). Although these studies focused on services other than MaaS, they all showed that privacy concerns can negatively impact users' adoption. Therefore, items from the questionnaire in Pavlou and Gefen (2004) were adopted to measure how MaaS users perceive the risk of MI.

- Generally, it is risky to provide location information to MaaS providers.

- There is much uncertainty associated with providing MI to a service provider, as users have no control over what information is used (e.g., for business development purposes).

- There is a potential loss associated with providing MI (i.e., data leakage is likely because of uncertainty about how MI may be used).

The wording of the measurements is the same as in Table 3.

Overall, the process of adjusting wording of the measurement scale and items are presented in this current section. In the next section, the process of testing the questionnaire’s items will be described.

3.6. Stage 2: MaaS user survey

3.6.1. Pilot survey

Before starting the survey, a pilot survey was conducted between August and September 2020. Twenty-three MaaS users were randomly recruited from Stavanger's "Innovation Dock." To distinguish the participants in the pilot survey from those in the primary one, they were asked whether they are employees or students at the University of Stavanger. Only those who did not belong to these two groups could participate in the pilot survey. The sample size was not set in

advance, as the purpose of the pilot survey was to improve the quality of the survey questionnaire. Hence, all items were reviewed by professors, researcher peers, and doctoral students for appropriateness and comprehensiveness. The testing and modifying of the questionnaire were based on the feedback of pre-testing participants. This process was repeated until no further changes were considered necessary.

3.6.2. Survey participants

The participants were MaaS users who had the following educational backgrounds: master's students enrolled in "the energy, society, and environment," " the regional and urban planning," "the energy engineering," "the environmental engineering," "the resource, and energy management," course of study at the University of Stavanger. The criteria for selection were that the participants enrolled in the abovementioned programs of study were proficient in English. It was assumed that the selected participants (240 postgraduates with the specified educational backgrounds) had strong intentions to support and complete the survey. This technique is a selective sampling based on participants' academic qualifications and English proficiency. Therefore, higher income and higher education groups were overrepresented in the sample. However, since the purpose of this study is not to generalize the results to any specific group, this bias does not cause any conflict. In addition, participants' demographic information, including age and sex, was also collected. A total of 187 usable responses were obtained from 240 postgraduates.

3.6.3. Quantitative data collection process

The data were collected using the software surveyXact, which was used to send the survey via email to MaaS users between October 2020 and March 2021. The survey was conducted as part of a service adoption questionnaire for MaaS users to mitigate possible non-response bias due to disinterest in information privacy.

3.6.4. Quantitative data analysis

The quantitative data were analyzed using IBM SPSS Statistics version 26. Factor analysis is a data reduction technique (Pallant, 2013) that is used when there is a need to condense

measurements into identifying groups of interrelated variables (Kissi et al., 2016; Norusis, 1992; Li et al., 2005). Further, this technique is ideal for reducing variables to an easily understood structure (Field, 2009). Therefore, factor analysis is applied to analyze the survey data to identify the underlying links between the 19 items.

The Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of sphericity were used to determine the suitability of the collected data for factor analysis. These tests are often performed before the application of a data reduction technique to verify that the technique (in the case of this study, factor analysis) can actually compress the data in a meaningful way (Norusis, 1992). KMO measures the sampling adequacy for each variable and the complete model (Field, 2009). According to existing literature (Child, 1990; Norusis, 1992), a KMO value greater than 0.5 is considered adequate for factor analysis. High values (i.e., those close to 1.0) generally indicate that factor analysis may be useful with a given set of data.

Further, Bartlett's test for sphericity was used to test the relationships among the variables. It checks whether there is a certain degree of redundancy between the variables that can be summarized with a few factors (Osei-Kyei et al., 2014). Essentially, it measures whether the correlation matrix is an identity matrix that tests the null hypothesis (Ofori- Kuragu et al., 2016). The test's null hypothesis is that the variables are not correlated, which indicates an identity matrix. If the significant level of the test is small enough, the null hypothesis should be rejected, which would indicate that the variables in the correlation matrix are not an identity matrix (Dogbegah et al., 2011). An identity matrix means the variables are not correlated.

Moreover, regression analysis was used to test the proposed hypotheses. Linear regression is a statistical tool for investigating relationships between one dependent variable and more independent variables (Alan, 1993). To explore such relationships, regression analysis was used to estimate the quantitative effect of the causal variables on the variables that they influence.

Regression analysis helps to identify which independent variables impact the dependent variable—for example, the effect of one's intention to use MaaS increases with trust. Further, the statistical significance of the estimated relationships is assessed by a p-value. The p-value is based on two hypotheses: One of these is the null hypothesis, in which it is normally assumed

that there is no effect of an independent variable on a dependent variable. This means that an observed difference could have occurred by random chance and that this difference is therefore not a real statistical one. The lower the p-value, the greater the statistical significance of the observed difference (Pripp, 2015). A p-value of less than .05 is typically considered to be statistically significant, in which case the null hypothesis should be rejected (Fisher, 1950). Thus, a p-value of .05 means there is a very good likelihood (namely a 95% likelihood) that the difference in outcomes would not be observed. In contrast, a p-value greater than .05 means that deviation from the null hypothesis is not statistically significant, and the null hypothesis should not be rejected.

3.7. Quality issues

Reliability and validity are two essential aspects of all research. This study includes a qualitative study and a quantitative one. The rigor and trustworthiness of qualitative research equate to the concepts of the reliability and validity of quantitative research, and all are necessary components of quality. The following sections discuss the potential quality issues and the effort to enhance the quality in both studies.

3.7.1. Stage 1. Qualitative study: rigor and trustworthiness

Since subjectivity is inherent in qualitative study, rigor and truth are more of a concern in qualitative research (Houser, 2013). According to Morse et al. (2002), rigor is defined as referring to the strength of a research design and the appropriateness of a method for answering the questions investigated in a study. To achieve rigorousness, a clear explanation of the rationale for the research design and methods was presented in the previous sections. Further, truth with regard to a qualitative study refers to "trustworthiness," which Schimit (2015) defines as quality, authenticity, and truthfulness. In this regard, the quality of qualitative research also relies on whether the data gathered can appropriately represent and explain what the participants intended to convey in the interview (Bryman & Bell, 2011; Gray, 2018; Saunders et al., 2016). Therefore, the interview data and interpretation process are presented in detail to convey the "truth" in this study. Meanwhile, some scholars have rejected the reliance on

methods or technical procedures to ensure truth. Instead, they argue that the quality of a qualitative study lies in the skills and knowledge of a researcher and how they use their knowledge and abilities as an inquirer (e.g., Smith, 1990; Phillip, 1987). Therefore, to ensure quality, the author of this study, who had the most well-developed understanding of the research topic among all parties involved, conducted all of the interviews. In addition, the suggestion by Morse (1991) was followed to ensure the quality of interview data by allowing respondents to speak freely according to their perceptions. In addition, all interview questions were open-ended, and interviews were carried out as natural conversations. This means that respondents could speak freely and steer the conversation's direction. If the respondent answered vaguely or in a way that required further explanation, the interviewer would request that they further elaborate on their views.

In addition, respondents were free to decide whether to express any specific personal opinions or perceptions. In addition, they were not asked any particularly personal questions that may have caused them to feel uncomfortable. These considerations may have reduced bias, as respondents may otherwise have felt uncomfortable answering questions freely. The interviews were also short, meaning that potential bias caused by impatience on the part of respondents was limited (Saunders et al., 2016). To conclude, all of the above measures demonstrate the author's efforts to ensure the quality of the first part of this study.

3.7.2. Stage 2. Quantitative study: reliability and validity

This study used different means of gathering information that supplement each other and boost the quality of the data. The quantitative approach was used in the second phase of the study, where validity and reliability determined the quality of the quantitative study. Validity refers to the degree to which a measuring instrument measures what it is supposed to measure (Heales & Twycross, 2015). For example, a survey designed to explore satisfaction but that actually measures well-being would not be considered valid. Therefore, using a validated measuring instrument is essential to ensure that the findings obtained from analyses are valid (Anastasi and Urbina, 1997). Several different approaches to determining the validity of a measuring

instrument have been suggested in the literature (see Oluwatayo, 2012). In the current study, validity was enhanced by scale development to provide the most appropriate measurements according to the purpose of the research. This is so-called content validity (Bollen, 1989), which refers to the extent to which a concept is accurately measured. The typical way to ensure content validity is to use the input of professionals in the field (Beck, 2020; Koller and Glück, 2017; Reynolds et al., 2009; Allen and Yen, 2002). They have expertise in writing effective test items and balancing the many tradeoffs that must be made (Webb, 2006).

In the second phase of this study, the instrument used to collect quantitative data was a questionnaire. The questionnaire items were developed based on the research objectives and questions. To ensure the developed items conveyed the appropriate construct, this process involved numerous rounds of expert feedback and pre-testing. It began with consulting the experts to evaluate each expression in the developed items regarding the content of the appropriateness scale. Further, there was a pre-testing. In this process, participants provided feedback, which helped identify ambiguous, problematic, or well-written words in the question items. Thereby, the clarity of each question item was improved. The items developed for the questionnaire were intent to be most appropriate for the purposes of the scale. Thus, the content validity of the measuring was enhanced by the mentioned process.

After the questionnaire items had been qualitatively developed, they went through a quantitative examination to evaluate their reliability. Reliability refers to the consistency of a measure (Heales & Twycross, 2015); more specifically, it refers to the ability of measurement instruments to give similar results when applied at different times. In fact, it is unlikely that the same results will be obtained every time due to differences when the measuring instrument is applied and changes in the population and the sample. However, similarity between the results of a measuring instrument is an indication of reliability. The reliability of a measuring instrument is essential for the results of a study to be sound. Therefore, it is necessary to ensure that the measuring instrument used is reliable.

The reliability test in the quantitative study used Cronbach's alpha (C- α). Cronbach's alpha is the most commonly used test to determine the internal consistency of an instrument (Heales & Twycross, 2015). This test determines the average of all correlations in every combination of scales. Instruments with questions that have more than two responses can be used in this test (Sürücü, L. & Maslakçı, 2020). There are different suggestions regarding the minimum acceptable level of the values of Cronbach's αlpha. A commonly accepted rule of thumb for describing internal consistency is a = 0.5 or above (George and Mallery, 2003; Nunally et al., 1967). However, DeVellis (2016) argues that a scale's coefficient alpha should be above 0.7, while Pallant (2013) advises that a figure of above 0.8 is preferable. Very high reliabilities (0.95 or higher) are not necessarily desirable, as they indicate that items may be redundant (Streiner, 2003). Further, item-total correlations refer to the correlations between scores on each item and the total scale scores. Total item correlation is a criterion for initial assessment and purification in several studies. Again, various cut-off points have been adopted; for example, Cristobal et al. (2007) used 0.3 and Loiacono et al. (2002) suggested 0.4. The threshold to be removed in the current study is load < 0.5 (Kim & Stoel, 2004; Nunnally, 1978).

Table 6 lists coefficient alpha values. All scales exceeded the acceptable level, and none of the items indicated are redundant (i.e., C- α > 0.95 or higher). This result indicates that the measurement items have high reliability. Further, the statistical results of the measurements of each concept are presented in table and figures in the Appendix A. Overall, the above discussion shows that the reliability and validity have been taken into account in research design. Thereby, the interpreting of the results should make this current work more credible and trustworthy.

3.8. Ethics

The first area of harmfulness is the violation of confidentiality assurances (Neuman, 2013; Saunders et al., 2016). Confidentiality refers to having proper safeguards in place to protect participants' privacy and information from unauthorized access, disclosure, modification, loss, or theft (NESH, 2016). The technical measures employed to ensure confidentiality included password-protected electronic data, where the researcher was the only one who had access to the data. The other safeguard measure involved the data collection process. For example, all interviewees were given pseudonyms in the form of numbers, and the researcher avoided asking or including information related to a specific individual.

The second area, lack of informed consent, refers to the need to provide participants with enough information before the data collection process to allow them to determine their willingness to participate (Neuman, 2013). Since this study consists of overt research, all participants in the data collection process were provided with information and instructions intended to clarify the purpose of the study. The researcher’s contact information was also presented, and the participants were encouraged to make contact if they had any questions or suggestions regarding the research objective. Further, there were no sensitive personal questions in these two processes, as overstepping privacy at the individual level is considered unethical. Therefore, the balance of obtaining helpful information and ethical considerations were reached.

Finally, the issue of deception arises when research is presented in a misleading way (Bryman and Bell, 2011). To address this concern, the logic of the research design was presented and the data gathering and analyzing process reported clearly. The goal was to make the entire process transparent to avoid the researcher's presuppositions hampering the participants’ descriptions.

