CHALMERS
UNIVERSITY OF TECHNOLOGY

UNDERSTANDING USER DESIRES FOR CONNECTED AND PERSONALISED ACCESS SYSTEMS

- A STUDY OF USER´S PERCEPTION OF SOLUTIONS FOR SEAMLESS ACCESS FOCUSING ON PRIVATE AND SHARED VEHICLES

Master Thesis at the Industrial Design Engineering program

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Understanding user desires for connected and personalised access systems

- A study of user´s perception of solutions for seamless access focusing on private and shared vehicles

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Göteborg, Sweden 2015

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Göteborg, Sweden 2016

ABSTRACT

People have always had the need to store personal belongings safely and nowadays there is a vast amount of technology that can raise the value of access sytems by personalisation through connectivity. This project was about analysing the desire today among people for personalised and connected access systems in the area of privately used areas which can be either privately owned or shared with others.

Through user journeys and other user studies together with extensive theoretical research, the project rendered a number of bullet points for design implications as well as a foundation for what to think about while designing these types of architectures. Some of the key results were that in general people are willing to give up much private data if it enhances functionality, there is a desire for a smart key that can learn behaviours and that cars seem to be a potential area for adoption as often car users. In general, peoples trust for fully automated access granting systems is low and there is a desire for certain physical inputs to feel in full control.

Keywords: user experience, user studies, design research, perception, mobility, internet of things

Aknowledgements

I want to give a big thanks to Pontus Wallgren who has been helping me a lot throughout the project and I am also equally greatful for the help from MariAnne Karlsson who was the examiner of the project. During the process there were several study collegues helping me with both knowledge, reflections and motivation. I also want to thank Mikael Gordh at Volvo Cars for his inputs and big knowledge and also helping with setting up user studies.

Thank you all.

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1. Introduction

The need and desire to protect personal belonings can be considered a fundamental need. However, new technology makes it possible to take this to new levels by flexibility and personalisation of access. Today there are numerous things that we lock and unlock on a daily basis throughout the world. Since technology has developed so far in the direction towards personalisation and connectivity, there is a lot of new possiblities to fulfill these needs for protection in a more convenient way. When looking at trends and forecasts of technology development, it can be argued that future users will have high expectations on seamless access to different buildings, to offices as well as private and public vehicles including for example cars and shared bicycle services.
This project will focus on access of cars, both privately owned and shared. There is a vast amount of types of access that is possible to study stretching from computer logins to access of bank vaults and the reason for this project to aim mostly towards cars is that many people have an everyday relationship to cars in one way or another and yet is it a relatively expensive and important product. The access systems of cars today is relatively advances which also makes it a suiting aim.

Figure 1.1 An example of a personalised access system.

This project looks at such a product, which can be thought of as a coin sized hardware (or even a smart phone application) which belongs to a specific person and a corresponding hardware in a car. The different devices will ”handshake” and based on the data from the personal device, certain functions will be triggered. This data may be everything from where a person is and at what times, to radiostations normally chosen in the car and even what products they buy and where. The principle is that the more data is being collected, the more functions are possible.
The assumption, on which the work is based, states that the perception of safety is particularly important when access is concerned as it affects products and environments of high economical and

affectionate values. This also affects trust in these products, probably more than many other types of products as it is so important that it really works according to its promise.

1.1 Background

Being able to protect your belonings including your home and the things you own is concidered fundamental. The need to feel safe and secure and that the things that you own and care for also are kept safely away from theft is something that, during this project, is considered a basic human need. For a long time, this has been about handling a number of keys, normally one key per lock for each door. With new technology there are new possiblities. It is possible not only to seamlessly unlock doors but also to tell the lock who is coming and thus provide different functions based on the persons desires or level of access. All of a sudden there are a vast number of new functionalities possible which are based on information, for instance personal preferences, geographical position etcetera. Today, when leaving your home and entering your vehicle there is usually two different keys needed. When leaving the vehicle and approaching the workplace there is often a third key. Even though technology is far developed, there seems to exist no solution for seamless access even though these tasks are carried out by most people on a daily basis.
Imagine then a product, which is part of a smartphone or a separate hardware, that will give you access to many areas and that "knows" who you are by collecting various data about you and that is able to provide you with a constantly "you-adjusting" experience. These might be functionalities that will be expected in the future, but then it may be equally important to maintain personal integrity and the users' control of the system.

Trends

Throughout the project, the focus has been based on a number of focuses as described below. Urbanisation, connectivity and automated mobility are a few examples.

Urbanisation

In 2007, more than 50% of the worlds' population was living in urban environments (Figure 1.2) (The World Bank Group, 2015). In 2014 there was 53,5%. In 2050 there will be 10 billion people on Earth of which 75% will live in cities (Dowling, 2013). The curve seems to continue rising.

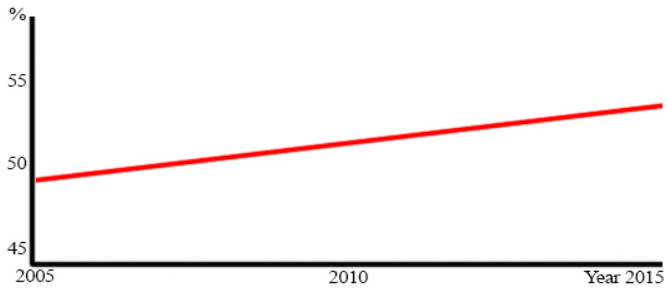

Figure 1.2 Development curve of persons living in urban environments, globally.

Connectivity and automation

There are many examples of forecasts that claim that there will be several times more connected products in the world only a few years ahead. The worldwide marked for connected products are forecasted to grow from $1,9 trillion in 2013 to $7,1 trillion in 2020 (Press, 2015). The number of products connecting each second was, in 2013, 80 each second and is believed to be 250 per second in 2020 (Tillman, 2013). The number of vehicles with IoT (Internet of Things which is a word used for connected products) applications is forecasted to be growing from 23 million in 2013 to 152 million in 2020. That is a sixfold growth in seven years (Press, 2015). The total amount of connected products is forecasted to be around 50 billion devices by 2020 (Tillman, 2013). This includes products such as mobile devices, parking meters, thermostats, cardiac monitors, tires, even roads etcetera.

Urbanisation however comes with congestion end emissions. People can spend hours every day going to and home from work due to over-crowded roads. One example is Los Angeles, USA, where the average commute time to and home from work is 56 minutes and 77% of the car commuters ride alone (Kuo, 2014).

Megacities, which are defined as having 10 million inhabitants or more, hold 6,7% of the earths' population but consumes 9,9% of global gasoline and 9,3% of global electricity. By using technology including connectivity, it is possible to lower the need for electricity due to tasks and services are being carried out more efficiently. "A smart city lets people do more with less" (Falconer, 2015). Given, for instance, an environment where cars communicate with each other it is possible to achieve a better sharing of street spaces based on information about where most/least cars are driving at the moment. Stop lights and pedestrian crossing signs that communicate with cars can create an even smoother traffic and thus a more efficient flow as well as a safer environment. If cars become autonomous it is possible to streamline even more. If cars are shared and, in combination with a more efficient public transport network, there will be less space needed for roads and parking spaces. These areas can then be used for something more constructive than holding cars which move at a relatively

slow pace and emit pollution.
The biggest cities often have too little space for cars and even housing, so it is becoming more and more popular with shared mobility, public transportation and compact and/or shared living spaces. Often new technology is developed with focus on bigger cities, internet connection, cell phone network coverage as well as solutions for efficient transportation of high quantities of people as well as goods. Two reasons for this is that there are much people being affected and also the needs for efficient solutions are big because there are much people.

Sharing economy

The industry of renting/leasing/borrowing rather than buying is also growing. People more often pay for access of products such as movies online, music online, apartments when travelling (such as AirBnB) etc. This type of consumption also includes means of transportation such as bicycles and cars within cities. Car sharing is a rapidly growing industry and has become popular as an alternative to owning and taking care of your own car. Only in the US is has grown from 253 million dollars in 2009 to around 3,3 billion dollars for 2016. Car sharing is one of the most popular access-based areas in todays' marketplace (Bardhi & Eckhardt, 2012).

Future mobility

To take a closer look at the situation when it comes to the development industry aiming at future mobility for connected products and the perception of the technology behind it, there were two events visited during the project:
In Berlin a "hackathon" visited, which was a weekend-long competition for coming up with ideas about connected products and then creating rapid prototypes. Most of the participants were software programmers and/or product developers. The event was arranged by several companies working with development of connected products such as Bosch and Spotify. The theme for the competition was "connected cars of the future". When listening to the participands it became clear that there were a few key challenges and potential areas of development. One example was the in-car personalisation as several teams believed in vehicle sharing and thus a potential desire for easy adjustability of the onboard environment. It was argued that connectivity of vehicle can enhance the shareability. Several concepts aimed at creating seamless access to on board entertainment such as music playlists, events happening in the near area, etcetera. The belief in connectivity as an important part of future mobility seemed obvious as they talked alot about the trends of the request for connectivity.

The second visit was to a Labathon which was arranged by the Royal Institute of Technology in Stockholm (KTH). The aim with the visit was to gather inputs from knowledgable persons within the mobility industry and their thoughts and forecasts regarding mobility of the future. In the group there

were representatives from Volvo, Scania, Ericsson, KTH mobility research department and a few consultant companies focusing on the car industry. Alot of the discussion focused on autonomy and sharing of cars. Several assumptions were made, for instance that cars will become smarter through connectivity as well as being more commonly shared among many users. The reasons for this was that it will be more economocally benificial as well as more environmentally friendly to use this type of technology. As this project focuses on access, connectivity and personalisation, there were questions posed on this theme. The idea among the participants was that the personalisation will be important as vehicles are shared. When discussing the questions of how to access the cars in the case they will be shared and maybe even autonomous, the thoughts differed. Ideas were that access would be granted mainly by vehicles being unlocked and thus only to enter and exit. If the cars would be only shared, and not autonomous, the discussion focused on the need for a convenient access, either by a personal device such as a smart phone or a smart watch, or as RFID or similar as it is a relatively simple yet reliable technology.

1.2 Aim and goal

Based on an analysis of the development of technology and in what way it affects the needs and wants of people, it can be argued that connectivity will be an important part of the future. However, it can also be argued that there is a limit to what people are willing to give up for a certain convenience.
The aim for this thesis project was to understand if and then what desires people have for connected and personalized access systems and how the functionalities should be perceived for best possible conditions for adoption. The goal was to form a basis for what to think about when designing for a higher level of convenience while maintaining the personal integrity and feeling of security for the user of the access system.
The main question to answer during the project was: “What are peoples’ thoughts on using connected and personalized products for privately used public environments, with main focus on cars?”
The fundamental idea for the project was that since there is a general need to lock and unlock things and that there are many technical innovations that could be used to enable this, this should be turned into a value raising product solution.
Subquestions were:

- Do people desire more automated access?
- How do people feel about privacy and collection of private data?
- What are the main issues and factors affecting adoption/rejection of such solutions?

To be able to answer these questions, the present situation needed to be studied to understand what has potential to raise value of. What exists today and what is actually being used and/or what is desired? Based on this, the question of what people may desire for tomorrow needed to be examined. What do

people think about these ideas? What desires do they have for the future products of this kind? Who will gain from the concept and in what ways?
The philosophical basis for this thesis is that if one wants to change something, one must first understand the problem that is to be solved.

1.3 Approach

The work started with setting up a plan for the research and parallell to that the theory research started. The challenge has been to create a research approach to collect knowledge about experience with using a product that does not even exist on a prototype level.

A summary of the layout of the research:

- Theoretical studies on the fields of diffusion of innovation, adoption of technology and understanding of user experience. This step has been partly iterated during the early parts of the user studies.
- The first user study was a broad and quick check on what people do today when it comes to leaving/entering their homes and their cars as well as workplace.
- Next stage in the research was to do benchmarking on existing access systems as well as talking to persons representing companies that sell advanced types of access systems.
- After the gathering of knowledge from the first two studies, there was an extensive user journey analysis carried out including both a physical user journey and a made-up scenario based on the physical user journey but with focus on the product concept.
- To broaden the perspectives and the ideas as well as experiences of the above mentioned, there have been interviews carried out with persons using car sharing services. This has been made to understand the car sharing users and not only the private car owners' perspective.
- Finally, to summarise these different types of studies there has been a cross study analysis. This has shown what the different studies have given in terms of the various questions and thoughts that were formulated in the beginning of the project. As this was done after the research, it was then possible to use this as a good foundation for the discussion chapter.

The layout of the project is visualised by the table below (Table 1). The theoretical pre-study was carried out partly together with the quantitative survey and the dealership interviews.

Theoretical pre-study
Quantitative survey
Dealership interviews
User journeys
Study with car sharing users
Cross-study analysis

Table 1 Overview of research methodology layout

To easier present the product to study participants, a concept was defined. The idea with doing so was that it is arguably easier to grasp the idea if it is presented in some form of relatable product concept. The concept was used primarily during the car sharing user study, the user journey study and it was discussed during the dealership visits.

The concept was developed with a foundation built during the analysis of the present situation in the early stages of the project. By processing the information gained during the studies and to constantly work on developing the concept, the idea was that there would be some cross-over discussions that treats both present and future. The concept has been used primarily as a mediating object, meaning that no concept tests have been carried out, but rather the concept has been a common thread thoughout all the studies with exeption for the first study which was strictly a study of what people do daily. By using such a mediating object, the aim was to create an understanding for the idea by having something to relate to. If only discussing the idea of the access solutions it may be harder to relate to it and thus create a realistic feeling for it.

The functionalities

The product is supposed to be able to give access to basically anything from doors, gates, to computer logins, hotel bookings, etcetera. The idea is also that it is supposed to, due to the fact that it is ”smart” and personalised, be able to store various information about the user. Examples of this could be that the settings of the car seats and mirrors are being stored and then prepared for the specific user approaching the car on the driver’s side. Also, radio station adjustments and sound volume could be programmed to be as last time the user left the car. In the home environment the lights could go on in the house when entering the front door. The alarm function could be automatically turned on/off depending on the users’ personal settings. Basically, anything that can be controlled by wireless

information and stored as memory could potentially be realistic functions. This will though require logging of personal data.

The form factor

The decision was to not present a certain physical form for the product. The reasons were that it easily became a discussion about the form and what other potential form it could have, rather than discussing the perception of the concepts' functionalities. The important thing is that the discussion is focused on the *idea* of this concept at this stage.

The scope of the project was to focus not on the actual technology, nor what exactly is possible to do with it, but rather propose a number of functions and possibilities and then study the reactions of the people. By studying existing technologies during the pre-study chapter, it was possible to use that knowledge during the research in terms of what would be needed for a product type like this, rather than to ask the study participants about it.

The challenge was to analyse the experience of users when being presented with something which could be perceived as a "vague" concept or idea. It was believed that it would depend on t the concepts were presented. Shared spaces versus privately owned space? How would the project render into the clearest and most reliable results?

So, the approach was to start with theoretical pre-study where the knowledge is gained to be able to outline a proper research phase. Then a relatively open online survey was carried out to gather information about the present situation, focusing on the home to car to work user path.
The idea was then to compile the results from that study and then carry out a car access benchmarking as well as interviews with car dealers to get an idea of their perception of user's desires. By having the results from the online survey as a foundation, adequate questions could be asked on the subject of access and user's perception of car connectivity.
When having done this, the plan was to take the knowledge from these two studies and create a physical user journey at the participants' home. Having them walk from home to car and back to home again. The aim with this study was to collect near reality knowledge. Since there is not a real product to test, this was considered close to testing a real product. When having walked the journey, a concept discussion session was carried out directly after. By doing so it was possible to effectively combine the actual user journey with discussing the concept based on the newly experienced journey.
In the same manner as with the physical user journey, a deep discussion was carried out with persons using shared car services in one of Europe's biggest cities. Here the goal was to present a story of a user journey. The results were then compiled and summarised.

Assumptions and delimitations

By stating that any person is a potential adopter and user of this type of functionality architechture, it may be interesting to study the users' perception of the ongoing development and the forecasts of future products.
Fields of early adoption may for example be office buildings with many different access levels and the possibility to combine the product with access to company cars when having booked them. Furthermore, it may be used by people working in several buildings, cities or even countries. Persons sharing cars or bicycles or any other publically or corporation owned mobility might also be early adopters. Also, obviously, the more products having the corresponding hardware, the higher the value of the system for everyone using it. A third parameter is the formfactor of the product and wether it will be possible to combine with many other functions, for example by using a smart phone or a smart watch. Wether it is combined with an already excisting ”smart” product or it being a separate hardware might affect who will adopt or not adopt the product.
An idea is that by providing a usage/movement pattern as similar to todays habits as possible, it is easier for people to feel safer when it comes to concidering adoption of a new solution.

One assumption is being made, saying that if looking at access of homes, cars, workplaces and other environments, the car has today in general the most advanced type of access system. If looking at what people use today in everyday life, the car is often the most technologically advanced product where the access is done by wireless keyfobs as opposed to homes which normally are being accessed by a physical key and a traditional key slot. The delimitations will therefore be to mainly focus on car access as the comparison of today's state of the art solutions might be easier to compare with the concept in this study, compared with a traditional house key.
The home environment is something that many people share with several people at the same time. In a home one often changes room and even floors. Comparing this with a car where always only one person at the time is driving or sits in a certain passanger seat. This creates a much more clearly divided environment in terms of what automated personalised functions can offer the user.

The focus will be on Europe and mostly on Sweden due to timely and practical delimitations. The focus will be on big cities rather than rural areas. The age span which is being focused on will be beween 18 and 50. The low end of 18 is that you must be that age to drive a car on your own.
Also the adoption analysis is limited to only individuals' adoption of the new innovation. Other scopes can for example be adoptions done by organisations or companies.

2. Theory

The theory chapter aims at describing theory behind the studies during the project. As the project aimed at understanding adoption of technology, theoretical concepts such as trust and diffusion of innovations are important. Also, user experience, i.e. users' experience when interacting with and using the product is highly relevant.

2.1 Trust

Trust is a complex area and has been shown many times to be important when it comes to adopting new products including new technologies. When it comes to adopting a new technology, trust can be defined as the gap between what you know about it and what it actually is. So, for example, if you hear about a new product you have to use the trust to fill in the gap since you need to buy and use the product before actually knowing its affect and usefulness. Trust is the result of the perception of gains and losses, weighed with the perceived risks. Research has shown that the attitude that a person has towards use has a strong affect on the intention to use a new technology (Bahmanziari, Pearson, & Crosby, 2003).. Several studies have shown that perceived relative advantage of a new product in terms of perception of being better than what it replaces, is one of the best predictors of the rate of adoption of a certain innovation.

When studying the area of trust in technology there are a number of key elements that seem to keep returning when discussing points affecting it. Important factors are:

- *Control* – a person's ability to control the outcome of the functionality. Control is also about knowing what will happen, when it will happen, why and how. "A system is trusted less when it is difficult to have the control over the assets in its custody" (Akinwunmi, Olajubu, & Aderounmu, 2015)
- *Time* – it often takes time to build trust. Either a person has a perception of trust for the technology or the brand from before, or the person has to gain trust for the new and unknown product. This also takes time. A new technology needs to build its reputation of good reliability and thus earn the users trust over time. Even though it takes time to gain trust (which will always be dynamically changing depending on various experiences with the product), the initial trust is very important as a user can build up a certain "bank" of trust over time (Li, Hess, & Valacich, 2008).
- *Risks* – the level of risk a person perceives affects the ability to trust. In the case of access controlling products, there is a risk of losing something of high value and therefore it takes more to build up trust. "Due to the transfer of a substantial part of control of activities to a third party, concerns are generated about the trustworthiness of the technology." (Akinwunmi,

Olajubu, & Aderounmu, 2015).

- *Similarity/difference* – how similar or different the new innovation is compared to the one which the user has former experience of will affect trust as will the way to use the new innovation compared with the old experience.

When users are buying products with high risk or a high price, the importance of brand trust becomes more important compared with low priced products. Companies need to work hard to gain potential customers' trust and common ways of doing this is advertisement, warrantees and of course by providing a reliable product which builds trust over time (Elliott & Yannopoulou, 2007)

Is it possible to know who will have access to the data which you are sharing? Is it possible to know what those stakeholders are doing with the data? How to know and who to trust with the handling and managing of data? Is the data stored properly? Is the data encrypted properly to avoid unwanted access? Is it deleted properly the day it is supposed to be deleted? If the product is heavily relying on connectivity it is important to be able to trust the functionality. For example, if the product relies on connectivity for locking and unlocking a car it is important to be able to trust the functionality as it will otherwise be left unlocked when leaving. Will the data be collected properly so that functionality can be enhanced according to the users' needs and desires?

The feedback from the product to the user is fundamental for the trust. If the data management and the connectivity are trustworthy, this information needs to be displayed with proper feedback to the user. What should be shown? What should not be shown? Will too much information about "it works as it should" make you think about the day it might stop working?

2.2 Adoption

"The usefulness of research on the attributes of innovations is mainly to predict their future rate of adoption. Most past research, however, has been *postdiction* instead of *prediction*." (Rogers, 2003)

When new possibilities arise for raising convenience, throughout the history it is clear that people tend to adopt the product that is providing this. When the automobile arrived over 100 years ago, there was a revolution in mobility as well as a dramatic reduction in need of horse carriages. As a result of this, peoples' lives changed with the possibility to move around in a whole new and much more effective way.
When the television arrived, people adopted it and it quickly became a natural part of many peoples'

lives. Also, in this case it is arguably so that peoples' lives, needs and wants changed with it as new possibilities for entertainment as well as news grew drastically. Several more examples can be provided, and the most recent type of product may be the smart phone. When technology develops and makes products more efficient, they tend to take over and eliminate the needs and desires for the old ones. All of a sudden, the phone is carried around and used much more and in new ways compared to the old version. People do not seem interested in going back to using the old type. Smartphone ownership rose 2200 % from 2006 until 2013 (Heggestuen, 2013) and it has risen even more since then.

2.3 Diffusion of innovations

"As only a fraction of new products are successful, a thorough understanding of factors underlying the innovation adoption decisions by potential adopters is necessary" (Frambach, Barkema, Nooteboom, & Wedel, 1998). Diffusion of innovations is a theory that tries to answer why, how and at what level new technology is spreading through different cultures. Diffusion can be seen as the process with which a new innovation is being communicated through various channels (Rogers, 2003). Either there is an identifiable need among people which is possible to meet with the new innovation and hereby create possibilities for adoption or there is what can be called latent needs/desires, meaning needs or desires that people do not know they have before they are introduced to a product providing that. One example is the color TV compared with black and white. The desire to see news and movies in color was introduced when the color TV was introduced.

Innovation elements affecting adoptaption

According to Everett Rogers, there are four main elements that influence the spreading of a new innovation (Rogers, 2003). The four elements are 1.) the innovation itself, 2.) the communication channels, 3.) time, and 4.) the societal system.

The innovation itself:

Obviously, the innovation it self is important for wether it will diffuse or not. According to Rogers there are mainly five elements of the innovation that affects adoption (Rogers, 2003):

1. Relative advantage – this is the level at which the innovation is perceived to be better than what it replaces. This may be in economical advantage, in functionality, in decreasing discomfort, in saving time, in status etcetera. Status as a motivator for adoption seems to be more important for the so-called innovators, early adopters, and early majority described later, and less important for the late majority and laggards. Relative advantage is often perceived party as a result of the various communication channels' messages. The various inputs a person gets about the innovation are greatly helping the uncentainty-reduction which is sought for. Therefore, this type of innovation-evaluation information is crusial for the diffusion

process.

2. Compatibility - this is the degree to which an innovation is perceived as consistent with personal values, past experiences and the persons needs. Depending on the persons previous values, ideas, experiences and present and future needs, the compatibility with these points affects the adoptability. There is however a need for a certain incompatibility with the former ideas because if it would have been correlating exactly with the old ideas, it would not be an innovation. A former idea can be a former experience of a similar innovation as the new one, depending on the experience with that former innovation, it may be positive or negative for the adoption of the new one. In general people do approach a new innovation the same way the used to approach the old replaced variant.
3. Complexity – is the level to which a new innovation is perceived as hard to understand and to use. The more complex the innovation is perceived, the harder it is to want to adopt it, in general. According to Rogers, the complexity and the relative advantage ofter are the two most important elements in terms of affecting adoption.
4. Trialability – this is how much an innovation can be experiences and experimented with before buying/adopting it. For example, if a smartphone is possible to test in the store, it is easier to decide to buy the "best" one for oneself. It is harder to adopt to products which are only heard of but not even seen. An example can be in insurance which are not possible to "test" ahead of buying. In general, early adopters' value trailability higher than late adopters as they already have a lot of information and knowledge from surrounding communication channels.
5. Observability – this is the level to which the results of the innovation is visible to others. This affects the various communication channels which affects the diffusion as the more people gets to know about the innovation and the more easily the information is spread, the better it is for the diffusion of the innovation.

The communication channels:

Rogers pointed out that exposure to information about a new technology or other innovations can be direct or indirect. People can learn about it from mass media, such as advertising, or by word of mouth. Both are generally present, but advertising is typically stronger early in the introductions of a new technology, when few people own it. Word of mouth among friends etcetera typically becomes stronger later, when more people are likely to own it. Furthermore, some products generate a lot of word of mouth, positive (e.g., the iPod) or negative (e.g., early DSL service), while other products sneak under the radar, thereby affecting the relative impact of advertising and word of mouth (Carey & Martin, 2010).

Time:
Rogers argues it is important to examine the entire adoption process and all groups of adopters, not only those who are the first to use a technology. Early users and later users often differ According to Rogers there are five categories of adopters; innovators, early adopters, early majority, late majority and laggards (Figure 2.1). Innovators are first to adopt and tend to be interested in new innovations. Early adopters are also quick to adopt, early majority and late majority is just as it sounds; the majority of the adopters i.e. most people (of those who will adopt). Laggards are the ones last to adopt and usually show low interest in new technology, new products, status of products, etc.

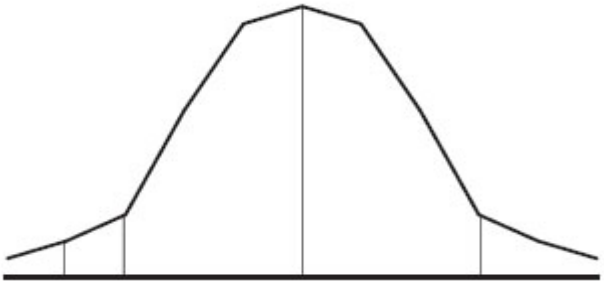

Figure 2.1 Time axis for different types of adopters spreading over time (Rogers, 2003).

The societal system:
Arguably people's adoption of innovations is driven by their social environment. Innovations used by other people in a person's social environment is likely to play a role in adoption of an innovation. Social influences are when members of a social group influence other people's behaviors in terms of adoption. The perceived pressure and influences that peers feel when adopting an innovation affects the adoption processn, and the influence is felt through messages and signals that affect the perception of the value of an innovation. Social networks have a strong influence on people in the adoption of innovations. Social networks provide information about the new technology and how to use it. People also give much value to a network's advice and recommendations because other people in the network's are also using the same innovation (Talukder, 2014). According to this perspective, people may adopt an innovation not only because of its perceived usefulness but also because of perceived social pressure. Communication between members of a social network can enhance the speed of innovation adoption. The opinions and positive attitudes of important referents could be part of the basis for a person's feelings about the usage and functioning of the innovation.
All elements also affect each other.