Chapter 4. Findings

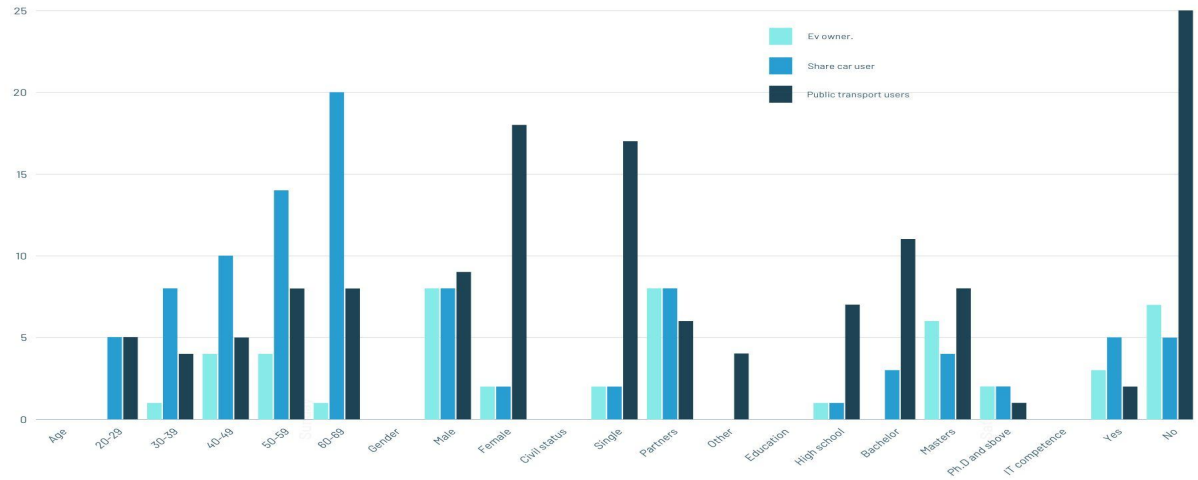
This chapter presents the findings of each of the data collection methods. The first sub-chapter (4.1) presents the results from the qualitative interview, where the results are reported based on the themes identified in the interview data. The second subchapter (4.2) presents the results of the analysis of the survey data.

4.1 Qualitative study

4.1.1. Interview Participants

Well over half of the interviewees were female (N = 47, 68%). More than half of those who responded were bus users (57.4%). They ranged from 20–69 years of age at the time of data collection; most of them (70%) were under 40, and almost half (42.5%) were under 30. Approximately half of interviewees were in a relationship, while the other half were single. More than a quarter of them held master's degrees, while 19.6% have a Ph.D. Less than a quarter of the interviewees had IT competence, in which case their opinion was excluded. Figure 2 and Table A in Appendix A show demographic characteristics of interview participants. A detailed information of interview participants are presented in Table J in the Appendix A.

Figure 2. Demographic characteristics of interview participants



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4.1.2. Word cloud

Following Braun and Clarke (2006), the researcher read the interview data extensively before the coding process. In this pre-coding stage, a word frequency query was run in NVivo to explore the most commonly used words. A word cloud was generated, which is presented in Figure 3. The word cloud helped to provide an overview of the commonly used words in the interview data. For example, a glance at the word cloud reveals that the interview participants used the words “information” and “privacy” frequently. These words provided confirmation of the existence of a certain degree of privacy concerns among MaaS users (see Figure 3).

Figure 3. Word cloud in NVivo 12

CLICK HERE to List of Figures

4.1.3. Qualitative result

The participants were divided into groups according to the spatial context and ownership of the device used to access the selected mobility services. Any similarities or differences in terms of these segments were identified.

Privacy concerns. The results of the interviews showed that most respondents had at the very least a few privacy concerns. It was also found that bus users were slightly less concerned with sharing personal data with mobility service providers than car users. However, this result does not indicate that the spatial context of the MaaS had an impact on users' privacy concerns. For example, it was apparent that young people, particularly those in the age group of 20–29, were less concerned with sharing their data. One respondent from this group explained that she could not be bothered with evaluating the data-gathering processes of mobility services because the service providers already had a significant amount of her information, so it was too late to worry about it. Another respondent who belonged to this age group said she had privacy concerns about the personal information collected by the bus operator but noted that they were not very serious.

Further, more than half of the female respondents indicated that their concerns about their privacy were more pressing than their personal interest in using MasS. In contrast, the other half of the female respondents argued that sharing their personal information makes MaaS easy to use. Additionally, a few female respondents said " I do not know " or "not so much of a concern" when indicating their perceived risk associated with sharing personal information due to their lack of knowledge and experience of information privacy. In contrast, many male users could name some data security problems, such as "data breaching" and "aggregate information." Furthermore, whether the users' privacy concerns are related to the spatial context of the MaaS platform remains unclear, which is further discussed later.

Further, the bus user group was divided into two segments according to the tool used to buy tickets: bus cards or apps. Bus users who use bus cards have less privacy concerns than those who use mobile apps. However, only a few respondents use bus cards, while most use mobile apps. The other two segments, shared car users and Tesla owners, have relatively more significant privacy concerns than bus users. However, the interview data do not indicate the difference in privacy concerns between Tesla owners and shared car users. These two groups of users differ in that shared car users, in principle, have fewer opportunities to determine the extent of data gathering by companies because they have fewer opportunities to consent to such. All these results indicated that privacy concerns were more related to information privacy than the ownership of the device used to access the mobility service.

Secondary use of information. Further, most respondents indicated a high level of privacy concerns related to the theme of SU. No explicit difference appeared regarding this theme related to the spatial context of the mobility services or the ownership of the device. In addition, there are respondents elaborated that they had privacy concerns regarding the purposes for which companies used user data. Several respondents indicated that commercial uses were "not acceptable," while using user data to improve services was considered acceptable. While almost all respondents from the shared car segment revealed deep concerns about the secondary use of personal data, one of them mentioned that these data should be used based on the contract [P14]. However, several respondents who belonged to the bus users group mentioned they did not mind [e.g., P29, 36, 40]. Interestingly, they belonged to the 20–29 and 30–39 age groups, and most were female with a lower level of higher education. However, more than half of the female respondents also discussed negative issues concerning the secondary use of their personal information. Further, all respondents with a higher level of education showed a unanimous negative attitude toward secondary information. These observations led the researchers to test whether SU has an impact on the participants' intention to use MaaS.

Ease of use. Most respondents expressed their impression that MaaSs are excellent and convenient. These statements were connected to the theme of PEU. Specifically, Tesla owners expressed the highest positive attitude regarding sharing their information in exchange for high quality services. Meanwhile, several contrary opinions appeared from the segment of shared car users. The issues that were specified were complicated registration and lease processes. While almost all respondents in all segments recognized that sharing information can contribute to ease of use, a few female respondents from the bus users segment did not think so. The latter participants belonged to the age groups 20–29 and 30–39. However, they could not describe the perceived risk of personal information, which indicates that they may have lacked relevant knowledge and experience of information privacy.

Trust. Most participants indicated that they had a high level of trust that service providers would handle their personal information in an appropriate manner. However, Tesla owners and shared car users had relatively low levels of trust in comparison to bus users. Many bus users expressed their belief that the bus operator would manage users' personal information well. The reasons for the trust were diverse. For example, one interviewee mentioned that a company in Norway was trustworthy because it had to follow the law (GDPR). In contrast, another respondent stated that large companies such as Tesla supposedly had better resources to manage users' personal information well. Meanwhile, there was no difference caused by spatial context or ownership regarding this theme.

However, a gradual reduction of trust could be observed with an increase in respondents' ages. Specifically, the level of trust was highest among respondents in the 20–29 age group, but it was moderately reduced among those aged 30–39. In the age group 40–49 and above, the level of trust appeared to be almost nonexistent. Further, the male respondents of the age group 50–59 emphasized that they did not trust that MaaS providers could handle users' information well. These respondents discussed examples of risks such as data breaching, unclear purpose of data usage, and aggregate information.

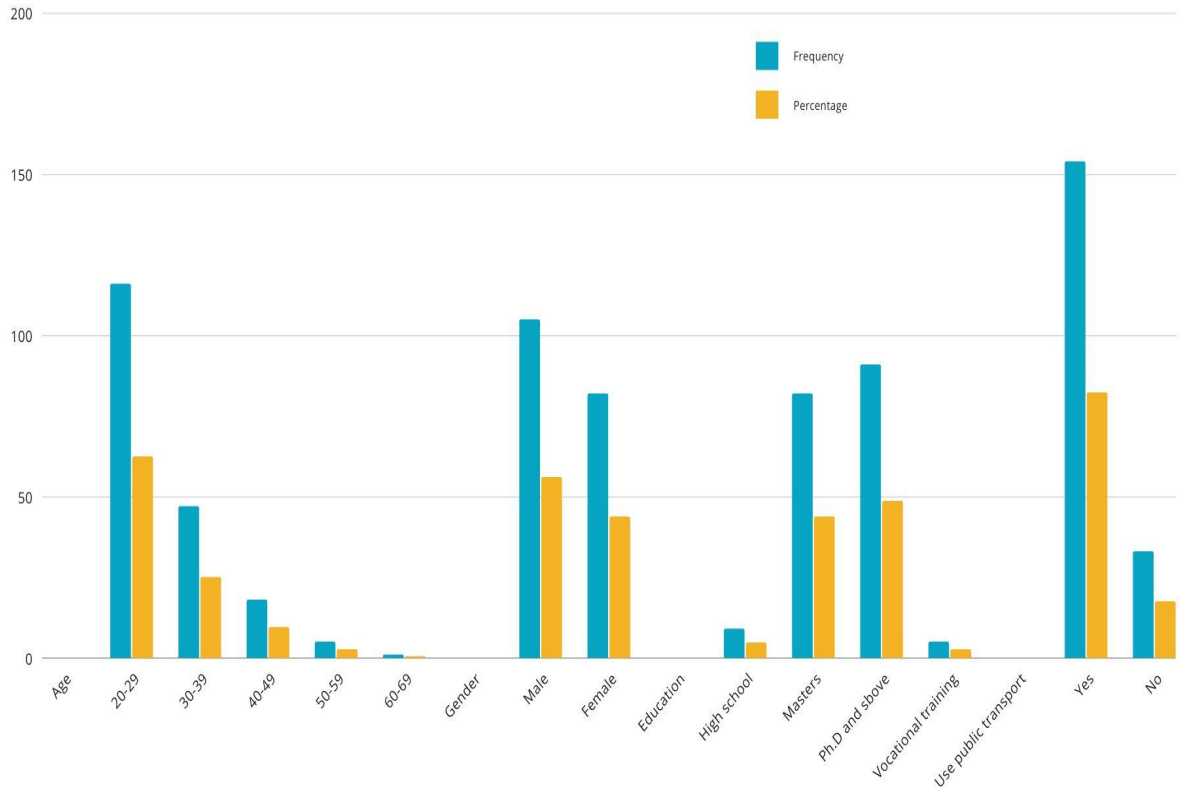
MI. Most respondents indicated that they have a high level of privacy concerns regarding MI. No difference was observed due to spatial context or ownership regarding this theme. However, there were many interesting statements concerning this theme. For example, one respondent who belonged to the 30–39 age group mentioned that it could be dangerous to reveal an individual's location information. However, he noted that a public authority could mitigate privacy concerns by securing this information. Another respondent, who belonged to the 20–29 age group, explained that she could not be bothered with evaluating data-gathering practices of companies due to the time and effort involved. However, some consumers expressed that they relied on the law to protect their data. Another respondent who belonged to this age group did not mind sharing personal data through a company website, but only if that data did not leave the website. Additionally, a respondent who belonged to the 20–29 age group was also unclear about his privacy concerns and, as such, remained neutral on the subject. The participants who belonged to the age groups 20–29 and 30–39 indicated that they were more concerned with personal interests than privacy.

4.2. Stage 2: Quantitative study

4.2.1. Survey Participants

The sample consists of 187 survey participants and their demographic information is presented in Figure 4 and descriptive statistics are included in Table B1 in the Appendix A. Table B2 and Figure 5-11 in the Appendix A reports descriptive statistics results of the measurements of each concept.

Figure 4. Demographic information of survey participants



CLICK HERE to List of Figures

4.2.2. Factors that influence user's intention use MaaS

The first question to be answered was whether the underlying factors that have implications for a user's intention to adopt MaaS relate to one or more general dimensions. In measuring the sampling adequacy for appropriateness of the factor analysis, the data were subjected to the KMO measure and Bartlett's test of sphericity. The KMO recorded a value of 0.8 (Table 4), which verified the sampling adequacy for factor analysis because it surpassed the threshold of 0.5. To explore the factorial dimensions in the selected sample, all 19 items of the instrument were subjected to an exploratory factor analysis with varimax rotation. The maximum likelihood factor analysis with a cut-off point of .40 and the Kaiser's criterion of eigenvalues greater than 1 (see Field, 2009; Stevens, 1992) yielded a five-factor solution as the best fit for the data, as it accounted for 83.96 % of the variance.

The results of this factor analysis are presented in Table 5.

Table 4. KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.8
Bartlett's test of Sphericity	Approx. Chi-Square	1875.080
	df	120
	Sig.	.000

Table 5. Exploratory factor analysis of the items of dimensions that influence MaaS support

Items	Factors					Dimension
	1	2	3	4	5	
MI1	.147	-.105	.205	**.864**	-.034	Perceived risk of MI
MI2	.371	-.135	.309	**.739**	-.009	
MI3	.279	-.102	.347	**.782**	-.042	
UI1	**.841**	.081	.260	-.003	.128	Perceived risk of secondary used of information
UI2	**.751**	-.004	.095	.364	.069	
SI1	**.852**	.153	.152	.136	.04	
SI2	**.765**	-.084	.070	.441	.049	
PEU1	.058	.177	.072	-.097	**.896**	Perceived ease of use
PEU2	.005	.132	.001	-.103	**.93**	
PEU3	.183	.208	-.102	.165	**.842**	
TU1	.031	**.959**	-.101	-.089	.172	Trust
TU2	.057	**.968**	-.080	-.106	.171	
TU3	.058	**.936**	-.088	-.098	.187	
PC1	.211	-.003	**.864**	.184	.062	Privacy concerns
PC2	.166	-.124	**.896**	.207	.004	
PC3	.130	-.172	**.764**	.344	-.107	

Notes. Extraction method; maximum likelihood; rotation method; varimax with Kaiser normalization. Loadings greater than .40 are in bold.