The diffusion relies heavily on human capital, this means that at a certain point (called the critical mass) it is adopted by so many that the adoption becomes self-sustained.

There are also other elements that affects the adoption of new technology, one example is the price of the product. As new technology is often expensive to manufacture, it will have a relatively high price for the customers to pay. Many companies also take advantage of the early adopters who are willing to pay a higher price for a new type of product. As the price drops over time, it makes it easier for a broader adoption. An example is flat screen TV's. Being quite expensive when first introduced to the market, the price dropped drastically the following years. Another common development is that the price stays relatively unchanged but the performance and/or functionality of the product increases over time. This can be exemplified with the PC.

The adoption process

In addition, Rogers describes the process for adopting (or not adopting) as consisting of five steps; 1.) knowledge, 2.) persuasion, 3.) decision, 4.) impremention, 5.) confirmation. These five stages normally follow each other in a time-ordered manner.

1. *The knowledge stage* is where the individual learns about the existence of the product and seeks information about it. Here the questions *how* and *why* are critical. There are two things which are crucial for potential users to consider adopting a new innovation: Perceived usefulness and the perception of ease of use. Perceived usefulness is the level at which the user perceives the product to help him or her carry out the task that the innovation is meant to do. It is common for potential adopters, before they make a decision, to investigate the usefulness of a new system. Many say they check the purpose of the technology to find out what they can do with it (Talukder, 2014).

   The innovation may be used only as long as the user believes it will help them enhance the task they are to carry out. Compared with the present situation, what will the new solution offer? However, not only that is important but of course also the actual ability of the product to carry out the task. If the user experiences the product to be more difficult to use than to carry out the task without the product, the result will be rejection (Talukder, 2014). Ease of use refers to how easily the new function will be to be carried out. These two elements create a certain *attitude* to the usage. Attitude and behavioural intention – If the person feels positive about usefulness and believes it to be easy to use, he or she will form a positive attitude which will, as mentioned earlier, have a positive affect on the trust and ultimately the adoptability (Bahmanziari, Pearson, & Crosby, 2003).

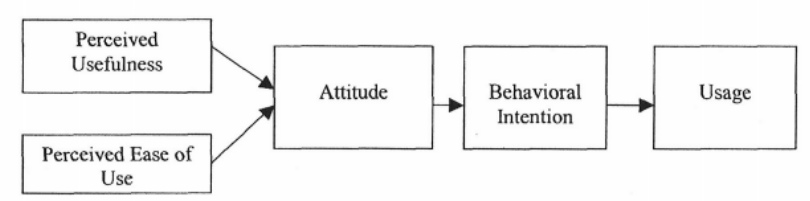

Figure 2.2 A figure showing the line from perceived usefulness and ease of use to actual usage (Rogers, 2003).

2. *The persuation stage* is when the individual has a certain attitude toward the product. The person shapes his or her attitude after aquiring knowledge the product. The knowledge stage is relatively cognition centered whereas the persuation stage is more affective (feeling-) focused. This means that the person is more sensitively involved with the product. Often, at this stage, the person rather seeks knowledge among friends than among advertisements or specification sheets.
3. *The decision stage* is where the person chooses to adopt or reject the product. The more the person knows about it the higher probability for the adoption to sustain, meaning that the individual may adopt the product but while learning more about it through usage, he or she may reject it after a while. This stage in affected by for example how much complexity is involved, i.e. it may or may not be too complicated to learn, or wether the user needs to change the way of doing things or change the way they think about certain things. This is affected by the users' past experiences, preferences and knowledge (Carey & Martin, 2010).
4. *The imprementation stage* is where the user puts the product to use. There can still be problems and uncertainties in this stage and as long as the product keeps the promise from before the implementation, the probability for keeping the product is high here.
5. The last stage, the *confirmation stage* is where the user looks for support for his or her decision. According to Rogers the user may reverse the implementation if he or she is "exposed to conflicting messages about the innovation". However, it is normally so that the user, at this stage, tends to ignore these messages and instead seeks positive supportive messages about his or her perception of the product thus far. There are generally two reasons for discontinuing the usage at this stage; either that the user finds something else that carries out the task more effectively or the other reason is simply because the product no longer carries out the task at the level the user wants it to.

S-curve

One way to visualise the progress of adoption is by an *S-curve*. This visualises a normal (successful) adoption of a certain product over time. It is possible to look at, either by market share or in number of persons (the market share S-curve naturally dips at the end of the products' lifetime as it is replaced by

something new). The natural way it develops is normally that it is slow in the beginning when few people have tried the innovation and can spread the word about it. Most people are still uncertain of wether they want the product or not. As more people do adopt it, it gets easier for the rest to adopt and this creates an exponential diffusion of the adoption. After a while the rate of adoption planes out as most people who are interested in the type of product have adopted to it. Over time the product is becoming outdated or gets replaced by something better. This curve creates an S-shaped line and thus is called an S-curve (Figure 2.4).

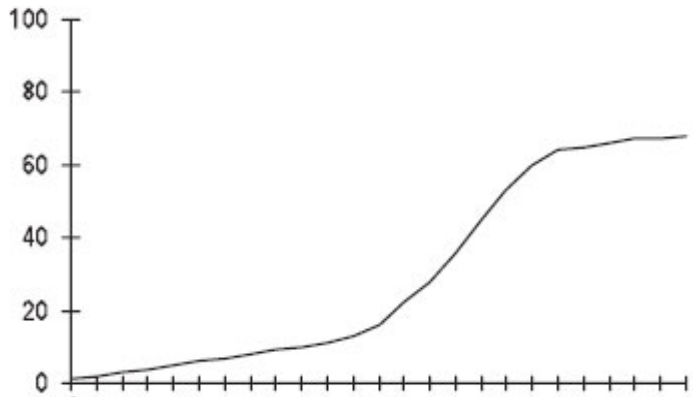

Figure 2.3 The S-shaped curve showing the adoption over time.

The "chicken-or-the-egg" problem

Another element that affect adoption and, which must be considered in the case of personalized and smart access systems, is what is called the chicken-or-the-egg problem. This means that for people to want to adopt the smart key system, there needs to be corresponding hardware that grants the access. However, if no one buys the smart key, no one is going to be willing to invest in, and install the corresponding hardware. An earlier example is DVD players. When few persons owned the players, there were few movies available as most people were still using VCR players. As more people bought DVD players, the selection of movies increased and thus the value of the product became much higher to finally totally erase the desire for VCR players as they ended up being out of selections of movies. This is also sometimes called the indirect network effect (Carey & Martin, 2010).

New behavior and new technology

Adoption is also affected by how big differences are in the user's way of carrying out the functionality, as mentioned above. Wether it is an enhancement (big or small) of a product or a completely new product. The figure (Fig 2.5) shows different combinations to be discussed (Carey & Martin, 2010). According to respondents in a study carried out by Taukder (Talukder, 2014), prior experience with similar technology is helpful. If a user had used similar technology before the user

will be able to compare it with the previous ones and see which features represent substantial improvements. Prior experience helps to make the transition from one system to another.

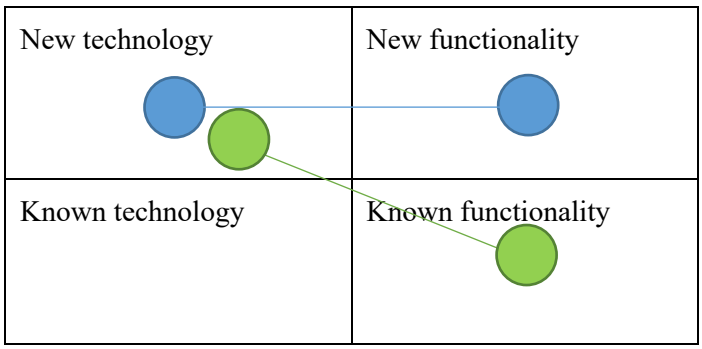

Figure 2.4 Adoptability depending on the product being new or just enhanced and if there is new technology needed or not. New technology and new functionality are challenging. New technology but known functionality is less challenging.

The biggest challenge is thus new functions with new technology as the user needs to learn both the functions which may affect how the user behaves as well as the new technology which is not before known to the user. An enhancement of a product with new technology is easier, or a known technology which provides new functionalies are also easier. Again, all mentioned elements affect each other, for example, if the product type is new and the technology is new, the price of the product will be high by the time of market introduction.

2.4 User Experience (UX)

The term user experience (UX) is widely used within several design disciplines and is supposed to cover all parts of the usage of the product. To design for experience is to design in a way that makes the user feel a certain way when using the product, system or service; UX highlights the experimental, affective, meaningful and valuable aspects and can also be defined as ”a person´s perception and responses that result from the use or anticipaded use of a product, system or service” (Karlsson, 2013) All stages of use of a product or service can be designed for a certain experience. For example, when you travel by train it is important with a comfortable seat as this will affect the experience of the journey. However also the bistro and the service are important and even buying the ticket before the trip is part of the whole experience. There are many examples where companies that have a good overall “experience thinking”, are gaining customers compared to companies only focusing on the direct usage of the product or service. One example of this is Apple who are working with not only designing a good product but also well-designed store interiors and the packaging of the products. Many people say that it is even joyful to unbox a new iPhone as it is such a luxorious package.

The usability of a product is an important part of the user experience. It is however important to clarify that usability is a part of the whole user experience. The ISO definition of usability is: ”*The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use.”* (UsabilityNet, 2006).
In a field as wide as personalised access systems, the actual usability is supposed to be a relatively discrete and “in-the-background” type of experience as the idea is that the user should not actively use the product much. The challenge of the usability then becomes to provide the function that the user requests without him or her having to do much actively. However, usability is one very important argument for either adopting or rejecting new technology.
This project aims at studying the overall experience of the product. In this case usability can be seen as not having to *use* the product (manually). By minimising the need for inputs to the device, the overall experience will hopefully be more positive.
By looking at the whole use cycle of the product, the over all experience (the UX) should be as high as possible.

Understanding how users perceive different parts of the user experience is key throughout this project. Many examples can be highlighted where the actual function differs from the perception of that function from a user´s perspective. For instance, the fact that even though it is relatively safe to pay online with a credit card, a user may perceive it as unsafe. A person who is waiting for the bus to arrive may perceive those few minutes as very long in the case of rainy weather and a lack of shelter, thus drastically changing the positive experience of using public transportation. Considering these phenomena during this project, it is important to study the perception of the UX throughout the various steps of usage. In what ways will it matter for the user who is providing the service? Earlier relationships with certain brands may affect the perception of trust, for example. Also, feedback may be a key element for creating a feeling of control and thus a higher level of trust. The desire may be affected by the products ability to provide an automatic and thus seamless journey.
The challenge can be seen as to minimize the gap between the perception of a function and the functions’ actual ability to carry out its task. If it is safe, it must feel as safe. Lauren Aguino Schuzas and Larry Leifer (Schuzas & Leifer, 2012) argues that the smaller the gap, the easier people tend to adopt to new technologies.
Yet further worth concidering beyond the gap between perception and reality is the fact that the brain also works unconsiously with sorting out ”important” and ”not important” information. In this project, there will be analysis on this field as the concepts are meant to lower the amount of information or inputs that the user needs to get during the journey. The brain can only process a certain amount of information and sorts it out subconsiously depending on the importance. (Rosenburg, 2015). By taking away parts of the active work during the journey, it is possible to focus more on other important tasks

such as making sure the children are getting dressed properly in the mornings. Or even just walking across the street to approach your car. This could mean that the UX is raised and also this might affect the potential of adoption.

2.5 The technology

The technology needed for this type of functionalities may be analysed in a deep manner. However, as the thesis aims at understanding the user rather than the technology, this will be a brief presentation of the technology that will enable the experience. This chapter will look briefly into that.
When studying companies which are in the cutting edge of ”smart products” development, it is common to find that they are creating products that adopt to specific users.
A smart and personalised access architechure would gain from using connectivity, bluetooth and/or RFID as well as preferably deep learning abilities. By knowing the technology and by concidering the importance of UX, a product concept can be developed.
Deep learning is a term being used for products which are being programmed to ”learn” new things as it is being used. Examples of this is speech recognition tools that are being programmed to log speech over time and as it learns it can also recognise variants of it or even more effectively sort out speech which is surrounded by various noise (Hof, 2014). This technique is also being used when a website learns about the visitors browsing patterns and in that way, it can provide personalised advertisement. For example, Facebook and Google are using data collection to optimise advertisement and search results. This technology needs big data collecting. A company like Google is in the forefront of managing big data and the term ”big data” is even used as a term describing this phenomenon that is growing rapidly. Some experts even claim that it soon will be possible to ”store data about everything, for ever” (Hunt, 2013). The term in general means amounts of data that is so big that it is not possible to process with traditional database methods.
If scouting around on the internet, it is clear that very many companies are created around ideas of connected products. Just a few examples are connected refridgerators, cars, toasters, watches, moisture meters, car counting devices, glasses, bicycles, steam irons, construction site machines, tennis rackets, skis, shelfs inside of refridgerators (specifically keeping track of how many eggs you have at home), tooth brushes, toilets and much more. The term used for this is often “internet of things” which basically means that a product, a “thing”, is connected to the internet to enhance its functionality.
Another form of technology that enables sensitive collecting of personal data and then being able to use it is ”ambient intelligence”. This is being used for products to work together to support people carrying out their everyday life activities. It is meant to be used to increase the communication from smart devises to humans to create a more seamless and natural interaction by collecting data without the user noticing it.

When products are getting smarter and get better ability to store big amounts of data and at the same time do this without actively affecting the user, it may be so commonly used and so descrete that users do not even know about what is happening in the background of the everyday life.

2.6 Related case studies

As part of the early research a number of case studies looked into. Three are worth mentioning as they contain some similar issues as the research in this project.