Interestingly, two of the five factors obtained had almost exactly the same structure as those found in the previous study (Park et al., 2017; Hsu and Lin 2016). The first of these factors was ease of use, with three subscales: PEU 1–3. This factor had an eigenvalue of 2.447 and accounted for 15.72% of the variance. The second of these factors was privacy concerns, with three subscales: PC1–3. This factor had an eigenvalue of 2.45 and accounted for 15.85% of the variance. The third factor of the five was trust, with three subscales: TU1–TU3. The eigenvalue of this factor was 2.9 and accounted for 18.17% of the variance. The scales related to use and sharing of personal information with MaaS providers (SU1–4) converged into one dimension. These four scales were loaded on one factor, which can be called "perceived risk of secondary information," with an eigenvalue of 2.954, accounting for 18.45% of the variance. The scales related to one's perceptions of the risk associated with location or MI loaded on another factor with an eigenvalue of 2.52, accounting for 15.75% of the variance. This factor can be labeled "perceived risk of mobility information." These findings suggest that the study participants perceived the structure of support of MaaS adoption through five factors. Further, scale analysis was used to estimate the reliability of scale (see Table K1-5 in Appendix). The values of Cronbach's alpha of each scale is presented in Table 6 . No value appeared to be problematic in any of these tests (e.g., no double loading, Cronbach's-$\alpha > 0.7$) (Taber, 2018), thus providing no evidence for a failed translation. The next question that needs to be answered is whether these five dimensions of increased or reduced intention to adopt MaaS can be explained differently.

4.2.3. Explaining factors that has implication on user's intention to use MaaS services

Table 6 shows the summarized results for an ordinary regression model explaining factors and their impact on users' intention to use MaaS.

Table 6. Factors that have implications for users' intention to adopt MaaS

	Parameter estimate (standard error)						
Independent variable	A	B	C	D	E	F	c -α
Trust	.21** (0.01)					.198** (0.014)	0.91
Ease of use	-	.18* (0.6)	-	-	-	0.01 (0.036)	0.886
Privacy concerns	-	-	-.21** (0.05)	-	-	.006 (0.042)	0.886
Secondary use	-	-	-	-.04 (0.46)	-	-.019 (0.03)	0.875
Mobility information	-	-	-	-	-.217** (0.048)	-.1* (0.039)	0.88
Intercept	7.18** (1.05)	2.17** (0.5)	14.23** (0.93)	11.58** (1.14)	13.83** (0.78)	4.474** (0.95)	
R^2	0.55	0.67	0.093	0.006	0.13	0.707	
N	187	187	187	187	187	187	

Notes: The dependent variable is the user's intention to use MaaS.

Standard errors in parentheses.

* p < 0.01; **p < 0.001. (Two-tailed *t*-test, despite directional hypothesis)

In column A, as assumed, an increase in ease of use was associated with a higher intention to use MaaS, controlling for all other factors. The results in column B indicate that lower trust in MaaS providers leads to less intention to adapt to the service. Column C shows that privacy concerns negatively influence users' intention to use the MaaS platform. However, statistical significance did not appear with secondary user information use. The results in columns D and E show that the SU does not imply a reduction in users' intention to use MaaS. By contrast, the perceived risk of MI does.

Thus far, with the exception of SU, each of the variables received at least some support. As can be seen in Table 6, the results in columns A through E do not control for the other explanations. The full multiple regression model results, in which the factors compete for explanatory power, is presented in column F. This column shows the situation where all five variables were entered in the same regression model. There, it appears that the effect of ease of use on users' intention to use MaaSs was reduced in the multiple regression context—compare the coefficient of 0.18 with the multiple regression 0.01. Similarly, the effect of trust remains almost unchanged in the full multivariate framework; however, the effect of privacy concerns changes. Before controlling for the other factors, the effect of privacy concerns was (as expected) negative and statistically significant. However, in column F, where trust, ease of use, secondary use of information, and MI were controlled for, the effect flips the sign. It is now not statistically significant, which means that when controlling for these factors, users' privacy concerns are less likely to affect their intention to use MaaS. Lastly, while the statistical significance of the perceived risk of MI remains unchanged in the multiple regression model, its effect on users' intention to use MaaS slightly decreases while controlling all other factors.

Table 7 presents different model specifications across the same sample. In Section 4.1.3, no clear evidence was found to show that MaaS users' privacy concerns were related to the services' spatial context or the ownership of the device used to access mobility services. However, in the quantitative stage, no participants used a bus card to access the service. Therefore, there is no data for testing the effect of the ownership. However, differences across

user groups were examined in terms of factors that have implications for one's intention to adopt MaaS according to the effect of the spatial differences of the MaaSs. Table 7, which focuses on the relationships of the proposed factors with the users' intention to adopt MaaS, shows such a comparison.

Table 7. Factors that have implications for users' intention to adopt MaaS according to the effect of the spatial context of the service

	Parameter estimate (standard error)		
Independent variable	All	Public transport user	Car user
Trust	.198**	.179**	0.239**
	(0.014)	(0.16)	(0.036)
Ease of use	.01	.036	.045
	(0.036)	(0.043)	(0.118)
Privacy concerns	-.006	-.043	.165
	(0.042)	(0.05)	(0.168)
Secondary use	-.019	-.023	-.094
	(0.03)	(0.034)	(0.128)
Mobility information	-.1*	-.095*	-.126
	(0.039)	(0.043)	(0.102)
intercept	4.474**	5.495**	2.4
	(0.95)	(1.152)	(2.01)
R^2	0.55	0.68	0.71
N	187	154	33

Notes: The dependent variable is the user's intention to use MaaS.
Standard errors in parentheses.
* $p < 0.01$; **$p < 0.001$. (Two-tailed *t*-test, despite directional hypothesis)

The first two columns (all and public transport users) show that, although the sample changes across the columns, the model specification is the same. However, there are differences in the column of car users in terms of estimated relationships. The table shows that when the model for two different groups defined by the spatial context of the services they chose was estimated, substantial differences appeared in the ways in which perceived risk of MI lost its impact on car users' intention to use MaaS. No statistical significance was found for the impact of privacy concerns related to the spatial context of the services. Instead, trust was the only variable that was statistically significant for intention to use MaaS among all users.

Chapter 5. Discussion

This chapter discusses the findings from the interviews, the quantitative analysis of this current study, and the findings from similar studies.

In the literature review, a significant gap regarding privacy concerns related to MaaS is identified. Two aspects are crucial: The first is related to the mobility service. The literature suggests that the spatial context of a service (i.e., whether one travels alone in a car or travels without distancing oneself from others through public transport) and the ownership of the device used to access the mobility service are relevant to one's privacy concerns. The second aspect is related to information. The use of MaaS requires information disclosure by users. It is widely believed that a decline in data disclosure due to privacy concerns will result in a decrease in data quality and incompleteness of data. It is, in turn, believed that privacy concerns are not favorable for the development of MaaS. Meanwhile, various studies have noted that trust is more influential in some cases than privacy concerns. There is thus an indication that the role of privacy concerns may be overstated. The results of this research indicate that there is indeed no clear evidence to support the claim that privacy concerns among MaaS users are related to the use of mobility services; instead, the results suggest that users' privacy concerns regarding MaaS relate to information and personal data disclosure. Surprisingly, trust, not privacy concerns, seems to be the key to users' intention to use MaaS.

These findings roughly cover the identified gap in the privacy literature. However, so far, there have only been a few studies that have made a similar attempt to fill this gap, for example Rohunen and Markkulas (2019), who aimed to explore the differences in privacy concerns between private and company users in a MaaS pilot. Previously, Pell et al. (2012) studied road users' acceptance of sharing their location information collection via company-owned and private cars. None of these works found any apparent difference in privacy concerns between user groups. Interestingly, both concluded that the fact that a large number of MaaS users have

no particular personal privacy concerns might be explained by trust. This study adds empirical evidence to support that conclusion.

Another explanation of the results is the “privacy paradox phenomenon,” which refers to the fact that users do not necessarily limit their data disclosure despite expressing concerns (for more details, see Acquisti et al., 2015). The findings show that many MaaS users are aware of privacy issues, but this awareness does not necessarily affect their intention to use MaaS. Hence, the difference between the use of services and personal privacy concerns possibly reflects the "privacy paradox phenomenon." This phenomenon may be explained by users’ expectation that they will receive better mobility services. Many interview participants mentioned their willingness to disclose their mobility data to make such services more convenient. This finding indicated that increasing the quality of services, such as by increasing users' PEU, might contribute to users' willingness to allow data collection and enable the development of open data-based services. This corresponds with Bandura (1986), who hypothesized that PEU positively influences a person's favorable outcome expectation toward accepting innovative technology. Although the current study failed to find evidence to support this hypothesis, it may have been limited by the selected samples. Hence, this failure does not mean PEU should be ignored in future research. By contrast, when trust appears to positively influence a user's intention to use MaaS, it is worth studying the interaction between PEU and trust and how their relationship influences the user’s intention to adopt MaaS. More specifically, the relationship between trust, PEU, and TAM should be included in the study of MaaS.

Further, the implications of privacy concerns should not be overlooked. Although there is no evidence to prove their impact on users’ intention to use MaaS, they are worth studying from a different perspective. For example, Li (2014) suggests studying privacy concerns by focusing on belief systems. The different ways in which individuals perceive privacy issues and personal privacy concerns may also have to do with the conceptualization of these issues and concerns.

Further, different services involve different privacy issues. The observed differences between them have important implications for developing privacy theories. Therefore, further investigation is needed into the relationship between different privacy issues and personal privacy concerns in contexts other than mobility data collection.

Finally, while trust appears to be the key to ensuring users' adoption of MaaS, the current study did not examine the interrelation between trust, ease of use, and privacy concerns or how they affect users' intention to use MaaS. This represents an important limitation that should be addressed.

Chapter 6. Conclusion

This chapter presents the conclusion of this study, along with implications and policy suggestions. Further, the limitations are discussed, followed by recommendations for further research.

Personal data such as that concerning travel behavior are key to the development of MaaS because they allow for the customization and personalization of mobility services. Hence, service providers need to collect users' personal information, and users need to accept data collection to enable these services. However, the ICT and data disclosure practices of MaaS make users vulnerable to cyber threats. Therefore, it is vital to understand whether privacy concerns impact individuals' willingness to use MaaS.

By exploring the underlying factors of MaaS users' intention to use the services, this study found that the relationship between data disclosure and users' intentions to use MaaS is not as straightforward as described in existing privacy theories. Put differently, privacy concerns do not affect the intention to use MaaS directly; instead, trust is the key determinant of users' intention to use MaaS. These findings suggest that, while privacy concerns do have implications for users' acceptance of service in many other studies, the broader social and cultural context in which this occurs needs to be taken into account. In societies where the trust level is high (i.e., the setting of the current study, Norway), privacy concerns do not necessarily become a hurdle to MaaS development. In contrast, where trust is generally low, the development of MaaS may be at greater risk due to individuals' privacy concerns.

Thus, increasing the use of MaaS requires lowering the barrier to accessing it. Privacy concerns do not play much of a role in that regard. Rather, the findings of this study suggest that enhancing the sense of trust between MaaS providers and users is the key to large-scale MaaS adoption. This finding has practical implications. MaaS functions best where the internet and

data are freely accessible. As the emerging mobility services will rely on smartphones and more extensive data transmissions, these issues are fundamental. The findings of this study suggest that to improve accessibility, unlimited access to the internet for all groups needs to be established—for example, for those who may likely need to reduce data use because of cost or data restrictions. Therefore, to lower barriers to accessing MaaS, facilitating more public support for the data access (such as through public Wi-Fi) is suggested. Trust is the key issue in that regard. To increase trust, measures such as offering services in different languages may be helpful to lower the barrier for certain groups, for example, linguistic minorities. Similarly, real-time communication through mobile applications may increase the trust in the new mobility applications among older groups.

In summary, the current study is subject to limitations that should be addressed through future efforts. First, the instrumental case study does not offer a clear picture of the study topic. However, it sheds empirical light on important theoretical concepts and principles for future work. Future research into privacy issues and MaaS should therefore focus on establishing a clearer and more universal picture of how privacy concerns and related constructs influence an individual's intention to use MaaS. Further, while this case study reveals that trust is the key to a user's intention to use MaaS, more advanced studies are required to gain more insight into the interaction between constructs to investigate, for instance, how trust, PEU, and privacy concerns interact. In addition, observational studies will be required to gain an understanding of whether there are other factors associated with frequent use of MaaS. Finally, on the methodological side, it is suggested that future researchers also use mixed methods to study complex issues relevant to MaaS. As MaaS is emerging over time, there will also likely be a need for further studies evaluating business models and market constellations as services and actors evolve. In parallel, user acceptance and operator responsibilities will become essential for the ongoing digitalization of mobility services. Therefore, this study offers valuable information for researchers, practitioners, and policymakers to continue seeking future MaaS development.

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Appendices

Appendix A. Tables mentioned in the text

Table A. Demographics information of interview participants (N= 47)

		EV owner	Shared car	Bus
Age (no.)	60 – 69	1	0	0
	50 – 59	4	0	0
	40 – 49	4	4	1
	30 – 39	1	4	8
	20 – 29	0	2	18
Gender	Male	8	8	9
	Female	2	2	18
Civil Status	Single	2	2	17
	Partner	8	8	6
	Other	0	0	4
Education	Ph.D	2	2	1
	Master	6	4	8
	Bachelor	0	3	11
	High School	1	1	7
IT competence	Yes	3	5	2
	No	7	5	25

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Table B1. Demographic characteristics of survey participants (N=187)

Age	n (%)	Education	n (%)
20-29	116 (62%)	High school	9 (4.8%)
30-39	47 (25.1%)	Post graduated (MSc /MPhil)	82 (43.9%)
40-49	18 (9.6%)	PhD	91(48.7%)
50-59	5 (2.7%)	Vocational training	5 (2.7%)
60-69	1 (0.5%)		
Gender	n (%)	Use of Public transport	n (%)
Male	105 (56.1%)	Yes	154 (82.4%)
Female	82 (43.9 %)	No	33 (17.6%)

Note. N=187 (n (%) = the number and percentage of participants that choose each alternative to this question)

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Table B2 . Descriptive statistics of independent variables

Independent variable	N	Mean	Median	Max	Min	SD
Ease of use	187	5.49	6	7	1	1.246
Trust	187	4.05	5	7	1	1.37
Privacy concerns	187	5.29	5	7	1	1,247
Secondary use	187	6.2	7	7	1	1.32
Mobility information	187	5.07	5	7	1	1.486

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The statistical results of the measurements of each concept (i.e., frequency and percentage) are present in Figures 5- 11.