Conference-communication solutions

In a study made on diffusion of three types of conferencing solutions, there are a number of things similar to this project. The three types of conference communications were audio conferencing, i.e. several people in different places communicating through audio only. The second was video conferencing, i.e. several people in one room communicating with another room of people through video plus audio. The third was video-telephones, i.e. telephone where each person have their own location, camera, screen, audio and microphone. They were all introduced around 1970.
The three variants have differed vastly in time it has taken for the diffusion of the innovations. According to the source (Carey & Martin, 2010), the audio conferencing was greatly spread within 10 years time whereas video conferencing took circa 30 years to moderately become spread and the video telephone has yet to spread after over 50 years. The focus here is on non-connected audio and video, i.e. not Skype conferances etcetera.

One issue that was to be dealt with in the early days of audio conferances was that there was a need to, for ensuring a good sound quality, monitor the sound by an operator. This was not allowed as it was not allowed to monitor telephone calls because it was trespassing the personal privacy of the users. When video conferencing was first introduced, it required roughly one thousand times the transmission capacity of a comparable telephone call. The gear needed was also extremely expensive and complex to both install and to use and to maintain. A video conference between New York and San Fransisco costed over $2000 per hour. Another issue early in video conferencing was the usability. Most users that had adopted did so because of a highly enough perceived need for this. Very few adopted the systems due to it was hard to use and often needed dedicated operators to run it. An example of high need was aircraft manufacturer Boeing who used video conferencing and thus drastically raised management efficiency and at one time was 30 days ahead of schedule thanks to video conferencing.
The video telephones, i.e. for each individual to use in a conference, suffered problems with reliability and also cost. Again, the cost compared to what it gives was simply too high. Another issue often mentioned was the fact the people were afraid of, without knowing it, being filmed and showed to

others in an unknown location. Privacy and integrity again, was an issue here.
One common problem these three systems encountered was the lack of feeling of confidence in both functionality and in privacy. The importance in this can be seen as lowering the threashold to dare to adopt. As designer of such a system, one must assuage the doubts and the anxiety that potential users feel by matching the system to what people desire (Lipartito, 2003).

One important behavior aspect to adoption of either of the three and why audio conferencing has become such a much wider spread solution is the fact that people want to not be seen. If not being seen, people can move around in the room as well as do other things simultaneously which could be considered rude to the person on the other end of the line if being seen. By not being seen one can relax more (Carey & Martin, 2010). This can be seen as that the video solutions, which unique selling point is that you can see each other, is commonly considered something negative among users. In general, users think that this is the case, or just that the video part of the communication is not of any high value and thus not worth spending money or energy on. This combined with the lower reliability of video compared to sound-only makes it even less valuable.
One common problem was that there was a low interest showed towards all three as people were unsecure of how to use the new technology (as mentioned in the beginning, the challenge of diffusing new technology is hard. Here it is also somehow a new function as well; distance-meetings.)

Electric banking

Another example of adoption of new technology, and also new functionalities, is with the arrival of electronic banking. The first electric banking service were the automated teller machines (ATM's) which people had very low trust in at first. Later attempts to with banking services via internet in the early days but was not adopted well as very few people had internet at all at home. Attempts were done to show banking information on the TV at home via a telephone line. This was unsuccessful, most likely because of the perceived lack of security and privacy (Carey & Martin, 2010). One mistake that banks made when connected PC's at home became common was to charge for the service, people were not that interested in it. Many thought it seemed strange that the bank could save money by being able to cut down on staff and at the same time charge the customers fot it. People wanted security, simplicity, convenience, control of their accounts and strong customer service – at no cost.

The mobile phone

The mobile phone was diffused throughout the world mainly in the in 1990's and the 2000's. The diffusion of the mobile phone is a good example of the complexity of forecasting the diffusion as well as how important it is with price and also how the use of a technology can change over time. It is also a good example of how a certain technology can change society.

Also, for mobile phones as for all other examples above, the price was very high in the beginning making only a few affording it. As price dropped, the diffusion accelerated. It was mostly businesses that adopted to mobile phones in the beginning.
In the late 90's parents started giving mobile phones to their children as a safety device to be able to reach them at all time. Entering the 2000's, the safety and security remained an important motivator for acquiring a mobile phone.
Mobile phones became important for people wanting to be able to (almost) always reach family members, get news about delayed trains, more effectively managing time etcetera. The key value was the feeling of control of their lives no matter where you are.
The so-called networking effect mentioned earlier was also an important aspect for the diffusion.
The smart mobile phone has made some major impact on other products and services when being more and more adopted. It has drastically lowered the desire for landline phone services and radio alarm clocks as well as armwrist watches, for example. It has also affected the way we purchase new things, how we gather information as well as how much we communicate with others. Since people now are reachable virtually always and anywhere, the privacy has been reduced (Carey & Martin, 2010). Also affecting privacy is the location-based communication, i.e. that users "check in" at certain places or tag places or just automatically communicate where an image is taken, etcetera.

3. The studies

The research was about analysing the present situation when it comes to how people act, think and feel related to accessing their cars, their homes and practically all types of unlocking of privatetly used areas and products. The intention was to use this knowledge while analysing the thoughts and ideas of the concept. The scope was to start broad and carry out quantitative studies to be able to grasp the wide area as well as hopefully also gain new knowledge which would then lead to new questions. Hence the flexible approach to the methodology and research layout.

3.1 Online questionnaire

A first step in the research was an online survey. The approach was to ask open questions as that should give directions and an overview of the participants' experiences, rather than concrete values from a set number of alternatives.

The aim

The aim of the quantitative survey was to gain an initial overview and a knowledge foundation for the later and more specified research. By asking questions about a "journey" carried out that included both the person's home, car and office (or similar final destination), there were three areas of use taken into the survey. As the aim was to focus on car access, the decision was made to involve a car in this user journey, as opposed to only analysing any form of transport from home to workplace. By having an online survey, the purpose was to quickly get an overview by easy-to-summarise answers and to take little time away from the respondents and thus presumably raise the amount of responses.

The procedure

The research started by creating a user journey mapping, i.e. there was a brainstorming around what steps most people might carry out when walking from the house to their car and then finishing by going to their workplace. The mapping rendered these number of steps:

- Realising you need to leave the home;
- Packing everything that is needed for the journey;
- Locking the house;
- Approaching the car;
- Unlocking the car;
- Entering the car;
- Driving the car;

- Exiting and locking the car;
- Entering the workplace.

These points were then used to create a number of questions. The idea was to keep the number of questions to a minimum and rather focus on collecting more in-depth answers for each question. The idea was that this would result in better and less predictable answers, was the idea. A number of examples were states after some of the questions to clarify the aim of the question. There were five questions asked, all based on these nine steps. The questions were asked in a way so it would spur their own thoughts, rather than providing alternatives and them having to choose the most correct one. The questions asked were:

- You need to take the car to work in the morning; what do you bring, both for the car ride and the rest of the day? Any specific issue that you experience often? (Finding things, keeping the time plan, carrying bags?)
- You are now by your locked car; how do you get inside? (Unlock, store bags, seat adjusting?)
- Does your car have electrically adjustable seats with position memory? Do you use it and how is the experience of the usage/why are you not using it?
- When leaving the car, do you feel safe that the car becomes locked? Do you feel like you get sufficient feedback?
- When arriving at your final destination, where do you keep the key? Any issues? Does it differ from when being at home?

By inviting the participants individually, it was also possible to actively control the distribution in terms of age and gender.

The results

In total there were 21 respondents of which 15 were between 22 and 35 years of age and 6 were between 36 and 55. The mix of gender was 13 men and 8 women, and the work type showed to, in this study, have low significance in the results.
The key findings are summarised per question.

- 13 persons said they sometimes or often had issues finding the keys in the mornings. 8 persons said they never or rarely had issues findning the keys. 7 persons said they bring 7 or more things in the morning, including keys, mobile phone and one or more bags.
- 17 persons have key fob unlocking and 6 persons have sometimes issues finding the key even if the keyring was used for locking the house just before. “I put the key back into my pocket and then have to take it out again because I can’t feel which way I am holding it”, said one

person. 3 persons have manual locking and unlocking of the car and 1 person had, by the time of the survey, a non-working key fob resulting in an ”annoying” procedure to unlock the car. 12 persons are annoyed when having more than one bag as they need to hold it in an unpleasant way. 7 persons claim they usually put in on the ground and/or do not mention that they are annoyed. 2 persons mention that they also have to unlock the trunk from inside the car which is concidered very annoying. “I usually don't put my stuff down on the ground so probably I would try to keep everything balanced in one hand or squeezed between me and the car door while I search fort the keys”, said one person. Another person said “I put everything on the ground before open the trunk door”.

- 15 persons claim they have electrically adjustable and memory storing seats. 5 of them claim to use it, 10 claim they do not use it. 6 persons claim that they do not have the function. One person said “My car has electrically adjustable seat and it can be connected to the car key. You can store three options. I think it is a good function but I don't use it anyway. I havn't thought about it before but probably I change how I want to sit from time to time.” Another person said “It has but i never use it as i just dont bother learning it but instead roughly adjusts it everytime it has changed.”
- Of the 21 participants, 13 persons said that they often double check the locking by pulling the door handle (on at least one door). 6 persons claim they press the locking button at least twice to make sure it is locked. Some persons said they do both of these. Only 2 persons said they fully trust the locking function of the key or keyfob.
- 17 persons have their keys in their pockets throughout the workday. 4 persons have a specific place at work where they put them. Some mentioned issues during summer when they do not have any pockets, then storing the keys can be an issue.

This early in the research it was hard to conclude anything deeper than stated above.

3.2 Benchmarking of automotive access systems

By visiting three different car dealers (BMW, Mini and Volvo), it was possible to study the existing state of the art access systems within the automotive field. The study was carried out at three different car manufactures to get a wider range of car types covered, both concidering car type and the cost of the cars.
future.

The aim

The aim of this study was to learn more about the existing state of the art access systems within the automotive sector, a sector that is concidered far developed and where customers have relatively high expectations on technological functionalities. The aim was also to carry out interviews with

salespersons and collect their inputs on customer desires and trends within the area of car access systems. By combining the access system study with the inputs from the salespersons, the goal was to get a clearer understanding of user desires within the access field. By creating this study based on the knowledge from the online survey, the last aim was to have a deeper understanding of the present situation. By combining the study with an interview with a salesperson it was possible to analyse the present situation in terms of customer desires as well as functionality development and forecasts of what will come in the near future.

The procedure

This study combined discussions about the present situation with discussions about future forecasts. The reason for combining the two into one was that they, in this case, affect each other and due to the visits being a combination of testing products and carrying out interviews, this became a natural combination of the two scopes. When discussing the trends and the near future, the concept was presented as a mediating object.

The study of the existing access systems was carried out by asking the salesperson for an explanation and a demonstration of the different types of access systems. Focus was on the automated and seamless systems for both doors and trunk. By getting to try it physically there was a good understanding for the functionality as well as a brief experience of the usage.
BMWs *Comfort Access* and Volvos *Keyless Access* as well as the smart phone application *Volvo on Call* which gives the user possibilities to carry out certain tasks in the car by using the smart phone. For example, pre-heating the indoor climate a certain time ahead of arrival to the car via an internet connection.

An interview guide was prepared before the visits. An assumtion was made that there would be some certain user groups being more interested in certain brands, for example that BMW would be appreciated by early adopters and Volvo cars would be appreciated by persons valuing traffic safety, rather than sportiness and cutting-edge technology.

The questions were kept open and flexible and it was started by asking the salesperson to present the brand and what may be concidered unique for it. As the focus was on letting the salesperson explain rather than specific questions being asked, a sound recording was made. This made it easier to translate the verbal discussion into text. The prepared questions were:

- Is there a ”typical” buyer of this brand? In that case is it possible to describe him, her or them?
- What do the customers usually ask for that you concider especially well provided by your brand, compared to others?

- Can you describe what has been developing the last few years in terms of connected devices and other ”technological gadgets” regarding the users’ direct contact to the car? Do people show concerns about integrity and/or safety regarding this area?
- Do you have any thoughts on what will happen in the field of connectivity and car access the upcoming 5-7 years?
- According to the onine survey, 11 out of 15 people who own a car with automated seat position claim they do not use it, do you have any comments or thoughts on why they do not?
- Do people request personalised access and functionalities in the car? For example, separated log-ins for in-car functionality personalisations?

These questions cover both the present situation and some discussion about the future.

The results

The result is divided into the three different car brands for easier comparison.

BMW

Traditionally BMW has been concidered a premium brand and thus being known for modern technology and many technical gadgets. BMW has a far developed access system (Comfort Access) which provides the owner with both keyless entry as well as foot activated hatch opening, this is very much appreciated by the owners and most buyers pay for these extra functions. BMW owners tend to accept a higher price for a premium product with high level of functionalities. Even though BMW have a number of entry level models now, they still are high end and premium versions of that respective size range. The best argument for selling the comfort access system is the foot ”kick” trunk opening function where you swipe your foot under the rear of the car to open the trunk. According to the salesperson, BMW are working on an even more open key solution including bank services, garage door integration etcetera. “I believe that a fingerprint based solution would be the best solution”, said the sales person. For notifying the driver about the locking procedure there are knobs going down into the doors as well as the rear-view mirrors are folding in. “In this way the user clearly sees that it is being locked properly”, claimed the salesperson. Some functions are, even according to the salesperson, not necessary but are still popular among the customers as they are either fun or expresses a certain modern lifestyle. Also automated seats were mentioned as something that is popular among customers. There seem to be a trend in asking for telematics (GPS, sending/receiving information via telecommunication, etc) and connectivity.

Mini

Mini is a brand clearly aiming for a younger audience. However, the range of models as well as the heritage of the brand also attracts the older generations. The cars are marketed as playful and joyful

cars but as they aim at a young audience, they are relatively simple in terms of extraordinary functionalities, compared to in this case BMW and Volvo. Including the access of the car which consists of a regular keyfob in most cases even through a keyless system exists. When talking to the sales person it gets clear that driveability and ”having fun” is more important than high tech devises and functions.