As mentioned earlier, each concept is measured by 3-4 items. For example, the result of the measurements of *Ease of use* are present in Figure 5.

The concept of *Trust* is measured in three distinctive scenarios, which measure users' trust in three different service providers- Tesla (electric car company), Hyre(share-car service provider), and Kolumbus (public transport operator). Accordingly, the results of the measurements of "trust" in each scenario are presented in Figures 6 -8.

Figure 9 presents the result of the measurements of *Privacy concerns*. The statistical result of the measurements for the concept of *Perceived risk of mobility information* and *Perceived risk of secondary use of information* are presented in Figures 10 and 11, respectively.

Figure 5. Measurement of the concept " ease of use" across the entire sample.

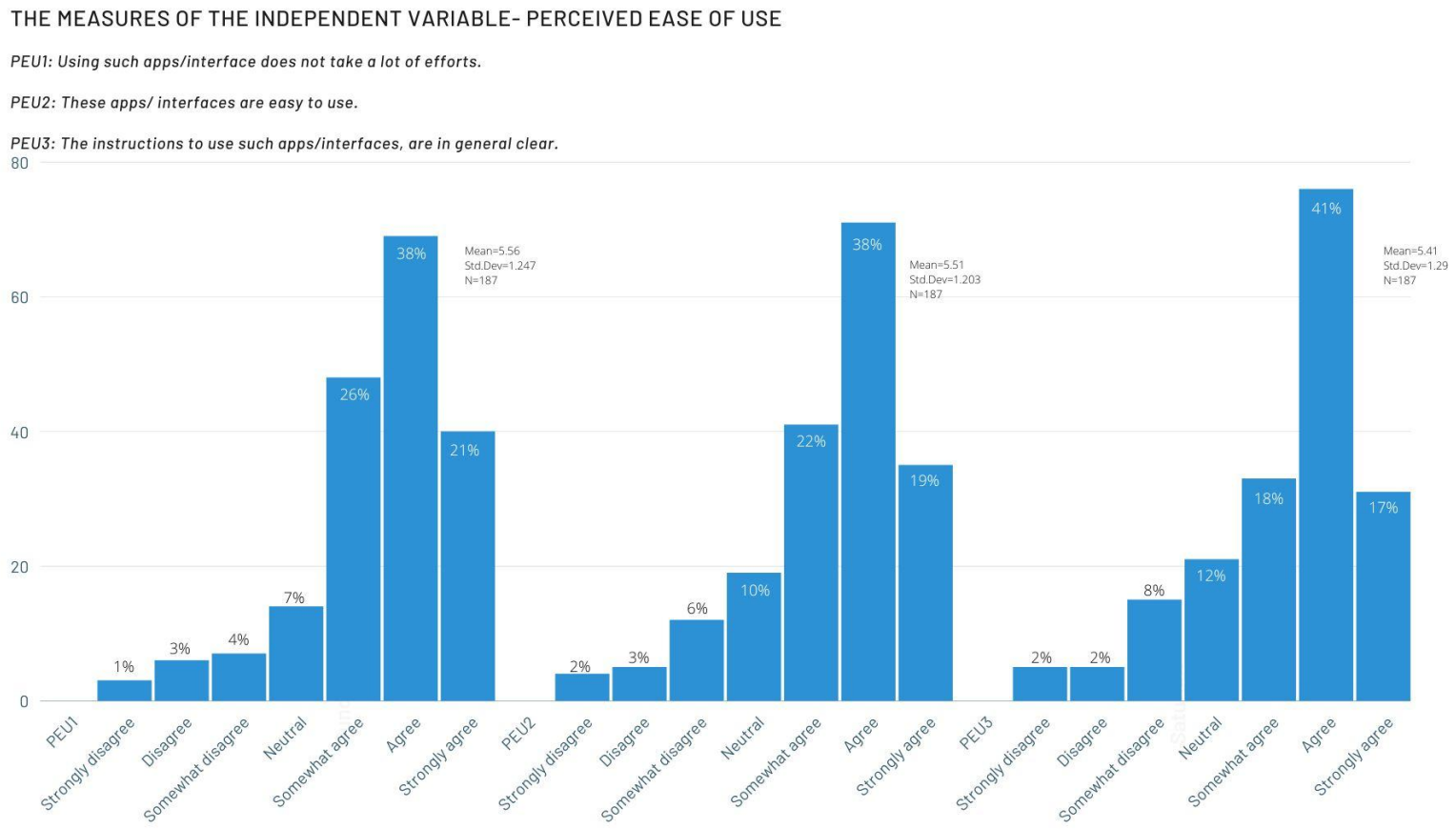

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Figure 6. Measurement of the concept of “ trust ” across the entire sample in scenario 1.

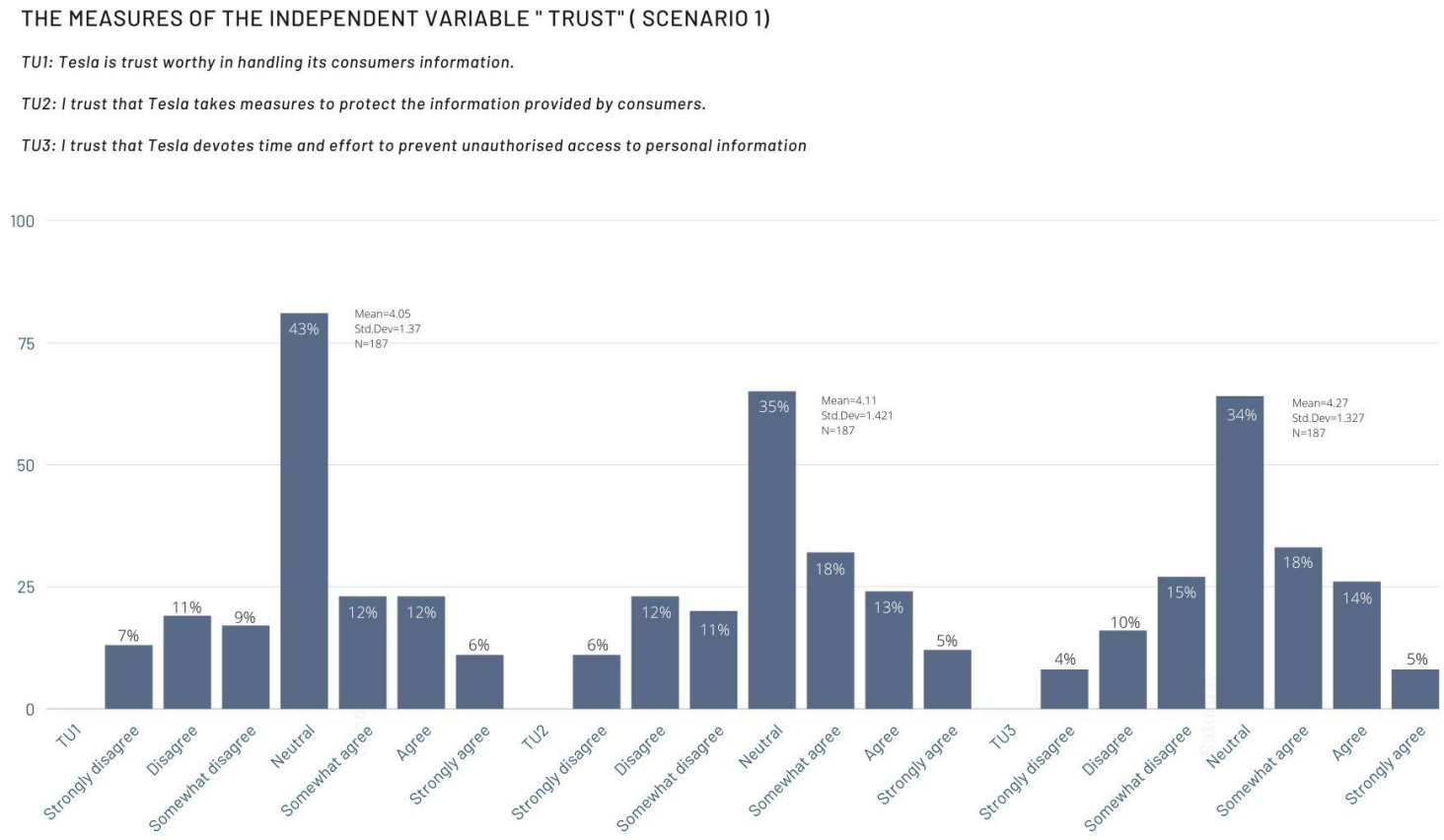

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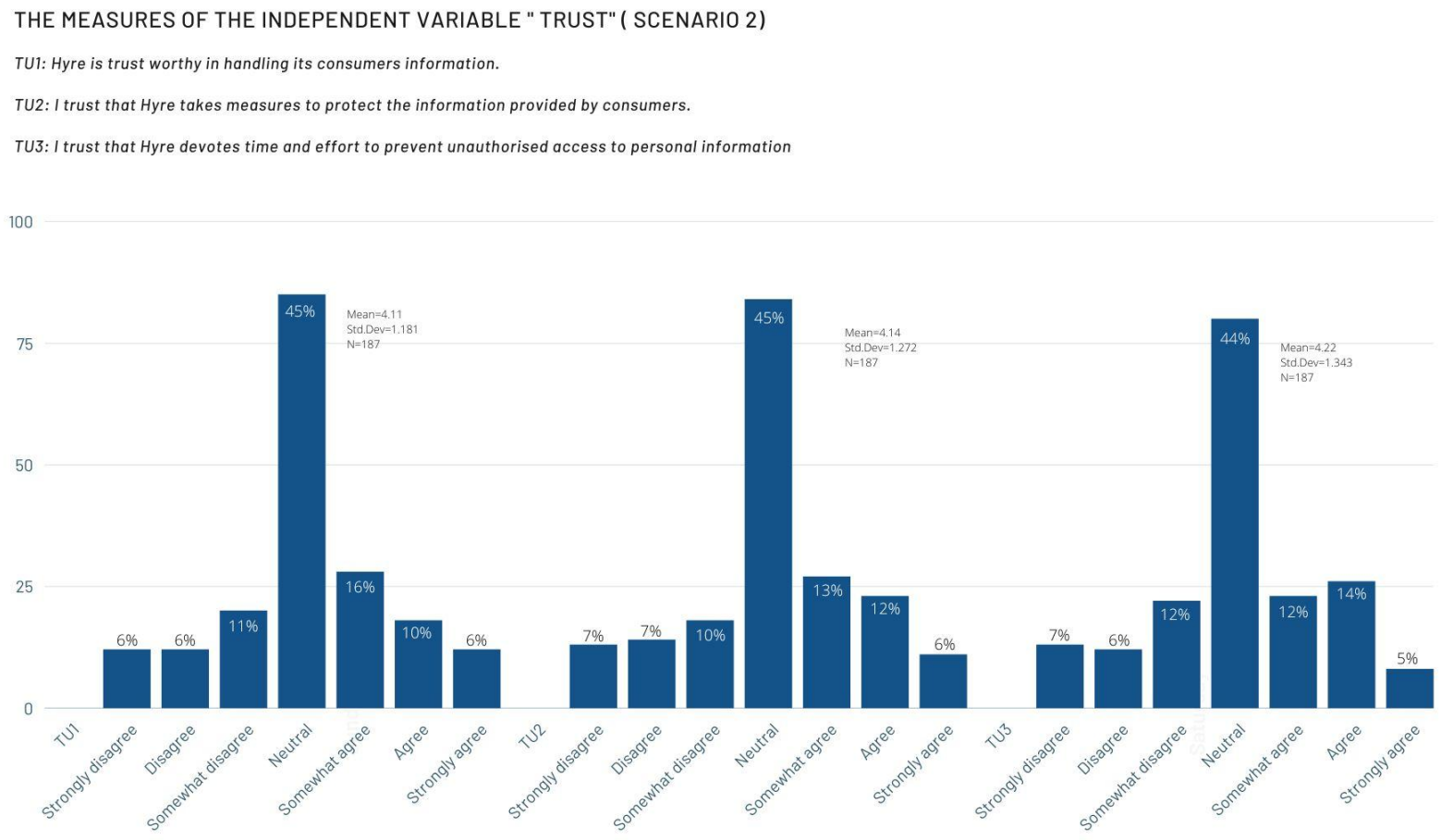
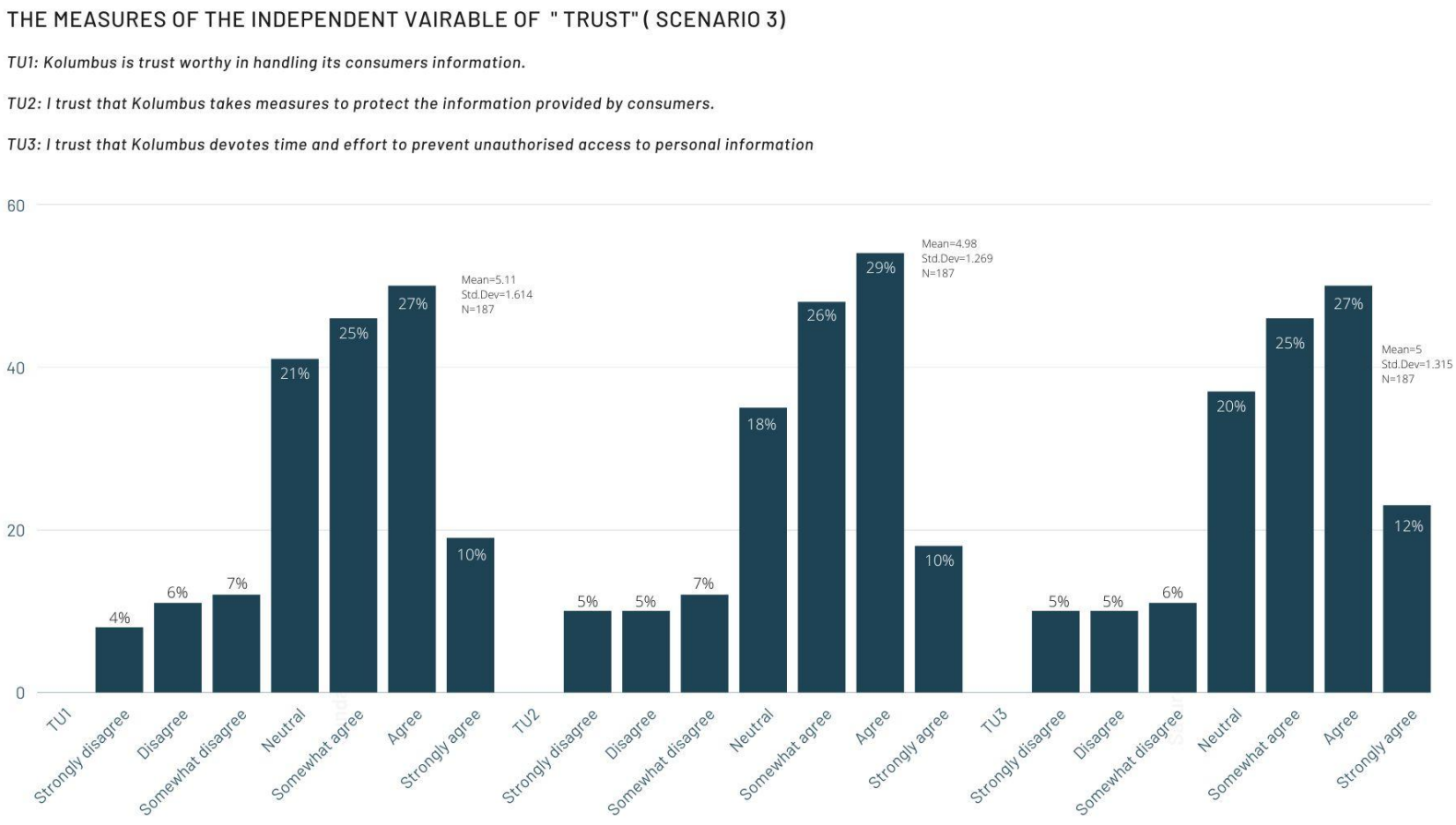
Figure 7. Measurement of the concept of “ trust ” across the entire sample in scenario 2.