Volvo

The Volvo cars are known in the world as the family friendly and safe car. However, the last years Volvo has worked towards raising the premium feeling in their models. The ”typical” persons buying Volvos has gone towards a more modern and technology interested audience compared to the late 20th century, according to the sales person. With higher quality and more technology, the customer range has made some shift which is interesting as it can be interpreted as high standard products attracts new user groups. According to the salesperson, the questions customers ask are about safety as it always has, but also about modern technological functions. The new Volvo cars have keyless access and keyless start as well as sensor activated opening of the trunk, something that is concidered highly valued by the customers and potential buyers. There are even possibilities to start the on-board climate system from a smart phone application wherever you are in relation to your car. The application is very popular and has been an important argument for buying a Volvo. There is even a service for food delivery companies to have access to the cars via internet connection. The service is new and yet to be seen if it will be popular or not. It does how ever take some trust from the users' side to let someone else control your car via internet. The salesperson said only one thing about customer concerns; they often do not fully trust the keyless system because the locking method is quite discreet.

3.3 User journey

This study is the most qualitative one including physical user journey analysis in the participants' home environment including leaving home, entering car, leaving car and re-entering home. The idea is that one can argue that asking a person about a certain task, many people have hard times telling exactly what and how they do carry out the task. Even if one carries out the task on a daily basis, a lot of the parts of the task are made subconciously and thus are hard to reflect upon when being asked about. If the questions, however, are asked right after having carried out, and *actively reflected upon*, the journey, it is arguably more effective to discuss new function propositions. This is also the reason why it was crusial to carry out the scope 2 of the study directly after scope 1 and also that it is the same participants for both scopes.

The aim

As mentioned in the introduction, it is important to understand the situation which you see potential

value raising in before trying to change it. If a proposition is to be made for a change, the present situation needs to be understood as well as properly presented. Therefore, the aim of this study was to carry out a physical user journey to learn even more about the present situation and then use the newly gather reflections to carry out a secord part of the study; a imagined user journey with the project concept. The aim was to gather as deep knowledge as possible when it comes to users' being at home and leaving for work by using their car.

The procedure

A visit was made to each participant and one person per family was the focus, however, during discussions the partner (but not children) was also invited to join. The reason for this was to create a discussion friendly environment. The decision to focus on only one person rather than two or even a group was based on the fact that an actual journey was carried out. This meant that each individual person was important to study alone as the point was to see a natural flow of happenings. The participant was encouraged to think out loud and to comment on anything potentially interesting for the study. This gave a clearer view of what was going on during the user journey. A number of questions were prepared for the journey, focused on spurring the mind in case it was needed. The questions were based on the online survey results.

The number of participants were 17. Ten female and seven males. The age range was 21 to 55. Twelve were living together with a partner and five lived by themselves. Geographically there were roughly a third living outside of Gothenburg or Stockholm, a third living in Gothenburg or Stockholm suburbs and the last third living within these cities. Three couples had children, the children were aged 4 to 13 and there were either two or three children per family.

The study started with an introduction of the product and this was carried out by the kitchen table. The reason for this is that most morning routines regarding leaving home at some point involves having breakfast by the kitchen table. A sound recording was made to easier transfer talk to text.
The journey started at the kitchen table, imagining it being a Tuesday morning before going to work. Here the participant was asked to describe the thought when knowing it is soon time to prepare for leaving home. What to bring for the day, is there normally someone else leaving at the same time? Do they have children? How are the preparations done and is it somehow divided between the persons leaving? Where are the keys kept and is someone more responsible for them than the other? Anything else in particular worth mentioning?

Leaving the house. How is the house locked? Is there an alarm system? How is that activated and by whom? Any issues with knowing wether it is activated or not? Where is the key(s) kept while walking

between the house and the car? Anything else in particular worth mentioning?
When entering the car; how do they unlock and enter the car? Questions are also asked about their experience with seat adjustment, is it manual or electrical? Does the electrical seat have position storing functionalities and are they used? Is there any phone-to-car connectitivy being used? If it is, how was that first installed and was that an easy and convenient task? Anything else in particular worth mentioning?

Leaving the car; how is the locking of the car made? Any issues with knowing wether it is locked or not?
After leaving the car, the participant walked back inside, unlocked the house and showed where they usually put the keys. (Or where they say that they are supposed to put them).

The procedure for part two is discussion based. While having fresh memory of part one, a number of questions were asked about the proposed concept. The concept again was used as a mediating object. A summary of the first phase was made to sum that up and to clarify what the questions in phase two will be about. In part two there is a certain need for imagination as there is no physical user journey carried out. The reason for not doing a physical journey was for practical reasons. If the aim would be to let the users try the functionalities and thus be able to discuss the actual usage and perception, there would have been extensive preparation work needed including functioning mock-ups for the keyless locking of the home, the automated unlocking of the trunk, the car doors as well as automated seat adjustments, etcetera. This was not possible to create within the time given for the project. Based on these timely constrains the decission was made to, for part two, base the study on questions and discussions only. The mediating object was an important part of these discussions.

The questions that were asked were:

- Do you think that, if concidering the present situation, a personalised and connected access architechure would be of any help during this journey? In what ways?
- If the device was connected and kept track of your use patterns, would you see that as raising convenience or as intruding your integrity? Or both? For example, to enhance the automation of certain functions.
- If we look at *leaving the home*; would you feel sufficient trust to the device for locking the home properly? Imagine leaving home, closing the door and just walking away. How do you think certain feedbacks can affect your experience? Do you have issues with privacy today with your devices such as smart phone, etc?
- Would the brand of the product affect you in terms of trust? For example, if it was the same

brand as the car, or the same as your smart phone?

- When *entering the car*, would you trust the device to unlock/lock properly in a fully automated manner? Or would you prefer to somehow actively lock it, for example?

Again, one person at the time were focused on, but also here the partner was welcomed to participate in a more passive role and thus only help reflecting together with the main person, rather than both being asked.

The results

The results in this study are to show the various participants experiences of each step and are to be presented by showing the relationship between the stages, rather than trying to quantify it exactly. The reasons for this was that it is not of high interest to try and put exact numbers on the result but rather to see which stages are most important to try and improve. And the most important thing was to see the participants' perception of each step in relationship to the other steps as well as interpreting them between each participant to see how many feel negative or positive about various steps. The questions that were prepared are also not always answered as they were mostly prepared in case extra questions were needed to be asked to get a discussion going.

Step 1. Ten out of 17 claimed that they usually know where the key is in the mornings. Some of the couples said that they have different places for putting the keys and thus not finding the keys. Seven persons claimed that they often put it randomly and thus do not find them quickly. A majority of the particpants claimed to bring seven or more things in the morning including one or two bags.

Step 2. Most participants claimed they only lock their home door with a key, not having an alarm. Four particpants had alarms and all are activated and deactivated manually. One couple said they have an RFID tag for ”easier activation” but they do not use it as it is easier to ”just push the four digit code and enter” rathern than keeping track of the tag and still having to raise the hand to the device on the wall. No one claimed there were any issues locking or knowing wether it is locked, also for the alarm it was generally concidered clear when it was activated or not.

Step 3. All participants asked had remote unlocking of the car. Three participants have key less entry which only needs a hand on the door handle and the key close to the person and car. They all found this convenient except it is not convenient to not be able to pull the door handle to double check if it is locked. In general, the participants had, and were using, electrically adjustable seats. Few had the feeling that they needed the seat memory in the case that they had it. The reason for this seemed to be it is only used together with one other person. Some person said that they only adjust the mirrors

whilst having the same seat position for both persons using the car. About phone-car connectivity, there were five participants using that, twelve did not.

Step 4. One person claimed that it felt unmodern with having to touch the door handle in a certain way to lock even though it is ”keyless”, one can expect more was claimed. The same person said it felt safer locking with the fob than having to put the key into the car key slot. The car needs to be even more automated, was also stated. Most partipants use key fob for locking. Few persons claimed that there were issues with this. One common comment on locking the car is that they often pull the door handle to see if the car really is locked.

Step 5. Similar experience with unlocking the house as when locking. During the study it was slightly hard to evaluate the step where the participant puts the keys back as this was commonly affected by the fact that they actively thought about it and thus lost the natural flow. This was mostly noticed in this specific step. However, most persons claim they have a special place for the keys (which does not quite correlate with the earlier statements of having to look for the keys in the morning).

The results for the discussion part will be presented in key findings as the interviews and discussions were open and the summarising of the content is best presented in this way.
When discussing the same journey as in the *user journey part 1* study, the participants were asked to reflect upon the mediating object and how it could possibly affect the user.

The key findings can be summarised as follows:

Share data/integrity
The interviewees generally did not mind sharing data for raised functionality. The perception of sharing data and what that does to personal integrity showed to be of little worry. Even several participants claimed to have no worries with sharing data as it is ”only positive”. Most people claimed however that it is unpleasant at some points but most of the time ”still worth it”. One person said that on a personal level it did not feel like a problem, but rather on a societal level as it can be used to control people in terms of what advertisement they get, etcetera.
People preferred knowing what data is being shared and to whom as well as when. Most persons asked did however say that even today there is too much data collection but as long as the desired functions are adequatly carried out it is worth it. There was a high tolerance for data collecting. The feeling of control over functionality seemed more important than the control over the data.

Perceived security/safety

People wanted proper feedback on what is happening, especially in the critical locking situations. One example was the locking of the doors where most people claimed that they wanted to double check by pulling the door handle. An automated locking procedure would, claimed by most participants, not be convenient. This would give an insufficient feeling of security. In the case of unlocking doors, most people saw it as a positive thing as long as it works properly and never unexpectedly unlocks a door. This would drastically lower the trust. Due to the high risks involved it seem very important with proper feedback for when it is locked or not.

The locking parts of the journey were concidered mostly important in terms of trust. This was brought up in some of the discussions. When being asked about what steps are most important, the answers in general were the locking and unlocking.

One person discussed ”the small things” such as getting a reminder if the fuel cap is off when driving away, or if the stove is still on when the home is being locked etcetera. This would be possible and would be a drastic value raiser.

Seamlessness

Several people discussed that they wanted more things done while doing fewer things actively. They had high expectations on functionalities with modern technology already today.

There were quite different ideas about fully automated unlocking/locking of car/house. Nine out of the 17 persons preferred to actively push a button or similar as it feels safer rather than fully proximity-based functionality. ”I want to make some concious actions” was said by several participants.

If something is supposed to be automated but turns out not fully being so, the level of trust sinks drastically. It could be enought with the device *not* locking *once* for it to be not possible to trust ever again. Several people agreed on this. Also, if just walking by the car close enough and it unexpectedly unlocks would be highly unpleasant and also lower the trust much.

HMI wise, a smart phone is hard to beat it seems, during the discussions. Most people preferred it being a part of the smart phone as they would not have to bring yet another device. Some said it is one of the major ideas with it, to physically get rid of the key(s) for car, home etcetra.

Personalisation

One person claimed that their family have a personal ID-ready key system for their car but do not use it as it is not worh the few minutes it would take to once activate it. ”Why do we not use it? It seems nice when talking about it” said one of them when they discussed it. The functions are not interesting enought today compared to the pros with using one key for both users and the second key being kept at home as a spare key, was the conclusion. Another person also claimed that they have the ID-ready key and have activated the function but have little use for it in their daily life.

The idea of the product learning your behaviours seemed in general quite exciting to most participants. If the product would do this efficiently, most particpants saw big potential in it although felt some scepticism against it ever really working.
One couple who had the Volvo on Call smartphone app said it was only annoying to get notifications that the other person had not locked the car. Sometimes this was on purpose, but you cannot tell and thus you become nervous about it.

3.4 Car sharing users

The second user group is persons living in big cities and using shared cars or bicycles as part of their commute. The aim was to see in what ways the desires and the use patterns differ when owning or when sharing cars. A visit to Berlin was made as there are two companies providing cars which are being used and payed by the minute. BMW and Mercedes have each a big number of cars placed throughout Berlin for anyone signed up to use as they find one.

The aim

The aim of the study was to interview a number of persons with experience of using shared mobility. By creating scenarios which were to be presented verbally, the goal was to manage to ask specific questions about the experience as well as gather knowledge about their own thoughts by including an open discussion into the study.
Also, part of the aim was to ask about in what ways a product like this would raise the value as much as possible. As mentioned in the introduction, the formfactor of the product may affect the desire to use it. Combining with an already existing product such as a smart phone, compared to introducing a separate small hardware. As the first research phase resulted in, it seemed like the possibly most potential field for adoption of this product would be persons that somehow share public spaces which are meant for private use.

The procedure

Before the actual interview session there was a testing done of one of the shared car services. The reason for this was to create an own opinion and get an own experience of the service. The test included finding a car with the smart phone application, entering, driving through Berlin and finally existing, locking and leaving the car. This gave a brief understanding of the overall experience which was thought to be useful during the interviews.
The participants were all in the age between 22 and 31. There were four male and three females. The group of participants were concidered potential for adopting the product as they were all working with developing various tech gadgets or working within societal development related areas. All were in some way involved in developing technological devices. The reasons for focusing on this user group

was that they were concidered potential adopters as well as they all had experience in car sharing services.

A descision was made to invite two persons at a time, the reason for not inviting *more* than two was that each person would have a chance to, in a relaxed way, tell their thoughts. This was concidered important as a large group may tend to create hierarchies of who speaks and who does not. By being only two participants at a time it would also be easier to create an open discussion rather than each have to wait for their turn and thus maybe forgetting or not bothering communicating their thoughts. The reason for not inviting *less* than two people was to enable a discussion. If one of two people, rather than one alone, tells a story, the idea was that the second person could agree or disagree and thus create more depth to the discussion. Also, as everyone has different experiences it was concidered possible for each one to give new angles to each other and thus create new ideas for discussion subjects. It was thought that it gives a better discussion, as also mentioned in *user journey part 1* study where the partner was invited to the discussions.