CLICK HERE to back to the text

CLICK HERE to List of Figures

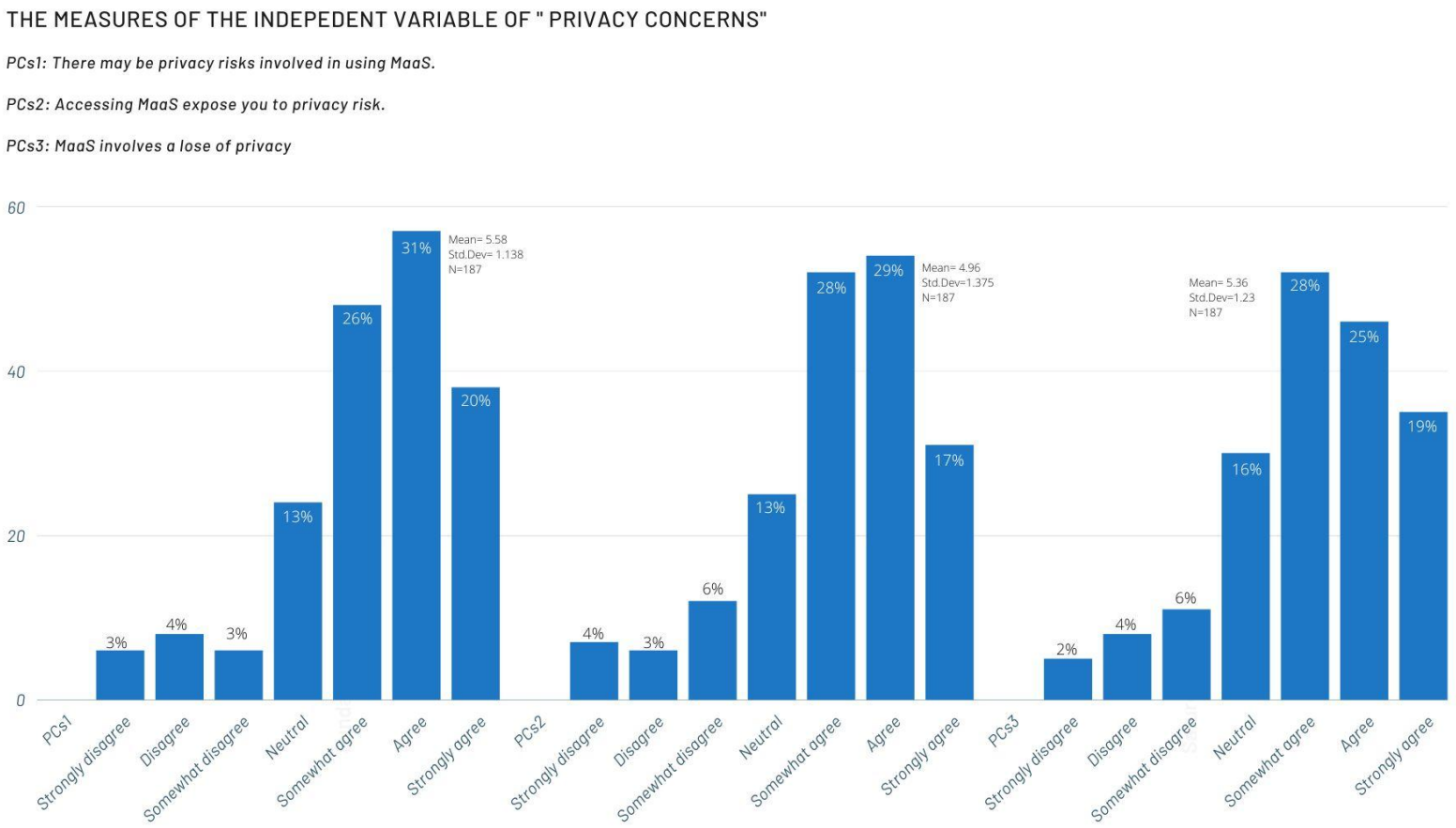
Figure 8. Measurement of the concept of “ trust ” across the entire sample in scenario 3.



CLICK HERE to back to the text

CLICK HERE to List of Figures

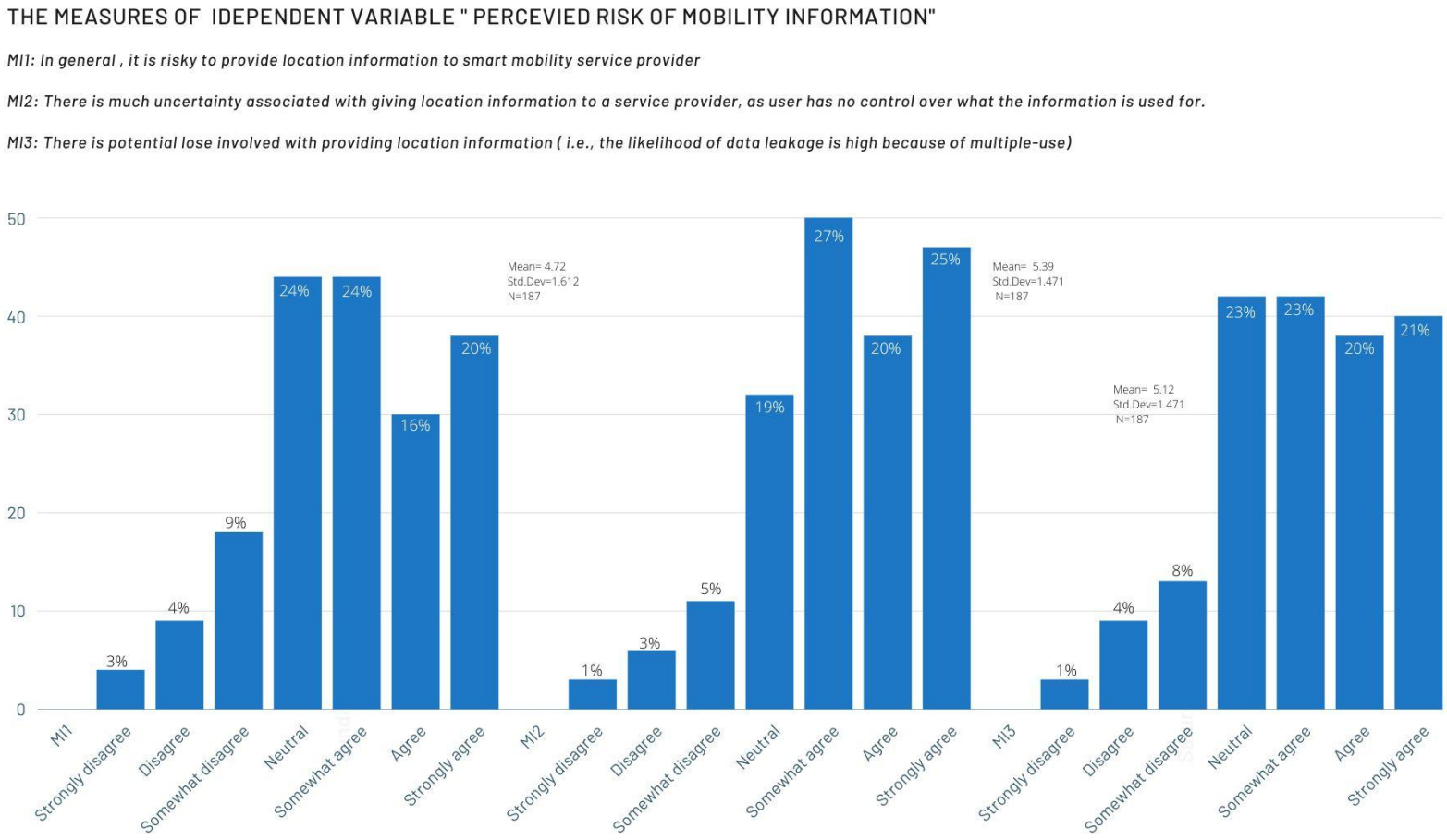
Figure 9. Measurement of the concept of "privacy concerns" across the entire sample.



CLICK HERE to back to the text

CLICK HERE to List of Figures

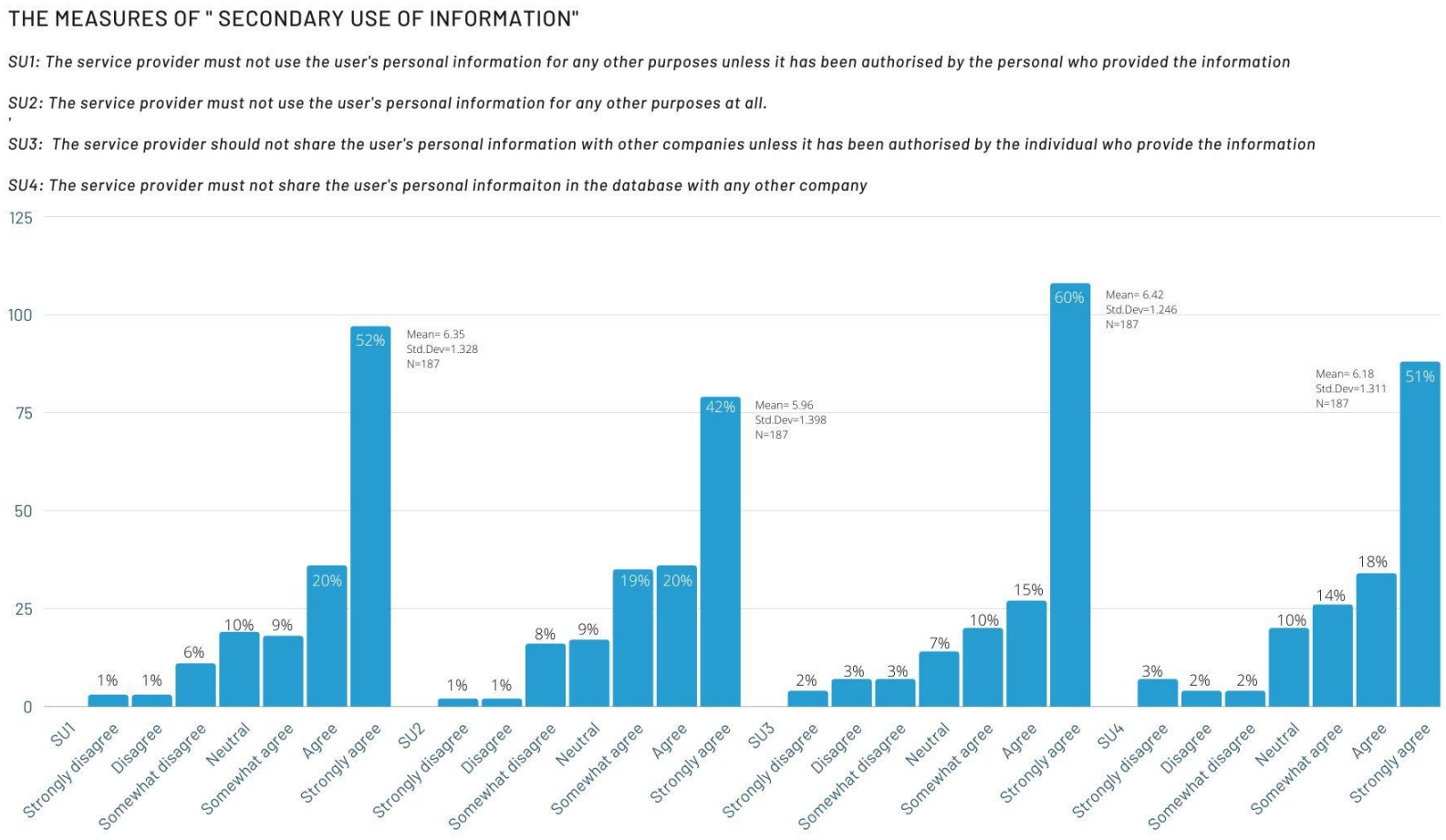
Figure 10. Measurement of the concept of " perceived risk of mobility information" across the entire sample.



CLICK HERE to back to the text

CLICK HERE to List of Figures

Figure 11. Measurement of the concept of "secondary use of information" across the entire sample.



CLICK HERE to back to the text

CLICK HERE to List of Figures

Table C. Questionnaire items used to measure constructs

Constructs	Descriptions
Perceived ease of use (Park et al., 2017)	PEU1: When using MaaS mobility does not require significant mental effort. PEU2: MaaS mobility service is easy to use PEU3: Using MaaS mobility is understandable and clear.
Perceived privacy concerns (Hsu and Lin 2016)	PC1. There is a considerable privacy risk involved in using MaaS mobility service PC2: My decision to access "MaaS mobility service" exposes me to privacy risk. PC3: Using MaaS mobility services would lead to a loss of privacy.
Secondary use of personal information (Stewart and Segard, 2002)	SU1: Service provider cannot use personal information for other purpose unless it has been authorized by the users providing personal information SU2: When a user provides personal information to a service provider for some reason, the service provider cannot use the information for any other purposes. SU3: Service provider should not sell personal information in the database to other companies SU4: Service provider should not share personal information with other companies unless it has been authorized by the users providing personal information
Trust (Lee, 2005) and (Pavlo, 2003)	TU1: This service provider is trustworthy in handling the information. TU2: This service provider keeps its promises related to protecting the information provided by me. TU3: This service provider keeps users' interest in mind when dealing with information.
Perceived risk of mobility information (adapted from Pavlou and Gefen, 2004)	MI1: In general, it is risky to provide location information to MaaS mobility providers. MI2: There will be much uncertainty associated with giving mobility information to service providers. MI3: There is a potential loss associated with providing personal information to service providers.
Intention to use (adapted from Lee, 2005)	IU1: I am willing to use this smart mobility service IU2: I am willing to provide my personal information to the service provider IU3: I will recommend this service provider to others

CLICK HERE to back to text CLICK HERE to List of Tables

Table D. Responses related to *Privacy concerns*

Theme	Responses
Perceived privacy risk	Data breaching. It can be problematic because you have no idea what people are (is) going to use this information for [P1].
	Telephone, address, etc (.) is public knowledge in Norway. So, no big risk. But there is a risk when it comes to driving history, driving behaviour (behavior), etc… This data can be sold and used in a big-data setting to profile me as a user[P3].
	Aggregate information, unclear of the purpose of us these data, data storage is also unclear [P5].
	Data misuse. You have full control over what the data will be used for[P6].
	Well.it can be exposed to many things. Data breaching[P8].
	I have nothing to hide, Google gathers more data[P9]!
	Don’t like it, no one can guarantee my privacy and how secure my info [P9].
	Some things (something) are (are) not possible to avoid, but I don't like sharing anything unneccesary (unnecessary) [P10].
	Five out of ten respondents (Tesla owners) express their privacy concerns about personal information collected by Tesla [P1, 3,5, 6, 7, 10]. One respondent means he has “a bit” privacy concern [P4]. Two Tesla owners mean they don’t have privacy concerns [P2, 8].
	One says, “It’s fine to share general info like mail (mail), age, per day running costs but not my location and browsing history [P9].”
	One says “This profile can (and will) be sold. (Like Google and Facebook do). In norway (Norway) it will probably not affect me personally that much, but in general this knowledge can be used to make my life more difficult in the long run [P3]. “

Five out of ten respondents (Tesla owners) mean their privacy concerns of personal information override their personal interest to use the service [P1, 2, 5, 7, 9]. Four respondents indicate[P6] “sometimes” while one indicates “maybe[4]”.
The responses that point out perceived privacy risk in relation to personal data, all respondents indicate certain levels of privacy concerns. One point out “Hacking and loss of personal information[P13] “; “Data abuse, traceability (refers to personal information e.g., telephone, address, driving history, browser history, etc.) [P14]”; “Data breaching and uncertainty about the purpose of using the data. [P16]”; “It varies by the type of information. Couldn't care less about my address, but I try not to share driving history, browser data, etc.[P18] “; “Risk of id (identity) theft [P19] “; and “(There is) Medium to high risk in relation to my personal information [P20].”
Four out of ten respondents (shared car users) express privacy concerns in relation to personal data collected by shared-car company- “(There is) Medium to high risk in relation to my personal information[P20]”; “Well, Yes, I do have (refers to personal information e.g., telephone, address, driving history, browser history, etc.) because it is stored in the system and God knows who will misuse it [P14] “; “Yes (privacy concern) refers to personal information e.g., telephone, address, driving history, browser history, etc.). For example, I don’t want people to know where I am [P16]”.
Four out of ten respondents (shared users) mean their privacy concerns of personal information override their personal interest to use the service [P11, 15, 16, 19], while two means it may sometimes be like that[P17, 18]. Four respondents indicate their personal interest overrides privacy concerns, one of them states that “Yes, it still does (refers to personal interest overriding privacy concerns). But it would be important not to provide so much privacy information[P14].”

	There are bus users indicate perceived privacy concerns in relation to their personal information, for example " The sum of information [P21]", " Don't like being too much controlled [P22]", "I am fine with sharing my personal details except bank card details and browser history [P23]", "data breaching [P24]", "aggregate information, data leakage [P25]", "they already have a lot of my info so it's too late to worry now [P27]", " Hiker (hacker) [P28]", "Personal data (refers to the type of information participants has privacy concerns about) [P31]", "Adress (address), driving history, browser history (refers to the type of information participants has privacy concerns about)[P33]", "Telephone and address (refer to the type of information participants has privacy concerns about))[P35]."
	eleven out of twenty-seven respondents (bus users) indicate that they do have privacy concerns over personal information collected by Kolumbus. While there are twelve respondents, they do not have privacy concerns over this information. One indicates "Some (refers to having privacy concerns in regarding to personal information such as telephone, address, driving history, browser history, etc.) [P22]", "Yes. I have privacy concerns regarding my bank details and browser history [P23]", "yes, I don't want others to know this information (refers to personal information such as telephone, address, driving history, browser history, etc.) [P24]", "yes, I don't want them to be misused ("them" refers to personal information such as telephone, address, driving history, browser history, etc.) [P25]", "There is nothing you can do about this in the future, cloud connected world.) [P46]",
	Nine out of twenty-five respondents (bus users) mean their privacy concerns of personal information override their personal interest to use the service [P23-25, P31, P35-37, P43,44], while one indicates maybe [P45].

Note. Responses from Tesla owners are high-lighted in orange, shared car users in blue while bus users in green (same as **Table E.-I.**)

[P number] refers to the interview participant's number in **Table J**

CLICK HERE to back to text CLICK HERE to List of Tables

Table E. Responses related to *Perceived risk of secondary use of information*

Theme	Responses
Secondary use of information	Eight out of ten Tesla owners mean that they do mind that Tesla uses consumer's information for other purposes than original ones. [P1, 2, 3, 4, 5, 7, 9, 10]. Two says it depends on the purpose to use gathered information [P1,7]. One of them says "Yes, it depends. If they use it to improve service, it's ok (O.K.). However, the commercial purpose is considered as not acceptable [P1] ". The other one says "Yes, I Do. However, they will do that for business purposes [P7]."
	There is one respondent (Tesla owner) express "Depends how, Again- Google gather much more (!) [P8]"
	One respondent indicates he doesn't mind "Not really. They do that anyway" [P6]
	Seven out of seven shared car users indicate they do mind if Hyre (the shared car company) uses personal information for other purposes than the original one[P11-20].
	Yes, I do (refers to using personal information for other purposes than the original one) . It is important that they use it based on the contract [P14].
	Nineteen out of twenty-seven bus users indicate that they do mind if Kolumbus uses personal information for other purposes than the original one [P21-28, 31-35, 41, 42, 46, 47].
	It depends. I should be informed [P34],
	Fine (refers to use personal information for other purposes) with the exception my bank information and browser history [P23]
	Well, I hope not. But it depends, if it is used for creating (creating) good things, it's ok. But they use it to make money; I won't like it [P24].
	They'd better ask for consent in advance [P25].

	I don't like that idea (refers to use personal information for other purposes) [P33]
	that will be not fine [P46]

CLICK HERE to back to text

CLICK HERE to List of Tables

Table F. Responses related to *Ease of use*

Theme	Responses
Ease of Use	I think it is a car with many benefits. For example, it doesn't use a combustion engine. In this sense, it's easier to repair and maintain. [P5]
	It's cheap to drive, easy to maintain. Price is accetable (acceptable). [P6]
	Very useful car. It's more than just a car. It enables the driving to reach the other level. [P1]
	It is VERY comfortable to drive! And cheap to drive! [P3]
	Eight out of ten Tesla owners think that by sharing their information, using their Tesla becomes more convenient [P 1, 2, 3, 5, 6, 7, 8, 9]. One of them has less certainty about it [P9]. Two points out by sharing their information, using their Tesla may become more convenient [P1, 5].
	(It is) Less work to maintain the car. [P1]
	Convenient, like to drive (it is convenient to drive), low cost. [P2]
	All responses from shared car users indicate a good impression of this service. For example, Good [P11].
	Not very user friendly (user-friendly) registration through invitation link, but very easy once registered [P12]!
	All good. Once I didn't manage to start the lease. But then I received a refund[P13].
	The service is simple, easy to use, but when finishing the car hiring, it was not quite clear how to complete /stop the hiring fully. I had to call the Hyre call center to help me fully stop the hiring[P14].
	Easy and convenient [P15].

	It's good, but not convenient. The registration takes time. The travel distance is somehow (somehow) limited [P16].
	Easy to use, cheap [P17].
	Quick setup, clean car, easy to use [P18]!
	It is good and affordable [P19].
	Very good[P20].
	Eight out of ten shared car users think sharing if their information makes this service easy to use [P 11, 12, 13, 15, 16, 17,18, 20], while two of them are not sure[P19], one doesn't think so[P14]. One indicates "I understand why there is a requirement of uploading the drivers' licence (license) [P12]."
	Eight out of nine shared car users think by sharing personal information, this service can become more convenient/effective [P11, 12, 13, 14, 16, 17, 18, 20]. One of them states "Once provided these personal data, next you don't have to because you are registered. It can be time saving [P14]." One respondent indicates no, while one indicates "not sure [P19]."
	I have no car. It is good that we can use them for various purposes (e.g., traveling) without having to be bound to public transport [P14].
	Convenience [P15]
	It's cheaper to drive, relatively convenient since I don't have to maintain the cars [P16].
	Just like that it is an option and cheaper than taxi [P19]
	Convenient and good [P25].
	Twenty-one out of twenty-six bus users think share of information contribute make this service ease of use [P21-25,27,28,31-34, 40-47], one bus users indicate "Probably (refers to sharing personal data make this service ease of use), since the service provider can use it to improve the services[P24]."

	Two bus users mean they are not sure [P29, 30]. One says “maybe[P29] “while four don’t think so[P26, 35, 38,39].

CLICK HERE to back to text

CLICK HERE to List of Tables

Table G. Response related to *Trust*

Theme	Responses
Trust of service provider	Three out of ten Tesla owners mean they trust their electric car company can handle consumer's information well [P3, 8, 9].
	Yes. For sure they have the capacity to do that quite well since the stock value and business is what they care about. That is capitalism! [P3]
	Six out of ten Tesla owners indicate they do not trust the service provider. However, one of them has an ambiguous attitude: "Not sure. But a big company like Tesla supposedly has good enough resources and strategy to protect their data base. "[P 6]
	Five out of ten shared-car users mean they trust the Hyre can handle consumer's information well. However, one of them says "I think they can…but everyone can be hacked [P19].
	17 out of 26 bus users mean they trust Kolumbus can handle consumer's information well, and one of them says "I think so, since it's operated in Norway, I think all companies in Norway are trustworthy because they have to follow the law [P 24]."
	The remaining nine respondents express their trust in Kolumbus in a more subtle manner. One of them says "I hope so[P22]", "litt (English: little) [P26]"," IDK(I don't know)[P27]"," Kind of [P28]", "I am not sure)[P31]" , and "Maybe [P35]".