A Powerpoint presentation was created ahead to present each step in the journey. The participants were encouraged to add steps if they had individual preferences. The mediating object was presented and a made-up scenario was used to spurr the minds of the participants. The scenario was that the person would need to go from a point A to a point B within Berlin, from home with the help of a shared vehicle. The reasons for chosing shared car services were discussed in relation to public transport, bicycle, private car, taxi and walking. Then the discussion went on to the procedure of finding a car and in what ways this was done and the experience of that. As one can use either smartphone or a RFID card to unlock, the differences in those experiences were discussed with the persons having experience of both. Alot was discussed around the question of personalisation of the on-board environment as well as the feeling of security and integrity regarding data sharing. The rest of the journey including exiting, locking, leaving and paying was also discussed step by step.

The reason for using a made-up scenario presented on a screen, rather than taking an actual journey was for practical reasons as the participants were at their office and thus did not have time to leave for a trip. Also, the time spent in Berlin was too short to try and invite people in the streets, so the persons invited were pre-invited ahead of the arrival to Berlin. The made-up scenario was concidered effective enough as each person was given a relatively generous amount of time for reflections.

When having discussed the present situation, the scope was redirected towards the potential future use of the product concept. The concept was presented verbally.

There were a number of pre-written questions asked:

Does the brand of the access granting product matter? Does it have a higher trust level if it is the same as the car maker? Do different car makers differ, for example Mercedes compared to Dacia? Can after market companies be trusted when it comes to access of, in this case, a car?

In the case of DriveNow and Car2Go, do you know what data is being collected and by whom?

DriveNow? BMW? Apple/Samsung?
Would the value of the service be higher if the on-board environment would be possible to make more personalised?
In what way would it affect that the product is combined with an already existing product compared to being a separate product? Elaborate on wether either one would affect the level of trust to the product.
A sound recording was made to easier translate from talk to text.

The results

The results will be devided into key points:

User experience of shared mobility

The participants were in general happy with the services existing within Berlin. The two car sharing companies were both appreciated in similar ways as they are basically the same service. The BMW version has a bit ”nicer” cars than the Mercedes (BMW 1-series and Smart Car, respectively) and thus the BMW seems slightly more popular. The fact that the services are so easy to use in terms of finding and accessing as well as leaving the cars had big impact on the user experience. The whole procedure is very convenient, from finding to leaving the car. However, some participants said that sometimes the previous user left something in the car and that affected the experience negatively. Two persons mentioned that there should be alcometers installed as sometimes people are using them late nights while being intoxicated.
The various steps of the usage are presented one by one as the participants describe them, summarised in key findings:
Finding a car – It is relatively easy to find a car for two reasons; one reason is that the cars are parked wherever people leave them and thus you can find them ”everywhere”, since there are so many cars throughout the city you often find one after only a few minutes walking. The second reason is the convenient usability of the associated smart phone application. These two elements together make it easy and even enjoyable to find a car.
Entering a car – This step is also in general concidered a positive experience. Some of the participants have a smart phone based unlocking device whereas most have a special card. The card is negative in the sense that you need two extra cards (one for each service provider) and thus filling up the wallet. There is a lag in the unlocking procedure due to computing time and this is concidered to not be an issue except when being in a hurry.
Driving the car – As you always have to adjust the seats and mirrors, the beginning of the journey is slightly unpleasant. Also, sometimes the previous driver left garbage in the car which is concidered unpleasant. The interior is the same or very similar in all cars within each service provider; this is concidered postitive since the user can learn maximum two interfaces and then be able to use all the cars available including the on-board functions.

Parking the car – both service provider has free parking wherever there is legal to park, this means it is very easy to find a parking spot within a reasonable distance of the final destination. This is highly appreciated and the feeling of not having to pay for the parking gives the user a feeling of saving money.
Leaving the car – leaving the car is easy and the procedure is the same as when entering; holding up a card against the window or using the application. The locking is properly shown and thus gives a feeling of control and erases the feeling of risk.
Paying is done separately at the end of each month. This is a collected fee for the last 30 days and can be done automatically. This is in general appreciated. Some participants felt it would be more convenient to pay directly after each ride.

The perception of safety and integrity
About the discussion about wether the brand matters when it comes to the access granting hardware, the participants thought that known brands are definetly prefered and severeal said that if the car manufacturer offers a service through an after market provider, the trust in the car brand was concidered high enough to also trust the after market company.
The connectivity of phone-to-car and other functionalities in the car is important. The general idea was that it would be little or no problem to share geographical data as well as other private data. The important point was that it needs to be easily turned on or off as the user want to. One person said that the home environment was prefered to keep offline while one other person stated that geographical data would be ok to share only to certain companies.
By knowing where you are and where you are going, the different parts of the journey could prepare for the arrival of the user. For example, if a meeting is booked in the smart phone, the car could prepare a route automatically and tell various information about the path. If you arrive at home, the lights could turn on just ahead of arrival, one participant said. The general statement was that it was ok to share data. Several participants said it is already being shared at such a high rate today, so it is little concern about the privacy.
When discussing the point that says that data sharing is gradually increasing and that companies know more and more was also an interesting topic. The participants discussed around the thought about what was concidered too private to share ten years ago compared to today and concluded that the limit for what is ok to share is constantly being move forwards. In the future the data may be more open, one participant said. If the data sharing becomes even more common and even more companies become interested in the data, the easier it will be to ”see” the data. By this the participant meant that it might become less ”scary” to share data. The good thing with this could be that companies might see positive effect with being open about what data they collect.
The value raising features

It would be highly appreciated if the on-board environment would be more personal. The idea of it knowing what person enters and thus adjusting automatically to the settings from the last time it was used was something that five out of seven strongly agreed on. The two who did not strongly agree said that it would not matter very much. ”It needs to feel like my space as that would make it feel more safe”, one participant said.

The level of automation compared with the feeling of control by doing certain steps manually was another topic discussed. It was relatively even for saying that it is convenient to actively lock the car as that feels more under control. Even proper feedback as in blinking indicators and even a sound would feel insufficient. The other part of the participants said it would be sufficient with lights and sound. Automatically synced playlists, seat position, mirror positions etcetera was much talked about as a positive idea. The trips are usually quite short (it costs around 4 SEK per minute so normally the trip is planned to be as short as possible, timewise) and therefore the automation of everything personalised would raise the value much.

4. Analysis

As the different studies have had somehow different approaches and different focuses, a cross-case-analysis will help finding what was being said throughout the research. The main questions for this thesis are being analysed one by one through all the studies to see what they render respectively. This chapter can be seen as a summary of the research results which then is being used during the *Discussion*-chapter later. The layout of this chapter is to look at the different key elements affecting adoption which are being taken from the theory chapter in the beginning and how each of the studies being made have said about them. The theory chapter as well as the aiding "other" studies are also being used to complete the information gained.

The project's main question:
"What are peoples' thoughts on using connected and personalized products for privately used public environments, with main focus on cars"

4.1 The innovation itself

What have people been saying when first having had the concept presented to them?

Many said it sounds interesting and appealing. Maybe also partly unneceesary although convenient. Trust seem to be an issue. Also, that it is hard to say if they would appreciate it. It would depend on the form factor. Depend on what exactly it will do/will not do. There was curiosity and many questions about what it can/cannot do. In general, the curiousity seemed to be about in what ways it can help which they cannot think of while discussing the concept. An ideation session would be interesting to see what the participants would come up with. This project has not been about detailed analysis of potential use cases, however.

Do people desire more automated access?

Through all the studies there were discussions about automated access in one way or another. In general, it can be said that the participants said that seamlessness is desirable. One problem that kept coming back was the feedback; for the flow to be perceived as seamless it needs proper feedback. As mentioned in the theory chapter, control is about knowing what will happen, when it will happen, why and how. It can be shown in different ways such as light/sound or physical movement that indicates a change in locked/unlocked status. The feedback from the product to the user is fundamental for the trust, as said in the theory chapter. It is interesting to analyse the desire for automation in access

systems as it seem to differ depending on wether it is a privately-owned vehicle or a shared one. In the private car studies the feeling of control seemed more important than in the car sharing study. Without the feeling of control there was little or no desire for automation as it does not feel secure. This is probably connected to the fact that risk is involved in a person's ability to feel secure. "Due to the transfer of a substantial part of control of activities to third party, concerns are generated about the trustworthiness of the technology, as discussen in the theory chapter. In the benchmarking of automotive access systems, the sales representatives talked about the popularity of connectivity and the example from BMW which has the foot operated tail gate which is very popular. This function does create a more near-automated access flow but it does not affect the integrity and arguably nor the feeling of safety as the trunk opens and closes in a normal way and the only difference in how you carry out the task is your physical input which is minor.

One commonly returning issue that interrupts the automation is the feeling of wanting to double check the locking of a door. Many persons said in all the studies that they have issues with trusting even a regular key fob when it comes to remote locking. In the online survey as well as the user journey and even the car sharing study people often mentioned this issue. So, when looking at this issue the majority seemed to want a *not* fully automated locking as they would prefer to actively lock due to taking back the control. There were quite different ideas about fully automated unlocking/locking of car/house. Nine out of the 17 persons in the user journey study preferred to actively push a button or similar as it feels safer rather than fully proximity-based functionality. "I want to make some concious actions" was said by several participants in the user journey study. In the car sharing study it was relatively even for saying that it is convenient to actively lock the car as that feels more under control, versus fully automated locking. However, when participants were asked how they would unlock the car if *carrying luggage* with both hands, they seemed to realise that that would be a highly desireble feature to have fully automated unlocking rather than having to bring out the key fob to unlock the car. So, unlocking seem to be desired to be fully automated, but not the locking. The car salespersons claimed that automated access systems are popular and much asked for. The BMW salesperson as well as the Volvo salesperson said that "most customers pay extra for the keyless entry system". They also mentioned that there are concepts for taking automation even further in such ways as connecting car to private garage doors etcetera. The Volvo dealer talked alot about product development aiming towards *connectivity* and *keyless entry* etcetera. Volvo also has the automated unlocking of the car as well as foot activated trunk opening. Volvo also provides the On-Call phone app which lets you control certain on-board functions from your smartphone wherever there is internet connection. If comparing the popularity with Volvo on Call with the popularity of unlocking the shared cars via smartphone, there seem to be an interest in using the smartphone.The car sharing persons said they much prefer using the smartphone before using the cards needed, mostly because of saving space in

the wallet and to have to carry around fewer things.The salesperson at Volvo did say that customers often mention that they do not fully trust the automated locking of the car.

In the journey study there was discussions about wether one would *want* automated access or actually *need* it. Four participants claim they have alarm on their houses which they all activate/deactivate manually. One person said they have an RFID tag for easier activation/deactivation, but it is not used as it is easier to just enter the four-digit code than to always carry the tag around. Three participants have key-less entry which only needs a hand on the door handle and the key close to the person and car. They all found this convenient except it is not convenient to not be able to pull the door handle to double check if it is locked. If comparing the discussion during the user journey study and the car sharing study with the answers from the online survey, it can be seen that many persons discuss that they want automated access and seamlessness in the movement flow but at the same time it is shown in the online survey that not many have or mention that they miss these features.

About seat adjusting features and other automated adjustments of the onboard environment, there were many persons discussing it during the user journey study and the car sharing interviews but also this was shown in the online survey to be common for people to have but rare for them to actually use. In the first study there were no questions asked directly about wether they wanted more automated access or not. However, a few interesting observations were made. 10 out of the 15 participants who said they have *automated seats* in the online survey said they do not use it. Several persons in the user journey study said there “is no problem adjusting the seats since its only two persons using the car”, sometimes it was only minor changes such as mirrors only. If this would be the same for automated adjustment of radio channel, radio volume etcetera is hard to say as very few in the present situation have those functionalities. In the user journey study, some persons said they do not mind what radio station is on when starting the car. The statements about not wanting to put time into once learn the functions says something about the importance of caring for the complexity of the system as mentioned in the theory chapter, meaning it needs to be very easy to use or people might not bother.The sales persons said it was common to ask for automation and personalization but it can be seen to be more of a desire than an actual need. Here it was more like few persons seemed to really care, rather than feeling a lack of trust for the functions. However, the car sharing users talked more about wanting automated adjustment of the onboard environment. This seemed to be due to the fact that so many different persons use the cars and you always have to adjust seat etcetera. The idea of it knowing what person enters and thus adjusting automatically to the settings from the last time it was used was something that five out of seven strongly agreed on. The two who did not strongly agree said that it would not matter very much. ”It needs to feel like my space as that would make it feel more safe”, one participant said. Another argument specifically for the shared cars was that the trips mostly are short,

and thus would it be convenient to save even more time as the price is around 4 SEK per minute. Only two participants said they have the Personal-ID function on their car keys; one person claimed that their family have it for their car but do not use it as it is not worth the few minutes it would take to once activate it. They actually asked themselves why they are not using it, their conclusion was that they did not think it was worth activating it even though it would take only a few minutes once. It seems like the functions provided with personalization in this case does not weigh heavy enough compared to the convenience of using one key daily and the second key as a spare safely stored at home. In the user journey study, there were interest shown in the idea of the product learning your behavior, this could probabliy raise the value of the product. Again, more long-time studies with more specific ideas of use cases would be good for testing this. However, in the user journey study and the car sharing study there was skepticism about wether that would ever work according to expectations.

Several people discuss that they want more things done while doing fewer things actively. If something is supposed to be automated but turns out not fully being so, the level of trust sinks drastically. It could be enought with the device *not* locking *once* for it to be not possible to trust ever again. Several people in all the studies agreed on this. The car sharing users seemed in general more interested in the personalisation of the on-board environment than the private car owners.

Trust

Trust can, as mentioned in the theory chapter, be devided into elements such as control, risks, similarities/differences, etcetera. They are analysed one by one though all studies below. The experience of control is stated as important in most discussions and one important aspect of the perception of control is the level of automation and in what ways that works. The probability for adoption is arguably raised with a higher level of control.

Control

“A person’s ability to control the outcome of the functionality”.

As mentioned earlier, the issue of not trusting a fully automated locking was a returning issue thoughout all studies. Proper feedback is hard to create when it comes to fully automated locking of both house and car. There is a desire for a certain manual input when locking. This was mentioned through all studies, including the car sharing study where the participant does not own the car themselves. As one person said: “Maybe give feedback later in your smartphone when having locked the door and left the car. The issue might be solved with better feedback when it is not locked, eg notes in smart phone”. It seems like most users prefer to have a partly manual locking to not have to trust autolocking. It was said by several that one faulty “automatic” unlocking or locking would ruin

the trust very much.

The issue of wanting to know who owns and manages the data that is being collected was also quite commonly agreed on that it should be transparent. What was interesting was that most people, in all studies, said that they do not care, or they do think its worth it and do not seem to worry at all or much about where the data is sent and used. Even a few persons in the user journey study said ”only positive with sharing data”. In the car sharing study it was said to be positive to share data if knowing what and to whom and when it is shared. They said they wanted control of it themselves. One said “home environment is too private and there I want to be able to shut the data collecting off”.

There were quite different ideas about fully automated unlocking/locking of car/house. Nine out of the 17 persons prefer to actively push a button or similar as it feels safer rather than fully proximity based functionality. ”I want to make some concious actions” was said by several participants.

One couple who had the Volvo on Call smartphone app said it was only annoying to get notifications that the other person had not locked the car. Sometimes this was on purpose, but you cannot tell and thus you become nervous about it no matter what.

When discussing the point that says that data sharing is gradually increasing and that companies know more and more was also an interesting topic. The participants discussed around the thought about what was concidered too private to share ten years ago compared to today and concluded that the limit for what is ok to share is constantly being move forwards. In the journey study and the car sharing study it was said that on a personal level it did not feel like a problem, but rather on a societal level as it can be used to control people in terms of what advertisement they get etcetera. Generally, in the interviews the people want to know who gets the data and when. The tolerance for when and what to share is high, however.

The level of automation compared with the feeling of control by doing certain steps manually was another topic discussed in the car sharing study. It was relatively even for saying that it is convenient to actively lock the car as that feels more under control. Even proper feedback as in blinking indicators and even a sound would feel insufficient.

Data management

Data management was something that was talked about in all the studies except the first one. In general, it can be said that there were no big issues regarding this. The salespersons claimed that customers seemed to have little issues with this and although one can be a bit sceptic towards that

statement as they are trying to sell it it actually turned out to be quite accurate with the user studies. The persons using the shared car services seemed to not bother at all except the fact that they would prefer knowing who gets the info, exactly what info is shared and at what time/place it is being shared. They did not seem to see it as an absolute must. Similar answers were given during the user journey studies as many claims they are used to share data daily already via smartphone etcetera. Of all the points in terms of trust, the data sharing seemed to be the smallest issue. Comparing it for example to what feedback is given or the risk the product not fully functioning, the data sharing seemed more or less negligible. If, in the case of car usage, the car companies were responsible for the data collecting, the users in both car sharing study and user journey study claimed they trust the car companies to treat the data respectfully. The trust for a third-party stakeholder would be lower, was said in both studies. If comparing the statements of the salespersons with the statement from the studies with what was said during the field studies at the hackathon and the labathon it all seems to correlate; data sharing is not a big issue.

Risks

When it comes to locking/unlocking products of high value it is indeed important that the system works flawlessly. Many people thoughout all studies were concerened about unwanted “automatic” unlocking of the car etcetera, which then leads to a risk of having the car stolen or destoyed somehow. The high risks do seem to affect more when it comes to high value products than the actual personal integrity and even the actual seamlessness. The relationship between privacy and access seem to mostly be focused on the convenience (the access) being more important than the privacy. To have control over the privacy is important although most are ready to give up on into an extent to get the convenient functionalities. Although the car sharing users do not own their cars that they use, they still seemed concerened about the risks of not locking properly.

The general opinion was that the trust in car companies is so high that the solution for personalized access is ok to be from a third party and not-so-known manufacturer as long as the car manufacturer itself selected it as their provider. So, trust in the (car) manufacturer is very important, according to several interviewees. Brand matters but the trust in the carmanuf is so high that the device could be “unknown” brand if the car brand choose it.

Similarity/difference

The main and most important difference in this concept compared to “traditional” keys and keyfobs is that all functionalities go via transferring of data and that it “knows it is *you* entering”. This difference seems in most studies to often be similar enough to certain products that exist already today for the persons to feel relatively safe with the idea. Because it has been used in many smartphone applications

for some years now, it seems easier to relate to the idea even for an area such as accessability to home and car etcetera. It was relatively common throughout all studies that the solution should preferably be part of a smartphone somehow as it would be a known interface as well as you would not have to carry an additional product. The term compatibility from the theory chapter is about how well the new concept is compatible with one's own ideas and values as well as the experience with using the technology, in this case it can be seen as an argument for aiming at using smartphone since many persons are used to that technology. Maybe a known technology enhances the adoptability since there still is a need to partly learn a new behavior/functionality as the figure s.s below shows. This case would be the green variant compared with the blue which is new technology and new behavior which is considered harder to adopt. Maybe a part of the familiarity is adopting a known brand. The brand as affecting trust was briefly discussed during the user journey study and the car sharing interviews and the trust in brands seemed relatively important.

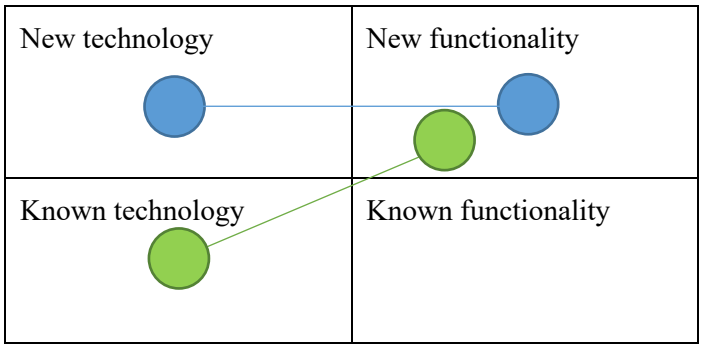

Figure 4.1 As mentioned in the theory chapter, the hardest thing to adopt is a product with new technology *and* new behavior.

UX

Although every aspect of usage is part of what is called UX, there still is a certain subchapter for UX as follows. The reason for this is that this UX part is concidered more zoomed out than looking at respective key element as above. In this project the studies have been on the *perception and anticipation* of usage and the concept.

In general, thoughout all the studies, the desire for an integrated product which preferally should be a smartphone app should have all the access functionalities. To look at a desired experience among potential users is about finding what would raise the values the most. The overall feeling of using the product must be positive. If the system gives you access via one physical product but need several passwords would probably lower the value. The challenge might be to provide as much access as possible but at the same time be clear with where the device works and not. The earlier mensioned ”chicken or the egg” problem is somehow affecting this. Again, as several persons have claimed in

various studies that they want to get more things done while doing less there will have to be a majority of locks/passwords that are accepting the device. However, this may be difficult to fulfil early in the products' life and thus fewer will want to adopt it. Hence the "chickor or the egg" analogy. If looking at what people want in terms of car access, the car sharing users seemed to wish for it more than the private car owners. One important part of the UX is that if something should be automated it obviously needs to work well and not give any unpleasant surprices, but again it also needs to provide sufficient feedback of what is happening. By having a product which can eliminate the need for a big key ring with several keys as well as remembering passcodes and passwords and at the same time giving an easier and more seamless flow seem desirable thoughout the studies. In the first study there was 13 out of 21 who said they had issues finding the keys in the morning, if the concept would be built in to for example a smartphone, or just be this one product to carry out all functions, it would raise the perceived usefulness of the product. This is quite well comparable with the participants in the user journey where seven out of 17 said the same thing. In the user journey study, it was mentioned that it feels unmodern or unfinished to have to push a button in a certain way on the door handle while using the "keyless entry". This lowered the perceived feeling of it being an innovation. Other than this the general conclusions of many participants in the first study was that it "works decent" as how it is today. So, there seemed to not be many things that people strongly disliked, although they also said several things that could be enhanced/changed for the better. In the benchmarking study and salesperson interviews there were discussions about peoples wants versus peoples needs and maybe the "works decent" can be enhanced by systems that are not really needed but still sought after. Sometimes people seem to want to buy things just to be able to brag about it or feel successful when owning it. However, in the end that is meaningless unless the product creates an easier situation. An important part of the adoption of new technology is the perceived relative advantage, as mentioned in the theory chapter. Again, the idea of adding even more functions and services to the device beyond access seem appealing in all the studies where this was discussed. The food delivery which Volvo just introduces is one example of service which could be provided though this type of device. Someone gets access to the car's trunk under controlled circumstances and thereby make it possible for such a service. Also, the mentioned BMW service which included banking service could be interesting. This is also comparible with the electronic banking study mentioned earlier. The trust needs to come step by step, according to Rogers and [PDF "Why do we trust new technology?"]. If adding for example notification if fuel cap is left unlocked would yet raise the value as said in the user journey study. All these ideas of "extra" features are preferably provided via smartphone was said in several cases.

The case of the car sharing users is a bit unique in the way that they seem to have more desire for seamless access and automated adjusting of the onboard environment compared with the private car owners. The car sharing users claimed to in general be happy with the services. The fact that the

services are so easy to use in terms of finding and accessing as well as leaving the cars had big impact on the user experience. The whole procedure is very convenient, from finding to leaving the car. One reason for the populatiry of the service is convenient usability of the associated smart phone application. In the case of entering the car the smartphone app was much preferred before the separate card(s). The fact that free parking was included in the service was highly appreciated. The convenient help with finding the car, again via smartphone, was also highly appreciated. These are a number of functions which seem much more sought after among car sharing users compared with private car owners as they rarely have to search for their car(s). Again, as mentioned in the theory chapter; ”several studies has shown that perceived relative advantage of a new product in terms of perception of being better than what it replaces, is one of the best predictors of the rate of adoption of a certain innovation.”

5. Discussion

This chapter will be important as the results for each part of the research needs to be interpreted and discussed. As the research throughout the whole project has been differing through the various studies, the results needed to be summarised in the analysis chapter and then discussed.

5.1 Today

Five out of 17 have connected car-to-phone functions today according to the user journey study. This is a number slightly lower than what was expected before the study. What is similar in this question to the one discussing the seat memory as well as the personal ID log-in functions of key fobs being owned, is that there were people owning it (and had payed extra for it) who did not use it. This is interesting as the question of what is needed and what is desired and even what is primarily a status symbol seemrelevant. Many people seem to prioritise ”just having” certain functions rather than actually needing them. This is already quite a known fact in general. In this project it becomes interesting as it means that further long-time research with functioning prototypes would show the true desires among people. However, it would have been good to also have asked about that in the online survey to get even more and better data on this ”today” topic. There is a trend within the automotive industry to provide personalisation of on-board environments by giving the users personal keys, however, the desire for this seem to lack among the users. Even though the respective user can have their private seat and mirrors settings automatically adjusted already today, the interest is low. Perhaps the functionality is yet not sufficient and therefore the value is not raised enough.

Car sharing is growing today and there seem to be a geniune interest in shared mobility and this is being made easier and more convenient by using various connected functionalities such as finding a car, logging driving distance etcetra. In a few years ahead this may very well be even more integrated into many big cities and thus spurring the use of connected access. This along with the fact that connectivity, both in general and in the automotive industry as well as surveillance (e.g. home alarms etc) also is growing may be positive for the adoption of this type of product. As sharing of public spaces as well as connected products increase already today it is likely to see a raised desire for this type of product. Maybe the desire to share cars etcetera is increasing due to the fact that also the urbanisation is growing, meaning that there are more and more times where a lack of space needs solutions. As cities are being more and bigger and the urbanisation does not seem to stop increasing any time soon, the need for this type of mobility is arguably going to grow with the urbanisation.

Many persons seem to prioritise “just having” certain functions rathern than actually needing them. In

terms of adoption of a product like this, it seems positive as one good reason for getting this while it is relatively new is this specific phenomenon. It may help spreading the product and thus spurring the diffusion of the architecture and while this is happening, over time, more people will learn about it and see the benefits, and this could become a positive spiral. If talking about the “critical mass” as mentioned in the theory chapter, this may be reached thanks to the early adopters who most likely will help spreading and broadening the areas of usage for this type of product.

5.2 Do people desire more automated access?

As mentioned in the analysis chapter, people seem to desire “doing less and yet get more things done”. This is quite easy to ask for but as many mentioned, the issue of trusting the functionality makes many persons feel unsafe and thus not wanting to use this type of product. If studying the answers from all persons in all the studies, it is clear that a feeling of control is more important than a fully seamless interaction with access devises. In short it can be described as the participants wants more automated access, but they feel so much hesitations towards feedback and functionality that they end up prefering locking and unlocking themselves with some sort of physical input. Although the locking seems more unsafe than the unlocking. In the case of unlocking, the issues seemed to be more towards unwanted and unexpected unlocking which means they also here want some sort of physical input. This can be seen as a very important aspect in the development of such a product as *yes* they do want automated access, but *no* they do not because they would no be able to trust it. This is all based on previous experiences up until and through these studies.

Similarity/difference

The statement made in the beginning about the adoptability based on changing the behaviours as little as possible proved to be hard to analyse. The reason for this is believed to be the lack of actual testing of the concept. The concept research was focused on discussions and there it is hard to really tell wether the use patters would change in certain ways and wether that would affect the adoption or not. One thing that can be said is that some behaviours should be kept or phased out over time, for example locking and unlocking actively. Even possible is that many people might not trust the functionality of this type of product. As many said they are carefully optimistic of such a product and that the feedback and the reliability is very important. In terms of similarity/difference with former systems and experiences, the four elements of usability can be concidered important; effectiveness, learnability, flexibility and attitude as described in the theory chapter.