CLICK HERE to back to text

CLICK HERE to List of Tables

Table H. Response related to *Perceived risk of mobility information*

Theme	Responses
Perceived risk of mobility Information	Seven out of ten Tesla owners mean they do mind if there are others who know about their location information [P1, 3- 7, 9, 10].
	Seven out of ten shared car users mean they do mind if there are others know about their location information [P13, 14, 16-20], while one respondent means "(It) Depends (depends) on who- I share my location with friends and family all the time [P12]." There are two respondents meaning they don't mind [P11, 15].
	One of the shared car users says "Yes. For example, I don't want people know where I am [P16]" while he described his privacy concern in relation to personal information collected by Hyre (the shared car company)
	Eighteen out of twenty-seven bus users mean they do mind if there are others who know about their location information. One says "yes. It can be a problem [P24] ", "Yes, I don't like that [P33]", "It could be dangerous but if it is with a public authority and secured, I do not have such concerns [P45] ", " Never, that's bad! [P46]". In contrast, there are three bus users clearly indicate they don't mind [P23, P30, P43]

CLICK HERE to back to text

CLICK HERE to List of Tables

Table I. Response related to *Intention to use MaaS service*

Theme	Responses
Intention to use	All respondents (Tesla owners) express their intention to use electric cars by recommending it to their friends. [P1-10]
	After asking a set of questions about privacy concerns, five out of eleven Tesla owners mean their personal interests of using electric cars override their privacy concerns in regarding the personal information privacy. [P3, 4, 6, 8,10]
	Eight out of ten respondents (shared car users) express that they have intention to continue using this service [P 11-16, 19, 20]
	After asking a set of questions about privacy concerns, six out of nine respondents mean their personal interests to use shared car service override their privacy concerns in regards to the personal information privacy [P12-14, 17,18, 20].
	All respondents in this group express their intention to continue using this service.
	After asked a set of questions about privacy concerns, sixteen out of twenty-five respondents (bus users) mean their personal interests override of using bus override their privacy concerns in regarding to the personal information privacy [P21, 22, 26-30, 33, 34, 38-42, 46, 47].

CLICK HERE to back to text

CLICK HERE to List of Tables

Table J. Demographic information of interview participants in detail

	Participant	Age	Gender	Sivil	Education	IT competence
EV owner	P1	50-59	Male	Partner	Master	No
	P2	50-59	Male	Single	High school	No
	P3	40-49	Male	Partner	Master	Yes
	P4	60-69	Male	Partner	Master	No
	P5	50-59	Male	Partner	Master	No
	P6	50-59	Female	Partner	Ph. D	No
	P7	40-49	Female	Partner	Master	No
	P8	40-49	Male	Partner	Ph. D	No
	P9	30-39	Male	Single	Master	Yes
	P10	40-49	Male	Partner	High school	Yes
Shared car	P11	20-29	Male	Partner	Bachelor	Yes
	P12	20-29	Female	Partner	Bachelor	No
	P13	30-39	Male	Single	Master	No
	P14	30-39	Male	Single	Ph. D	No
	P15	40-49	Male	Partner	Ph. D	No
	P16	40-49	Female	Partner	Master	No
	P17	30-39	Male	Partner	Master	Yes
	P18	30-39	Male	Single	Master	Yes
	P19	40-49	Male	Partner	Bachelor	Yes

	P20	40-49	Male	Partner	High school	Yes
Bus	P21	20-29	Male	Single	Master	No
	P22	20-29	Male	Partner	Bachelor	No
	P23	20-29	Male	Single	Master	Yes
	P24	40-49	Male	Single	Master	No
	P25	30-39	Female	Single	Bachelor	No
	P26	20-29	Female	Single	Bachelor	No
	P27	20-29	Male	Other	Bachelor	No
	P28	30-39	Female	Single	Master	No
	P29	20-29	Female	Other	High school	No
	P30	20-29	Female	Single	High school	No
	P31	30-39	Female	Single	Master	No
	P32	20-29	Female	Single	Bachelor	No
	P33	20-29	Female	Single	High school	No
	P34	20-29	Female	Other	Bachelor	No
	P35	30-39	Female	Other	Master	No
	P36	20-29	Female	Single	High school	No
	P37	20-29	Female	Single	High school	No
	P38	20-29	Female	Partner	Bachelor	No
	P39	20-29	Male	Partner	High school	No
	P40	30-39	Female	Single	Bachelor	No
	P41	20-29	Female	Partner	Bachelor	No
	P42	20-29	Female	Partner	Bachelor	No

	P43	20-29	Female	Single	High school	No
	P44	20-29	Female	Single	Master	No
	P45	30-39	Male	Partner	Ph. D	No
	P46	30-39	Male	Single	Master	Yes
	P47	30-39	Male	Single	Bachelor	No

CLICK HERE to back to text

CLICK HERE to List of Tables

Table K1. Scale analysis *Trust*

	1st factor
Kolumbus (public transport operator) is trustworthy in handling the information.	0.657
Kolumbus (public transport operator) keeps its promises related to protecting the information provided by me.	0.685
Kolumbus (public transport operator) keeps users' interest in mind when dealing with information.	0.752
Hyre (car-sharing company) is trustworthy in handling the information.	0.818
Hyre (car-sharing company) keeps its promises related to protecting the information provided by me.	0.884
Hyre (car-sharing company) keeps users' interest in mind when dealing with information.	0.867
Tesla (electric car company) is trustworthy in handling the information	0.802
Tesla (electric car company) keeps its promises related to protecting the information provided by me.	0.833
Tesla (electric car company) keeps users' interest in mind when dealing with information.	0.761
Eigenvalue	5.585
R^2	0.62
N	187

CLICK HERE to back to text

CLICK HERE to List of Tables

Table K2. Scale analysis *Ease of use*

	1st factor
When using MaaS mobility does not require significant mental effort.	0.899
MaaS mobility service is easy to use.	0.93
Using MaaS mobility is understandable and clear.	0.879
Eigenvalue	2.447
R^2	0.81
N	187

CLICK HERE to back to text

CLICK HERE to List of Tables

Table K3. Scale analysis *Privacy concerns*

	1st factor
There is a considerable privacy risk involved in using MaaS mobility service	0.897
My decision to access “MaaS mobility service” exposes me to privacy risk.	0.94
Using MaaS mobility services would lead to a loss of privacy.	0.878
Eigenvalue	2.45
R^2	0.81
N	187

CLICK HERE to back to text

CLICK HERE to List of Tables

Table K4. Scale analysis *Perceived risk of secondary use of information*

	1st factor
MaaS service provider cannot use personal information for other purpose unless it has been authorized by the users providing personal information	0.834
When a user provides personal information to a MaaS service provider for some reasons, the service provider cannot use the information for any other purposes.	0.848
MaaS service providers should not sell personal information in the database to other companies.	0.865
MaaS service providers should not share personal information with other companies unless it has been authorized by the users providing personal information.	0.868
Eigenvalue	2.91
R^2	0.72
N	187

CLICK HERE to back to text

CLICK HERE to List of Tables

Table K5. Scale analysis *Perceived risk of mobility information*

	1st factor
In general, it is risky to provide mobility information to MaaS mobility providers.	0.897
There will be much uncertainty associated with giving mobility information to service providers.	0.94
There is a potential loss associated with providing mobility information to service providers	0.878
Eigenvalue	2.45
R^2	0.81
N	187

CLICK HERE to back to text

CLICK HERE to List of Tables

Appendix B. Interview guideline

1. Interview guideline for EV owner

It is a survey for a master thesis (UiS). THREE parts of this survey: the first part is general information about you; The second part is about your experience of using an electric car. The last part is about your privacy concerns about your personal information collected by the car company. All in all, these questions won't take you more than 10 minutes!

Part 1. Demography

Age

☐ Under 19 ☐ 20-29 ☐ 30-39 ☐ 40-49 ☐ 50-59 ☐ 60-69 ☐ Above 69

Gender

☐ male ☐ female

Sivil status

☐ Single (you live alone) ☐ Partner (you live with someone) ☐ Other

Education level (the highest level that you are completed)

☐ High school ☐ University (bachelor) ☐ Postgraduate (master) ☐ Ph.D. ☐ Others

Do you have **expertise in** the **IT** industry?

☐ YES ☐ NO

Part 2. Your experiences of using EV

In this part, I would like to know your using experience of EV.

1. Why do you purchase an electric car?
2. How often do you use it?
3. How did you get to know electric cars?
4. What is your first impression of your EV?
5. Do you like it?
6. Will you recommend it to your friends?

Part3. The information you gave to the car company

When you have EV, you establish a personal profile which contains certain personal information.

1. Do you think your sharing of these data makes using your electric car easier?
2. Do you think by sharing your information, using your electric car will become more convenient?
3. What is your perceived risk in relation to your personal information? (e.g., your telephone, address, driving history, browser history, etc.)
4. Do you have privacy concerns about this information?
5. What is your personal interest/need in using an electric car?
6. Does your personal interest override your privacy concerns?
7. Do you trust your electric car company can handle consumer's information well?
8. Do you mind if the car company uses your personal information for other purposes than the original one?
9. Do you mind if there are others who know about your location information?
10. Last but not least, do you have any suggestions about this survey?

Thanks for your participation!

II. Interview guideline for Shared-car users

It is a survey for a master thesis (UiS). THREE parts of this survey: the first part is general information about you; The second part is about your experience of using an electric car. The last part is about your privacy concerns about your personal information collected by the car company. All in all, these questions won't take you more than 10 minutes!

Part 1. Demography

Age

☐ Under19 ☐ 20-29 ☐ 30-39 ☐ 40-49 ☐ 50-59 ☐ 60-69 ☐ Above 69

Gender

☐ male ☐ female

Sivil status

☐ Single (you live alone) ☐ Partner (you live with someone) ☐ Other

Education level (the highest level that you are completed)

☐ High school ☐ University (bachelor) ☐ Postgraduate (master) ☐ Ph.D. ☐ Others

Do you have **expertise in** the **IT** industry?

☐ YES ☐ NO

Part 2. Your experiences of using shared-car service

In this part, I would like to know your using experience of using shared-car service

1. How often do you use shared-car service?
2. What do you use shared-car service for?
3. How did you get started in using this service?
4. What is your first impression of using this service?
5. Do you like this idea of shared-car service?
6. Will you continue to use it?

Part3. The information you gave to the car company

When you use the shared-car service, you give "Hyre" (the shared-car company) some personal information. I would like to know whether you have privacy concerns over personal information.

7. Do you think your sharing of these data makes this service easier to use?

8. Do you think by sharing your information, this service can become more convenient/ effective?

9. What is your perceived risk in relation to your personal information? (e.g., your telephone, address, driving history, browser history, etc.)

10. Do you have privacy concerns about personal information?

11. What is your personal interest/need in using shared-car service?

12. Does your personal interest override your privacy?

13. Do you trust “Hyre” can handle consumer's information well?

14. Do you mind if Hyre uses your personal information for other purposes than the original one?

15. Do you mind if there are others who know about your location information?

16. Last but not least, do you have any suggestions about this survey?

Thanks for your participation!

III. Interview guideline for public transport users

It is a survey for a master thesis (UiS). THREE parts of this survey: the first part is general information about you; The second part is about your experience of using collective transport. The last part is about your privacy concerns about your personal information collected by the shared-car service provider. All in all, these questions won't take you more than 10 minutes!

Part 1. Demography

Age

☐ Under19 ☐ 20-29 ☐ 30-39 ☐ 40-49 ☐ 50-59 ☐ 60-69 ☐ Above 69

Gender

☐ male ☐ female

Sivil status

☐ Single (you live alone) ☐ Partner (you live with someone) ☐ Other

Education level (the highest level that you are completed)

☐ High school ☐ University (bachelor) ☐ Postgraduate (master) ☐ Ph.D. ☐ Others

Do you have **expertise in** the **IT** industry?

☐ YES ☐ NO

Part 2. Your experiences of using collective transport

In this part, I would like to know your experience of collective transport.

1. What do you use to access collective service?

□□□ APP □□□ Bus card □□□ Both □□□ I used to use bus card, but I am using an app now □□□ Others

2. How often do you use collective transport (i.e., bus, ferry, train)?
3. What do you use collective transport service for?
4. How did you get started in using this service?
5. What is your first impression of using this service?
6. Do you like this idea of collective transport?
7. Will you continue to use it?

Part3. The information you gave to the Kolumbus (service provider)

When you use the collective transport, you give "Kolumbus" (the collective transport operator) some personal information. I would like to know whether you have privacy concerns over personal information.

8. Do you think your sharing of these data makes this service easier to use?

9. Do you think by sharing your information, this service can become more convenient/ effective?

10. What is your perceived risk in relation to your personal information? (e.g., your telephone, address, driving history, browser history, etc.)

11. Do you have privacy concerns about personal information?

12. What is your personal interest/need in using collective transport?

13. Does your personal interest override your privacy?

14. Do you trust that Kolumbus can handle consumer's information well?

15. Do you mind if Kolumbus uses your personal information for other purposes than the original one?

16. Do you mind if there are others who know about your location information?

17. Last but not least, do you have any suggestions about this survey?

Thanks for your participation!

Appendix C. Questionnaire

Smart mobility

Thank you for taking part in this survey. This survey looks at Smart Mobility and privacy.

Mobility services such as buses, shared-car, and electric cars offer real-time information, which enables users to reduce time spent traveling or avoid unnecessary travel (e.g. by providing real-time information of the traffic situation or of the next and fastest public transport connection). When you use these services, the service providers also collect information about you. I'd love to hear from you about what you think about information privacy. This survey is part of my master thesis project at the University of Stavanger. The questionnaire should only take you 10 minutes, and your responses are completely anonymous.

This survey consists of 4 parts. The first part contains demographic questions about you, followed by questions about "ease of use" of smart mobility in the second part. Further, the third part is a set of questions about your attitude towards smart mobility services in hypothetical scenarios. Here, we also investigate your trust in companies on how they handle personal information. Last but not least, the fourth part is about the perceived privacy risk of these services.
You are welcome to leave comments at the end of this survey.

We appreciate your input!

Part 1. Basic demographic and mobility data

1. Age

❍ under 19
❍ 19-29
❍ 30-39
❍ 40-49
❍ 50-59
❍ 60-69
❍ 70-79
❍ 79+

2. Gender
❍ male
❍ female

3. Highest level of educational attainment
❍ High school
❍ Undergraduate (Bsc)
❍ Postgraduate (Msc / Mphil)
❍ PhD
❍ Vocational training

4. Which program are you studying in?
❍ Science in city and regional planning
❍ Energy, environment and society
❍ Both
❍ Others

1.1 Use of Public Transport

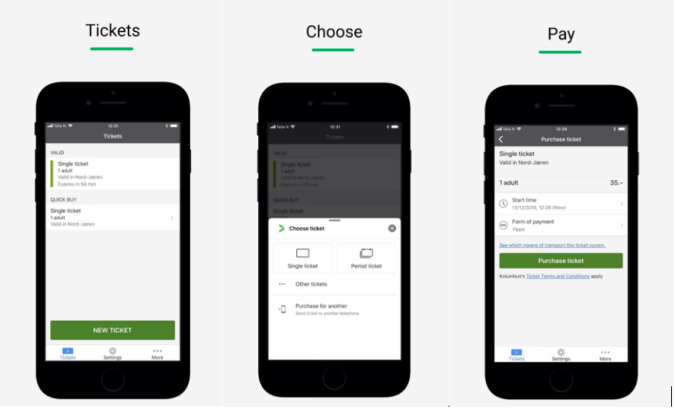
5. Do you use public transport (e.g., bus, ferry, train)
❍ yes
❍ no

Thanks for the information mentioned above. Part 1. is finished.
Part 2. starts with photos of some interface to access different mobility service,
The focus is on how you feel to use these apps/interfaces.

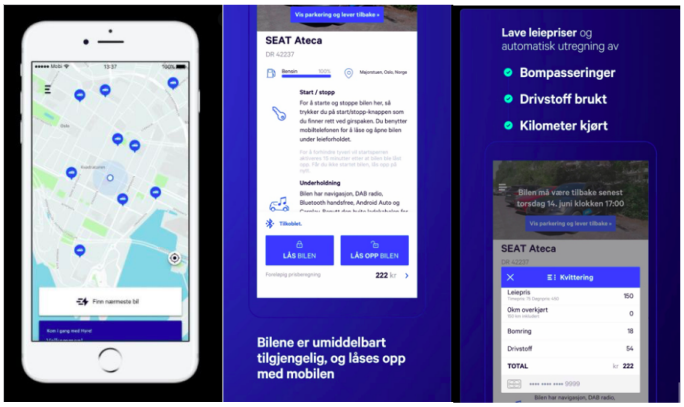
Part 2. Use of Smart Mobility Tools

There are many smart mobility services that can be accessed via mobile apps, as shown in the figure below.

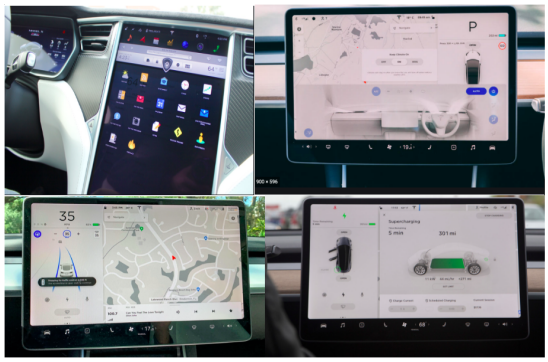
Purchase bus tickets



Car-sharing apps



Touch screens to operate cars



2.1 Ease of use

To which extent do you agree with the following description?

1. Using such an app/interface does not take a lot of effort.
2. These apps /interfaces are easy to use.
3. The instructions to use such an app are, in general, clear.

Part 3. Use of Smart Mobility Services.

This section is composed of THREE sub-sections. All sections contain scenarios. The first section is about a scenario of having an electric car. Sub-section two is about the use of a car from a car-sharing company, and sub-section three is about using bus/collective transport. Each subsection first introduces you to the service provider's collection of personal information. You are then asked about your view of how service providers handle personal information. The final part asks you about your intention to use the respective mobility service.

3.1. EV owner

The electric car companies collect consumers' mobility information from various channels. For example, online information such as users' browser history, the use history of the car, use of energy products, and even events that one attends. According to companies like Tesla, data processing is partly for business development and partly to offer customized services. Information about individuals may be stored and processed in any country where Tesla has facilities or in which they engage service providers. Those countries may not have the same data protection laws as those in which the object initially provided that information. On that account, Tesla has an internal privacy policy. They assure that its adherence to the legal framework in different countries. In Norway, all personal information is treated and stored under the General Data Protection Regulation (abbreviation: GDPR; Norwegian: personopplysningsvern).

3. 1. 1. Handling information

To which extent do you agree with the following description?

4. Tesla is trustworthy in handling its consumers' information.

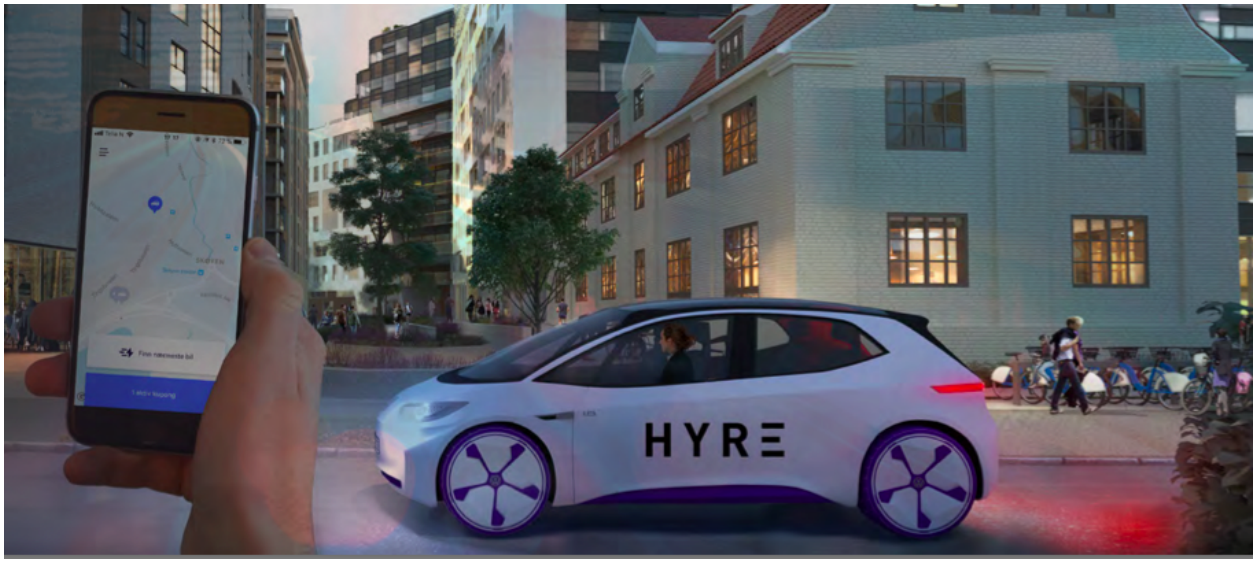
5. I trust that Tesla takes measures to protect the information provided by consumers.

6. I trust that Tesla devotes time and effort to prevent unauthorized access to personal information.

7. In how far is your previous choice (4-6) representative for electric car

3.2 Car-sharing service

In general, the car-sharing service requires users to download an app and make a customer profile. It requires the user's full name, birth date, driver's license photo, telephone number, debit card, e-mail address, driving history, and car number. According to companies like Hyre, processing personal information is partly for business development and partly required by the mobility provider's insurance partner and Norwegian law. They assure that all personal information is treated and stored under the General Data Protection Regulation (abbreviation: GDPR; Norwegian: personopplysningsvern). Besides, they also developed internal routines for handling personal information.



3. 2. 1. Handling of information

To which extent do you agree with the following description?

8. Hyre is trustworthy in handling its consumers' information.

9. I trust that Hyre takes measures to protect the information provided by users.

10. I trust that Hyre devotes time and effort to prevent unauthorized access to personal information.

11. How far is your previous choice (8-10) representative for car-sharing companies in general (in Norway)?

3.3. Public transport

Kolumbus offers public transport services in the region of Stavanger. To use this service you need to have a bus card or install mobile apps, which require some personal information (e.g., name, email, and billing information). All personal information is supposed to be safely treated and stored under the General Data Protection Regulation (GDPR). In addition, internal routines for handling personal information exist.

3. 3. 1. Handling of information by Kolumbus

To which extent do you agree with the following description?

12. Kolumbus is trustworthy in handling its customers' information.

13. I trust that Kolumbus takes measures to protect the information provided by users.

14. I trust that Kolumbus devotes time and effort to prevent unauthorized access to personal information.

15. How far is your previous choice (12-14) representative for car-sharing companies in general (in Norway)?

Part 4. Your view on privacy in the context of smart mobility services

Now that you have gained an understanding of smart mobility, this part relates to your view of privacy in the context of smart mobility.

Part 4. 1. Privacy Concern

4. 1. 1. Privacy in the context of smart mobility

Here are some statements about privacy in smart mobility services. Please indicate the extent to which you, as an individual, agree with these statements from scale 1 (strongly disagree) to 7 (strongly agree).

16. There may be privacy risks involved in using smart mobility services.

17. Accessing " smart mobility service" exposes you to privacy risks.

18. Smart mobility involves a loss of privacy.

4. 1. 2. Use of Information

Please indicate the extent to which you agree with these statements from scale 1 (strongly disagree) to 7 (strongly agree).

19. There may be privacy risks involved in using smart mobility services.

20. Accessing " smart mobility service" exposes you to privacy risks.

21. Smart mobility involves a loss of privacy.

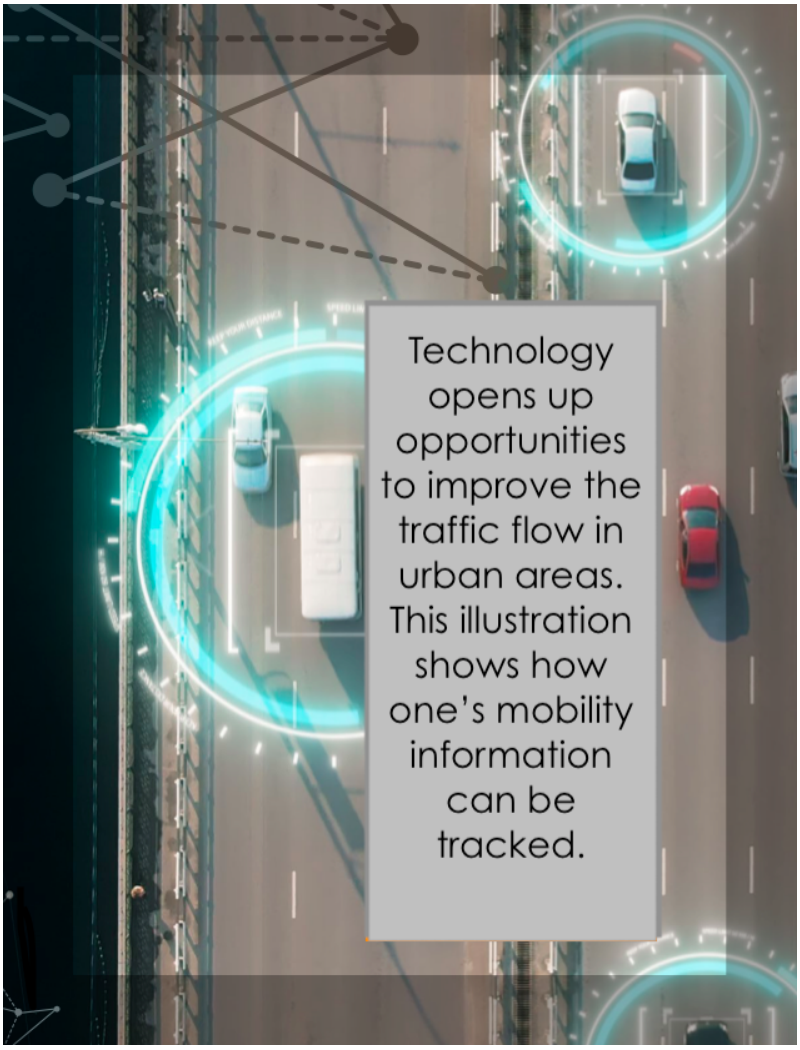
4.1.3. Sharing of Information

Please indicate the extent to which you agree with these statements from scale 1 (strongly disagree) to 7 (strongly agree).

22. The service provider should not share personal information with other companies unless it has been authorized by the individual who provided the information.

23. The service provider must not share personal information in the database with any other company.

4.2. Location information in the context of smart mobility



When you use mobility services, the service provider also obtains location information from you. For example, a shared car company can track where you were at 3 p.m. yesterday. How do you think about this?

24. In general, it is risky to provide location information to a smart mobility provider.

25. There is much uncertainty associated with giving location information to a service provider, as a user has no control over what the information is used for (e.g. business development, service mapping).

26. There is a potential loss involved with providing location information (i.e., the likelihood of data leakage is high because of multiple-use).

27. Last but not least, do you have any comments on the survey?

Thank you for participating in the survey. Your answers are now saved.

Note: All questions are measured by a 7-likert scale presented in Figure A. The exceptions are questions 7, 11, 15, which are measured by likert scale present in Figure B.

Figure A .

Figure B.