5.3 Innovation optimism versus user needs

The industy for connected products is right now very positive about the development and the growth

in the near future. Most forecasts say the number of connected products will go “through the roof” and to judge from the hackathon and labathon, the ideas for applications seem to not be deficient. It is obviously hard to predict what will happen in 5 or 10 years, but judging from this project, it seems like the developers are more positive and more excited than the potential users. The development seems to actually go faster than the user’s requests. As mentioned in the technology chapter, there are a vast number of connected products which may have little importance to people. On the other hand, connectivity is something that might be so natural in so many products that you will expect the egg shelf to be connected or you will be frustrated as you do not know how many eggs you have at any given second. Arguably the more connected products that will be introduces, the lower the treshold will be for adoption.

5.4 Relative advantage

As companies are coming up with more and more ideas for personalisation through connectivity as well as better and more reliable ways to carry this out, there is most likely going be more and more people seing the relative advantage of using this type of product. In the car sharing study there was already alot of talk about the relative advantage of the easy access of the vehicles as well as the automated logging of the time and distance driven with an automated payment being connected. Also, the desire for an easier personalisation of the in car environment was a big relative advantage that seemed to be desired by many participants. If looking at the reflections of people from the various studies this was quite clear. When the system gives you an overall postivite experience, the participants seemed excited about the idea. There must be a certain and a clear need for the system. In the car sharing study, the desire to feel safe in a shared environment was important and this type of system could help with that and all of a sudden there was a clear relative advantage there.

5.5 Trust

What are the main issues in terms of trust as an affecting factor for adoption/no adoption? For trust it is important, as stated in the theory chapter, with the feeling of control in all situations. To feel control gives a feeling of trust. It is in general more important to make the user feel trust in the functionality rather than in compensations, in other words feedback becomes very important. Initial trust is in general important and in the case of this type of product which handles parts of a person’s life with high economical as well as emotional value it is indeed crusial. During the car sharing interviews it was mentioned several times that if the car would show to have been unlocked unintentionally *once* it would be hard to, if ever, be able to trust the system again. As word of mouth goes around quickly this can be concidered one key factor for success or failure for a product like this. Trust is about this so called “leap of faith” as mentioned earlier, one must dare to take this step to be able to use and adopt a

new type of product. If the feedback is sufficient as well as the functionality shows to be reliable, this leap of faith can be shrunken down to as small as possible and thus being easier to take. The initial trust is obviously very important at this stage. Even though trust is extra important in the beginning, which is relatively easy to test in user studies compared with long term trust, the long-term trust is dynamic and can obviously always be erased in the product stops working properly after a certain time. A returning issue in this project has been the fact that no one have been able to actually try the concept and definetly not have been able to have it as part of their everyday life and having to actually rely on it. Again, if looking at the desire for seamlessness and comparing it with the phenomenon of trust, it is hard to stress the importance of trust enough. Maybe the fact that people have not used this type of product before can be to an advantage as trust (or lack of it) comes from earlier experiences.

Throughout the studies, trust seem to be more an issue in terms of functionalities, seamlessness and feedback, rather than data collecting and management. In general, the participants in the various studies said they were not concerned about data collection as long as the functionality was convenient and reliable. Privacy does not seem to be an issue in general. The discussion about wether the brand matters when it comes to the access granting hardware, the participants thought that known brands are definetly prefered and severeal said that if the car manufacturer offers a service through an after market provider, the trust in the car brand was concidered high enough to also trust the after marked company. This can be interpreted as the trust in car companies is high. High enough to trust an after marked company even if it is little known to the person before.

5.6 Control

About feedback: half of the shared car study participants thought it was OK with automated locking with lights and sound as feedback, the other half thought it would be important to manually push a button to feel that they own the control and even lights and sound would not be sufficient for the feeling of control. In the user journey study part, 9 out of 17 said they would not want fully automated locking but rather doing it manually. This may be seen as it does not really matter wether you own of share vehicles. People still want to feel in control of the actual locking of the car.
One important part of the UX is that if something should be automated it needs to obviously work well and not give any unpleasant surprices, but it also needs to provide sufficient feedback of what is happening. Sometimes it is preferred to not tell what is happening as some persons said it can make them think about the fact that they are giving the device the control. The experience of control is stated as important in most discussions and one important aspect of the perception of control is the level of automation and in what ways that works. The probability for adoption is arguably raised with a higher level of perceived control.

One thing that kept coming back among many users was the double checking of the locking of the car doors. This, together with statements about not trusting fully automated locking can be seen as the product should have certain manually activated functions.
Most of the research during this project show that there is little worry for private data integrity. It is interesting to see that the difference between generations seem smaller than expected in the beginning. Young people seem to accept most offers of value raising functionality at the cost of sharing private data. However, also persons being over 50 seem to think similar. This can be seen as it not being age-based. As the shared cars study as well as the user journey part discussion both resulted in similar statements that data privacy in general not being an issue, it is believed that a conclusion can be drawn about this. Many people throughout the studies has said something like ”when thinking about it, it does not feel very good to share all this private data, but still it is easily worth it and you can always turn it off if you really want to”. This being a good summary of the statements of most persons participating in these studies.
When looking into big data collecting and start talking in terms of ”collect data about everything and keep it forever” as Hunt talked about (Hunt, 2013), it is hard to create an understanding for peoples perception during this project. It is simply to complex to cover within the time given.

Risks

It is important to concider the promise of the product. When designing such a product it is important to rather function very reliably than having one too many functions. This is based on the discussions around the locking device being specifically important in terms of trust.
During the car sharing study, the brand was discussed. Since this was only really discussed with these seven participants, it is hard to draw any conclusions about people’s perception of trust based on the brand. It was interesting to hear that the trust for car companies was so high. The participants seem to agree in general that if the car company would provide a third-party access system thought the purchase of the car, it would be fully trusted to the same level as the car company itself. However, this was when focusing on shared mobility and not privately-owned cars. The results may differ if this was discussed during the user journeys.

5.7 Adoptability

Concidering Rogers’s theory of adoption, the project mainly focused on the *how* and *why* as the later stages in the adoption process were not possible to study here. The questions of *why* to adopt was discussed alot and the results pointed at key words such as *convenience, personalisation, seamlessness* but also (negatively) towards *lost control* and *integrity issues*. The *how* was being discussed both when presenting the concept but also as a result of the discussions of users’ needs. As the type of innovation already exists although not at a very advanced or well spread level, it can be seen as this technology

needs more time. The technology is already existing, products also already exist, some of them at a relatively low cost and also some desires seem to be there. Something, however, seem to hinder the diffusion. One thought is that still, people are careful when it comes to adopting new types of access granting products. Also do they possibly not see the full befinits of having this.

For it

- Connectivity is growing.
- Car sharing is growing.
- Car dealers are developing simliar systems although right now focused on car (expands now into opening garage doors as well as the food bag service-to car). In a way this can be seen as a cradle of the fully automated personalised access architecture.
- In terms of UX; The persons in the car sharing study seemed to be much more interested in the automated personalisation of the on-board environment of the cars. This is arguably due to the fact that the cars they are using are actually being changed for every time they drive. This also means that everytime they drive there is a new setting for the seats, mirrors etcetera. Comparing this to privately owned cars clearly shows that the desire for this is smaller in private cars. In the shared cars discussions there was statements about the perception of safety would be raised as one feels more ”at home” in a service that is similar each time. This will then be important to concider in terms of adoption of such a system. IoT can enhance the UX as it can help the user actively along the way.
- The number of things to think about while leaving home and to have to bring decreases as well as fewer steps of the “journey” from A to B will have to be carried out manually. This leads to a lowered need for keeping many things in the head at the same time.

Against it

- “Chicken or the egg”.
- Price.
- Lack of trust in fully automated things (lowers the value of this type of architecture).
- Hard to ”sell in” the system as it is hard to explain it, including its many pros.
- Needs many functions to give any particular value (leads back to the chicken and the egg problem).
- The form factor can be both positive and negative, but the risk of it become just another thing to bring makes the adoption less probable.

Some of the words from the theory are possible to analyse, some are more based on long-term issues, such as adoption being based on communication channels and time.

So, will the hype last and will people buy such a product in 5 years? People already do at a certain level but again, the threshold for adoption needs to be lowered for most people as still today few feel a genuine need for it. As the innovation gets spread more widely and the number of corresponding hardware increases, and people get more (positive) experiences with it, maybe the step towards adopting will be small enough. The potential for the technology and for the functionality and its ability to create an easier everyday life is big.

5.8 Time

As this type of technology as well as certain similar functions has been existing for as much as several years now and yet has not reach out to very many users, the time seem to be an issue for the diffusion. Arguably not only but rather obviously also affected by people's desire or lack of desire for it affects. If looking at the related studies described earlier the issue of time when it comes to general trust in new systems, it can take many years for people to adopt something. In the example of the meeting communication systems where the sound-only system was adopted much quicker compared with the sound-and-video system it can be seen as there were *two* new functions needed (video and sound) adoption compared to only one (sound). This affected people's ability to want to adopt as they had hard times enough with only using the sound system. In the access granting systems, it may be the same thing; either there are not many functions enough for people to want to adopt to it, or it will have too many functions i.e. become too complex for people to be able to grasp it. Both cases are making it hard for diffusion and thus creates sort of a catch 22. This is a system that has not been introduced at BMW nor Mini so far and maybe that is simply because they aim at providing other functionalities? Maybe BMW focus on the keyless entry as well as the bank card connection and therefore takes "one step at a time" in terms of introducing new technology. The same goes for Volvo who maybe right now are focusing on the On-Call app and therefore choose not to introduce even more new technologies to avoid too big steps for their customers?

The S-curve described earlier shows the saturation of the market with a specific product and normal distribution curve (Figure 5.1) shows the amound of adopters at a certain time, beginning from left and time is passing on the X axis. As stated before, time is not the only element affecting the number of persons adopting as one could for example look at the normal distribution based on amount of functions or amount of locked environments being compatible with this product. A higher number of corresponding doors etcetera the bigger the probability for adoption. The point is still the same, however, that the first part of the normal distribution curve are the early adopters, the middle part (the top) is the most common type of user/adopter and then there are the laggards who are late with

adopting. The before mentioned critical mass is very hard to analyse and predict if it is even possible at all to guess. This depends on the size of the market the product is being sold, price of the product etcetera. Again, all these mentioned elements throughout this project affect the adoptability of a product and even many more elements. I.e. it is, as said, hard to predict. Early adopters will always be important for spreading products as well as being “test pilots” whom other persons can study or ask about the experience of a new type of product.

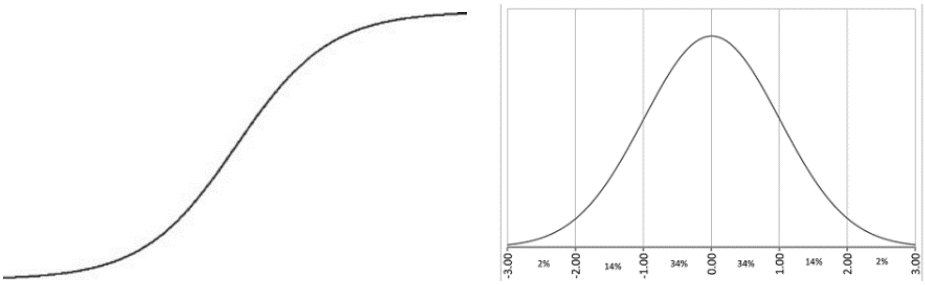

Figure 5.1 S-curve and normal distribution curve

Societal system

As the urbanisation is growing and seem to keep growing the near future, the social system is being affected. Most likely this type of product will be of highest interest in urban environments as time and space are important factors to streamline here. The pace is high in big cities and if time can be saved by providing a more seamless movement from point A to point B, a product like this should be of interest for adoption. Also, the communication channels are more effective in urban areas. Advertisent and word of mouth spreads faster in cities.
Communications channels are more effective in cities. In general, urban societies are faster to adopt systems like this. Urbanisation - how does this affect the adoption? Most likely by effective communication channels in cities compared with rural areas.

5.9 Project layout

Several user focused methods have been used thoughout the project. By combining them and also by having slightly different scopes for them proved to be effective in terms of gaining further knowledge by comparing the results. By asking persons openly about their present situation and later actively taking them through a physical user journey was effective as it became possible to both hear even more persons’ thoughts as well as comparing the way to present the research. By further comparing this to the persons using shared mobility and in what ways this affects the desire for security and feedback was also effective and gave interesting results. Wether the various visits to car dealers and

hackathons etcetera really gives reliable inputs or rather inputs aimed at suiting their own needs and desires is hard to tell. However, the decision was to still use this research as these people do know much about their respective fields and hopefully by keeping in mind that they might be biased also creates an additional layer of analysis.

It can also be seen as when having so many sources of information and knowledge it can be hard to interpret the results and to combine them. The user journey and the shared cars-discussion were both giving alot of input but are hard to compare directly. It is imporant to separate the goal of the respective studies as they will give different results due to the different user groups in each study. However, by having several types of studies and also keeping the outcome separated for each study, it is quite effective in terms of width of knowledge.

The idea to use a relatively vague concept which was mostly presented as an idea of a product with ”certain” functions and then to use that as a mediating object to spurr discussion was in general good. This can be seen as the original approach was to actually present a physical product mock-up. The idea with this mock-up was that the participants could relate to something physical. However, this resulted in bad focus on the actual questions. So even though the discussions were actively re-directed towards the actual aim several times, the focus still often ended up discussing ideas of form factors and to what the hardware could be integrated. Since this was not the intent of the discussions as well as it was to hard to keep focus, the physical mock-up was completely left out of the upcoming research. This proves that not only the idea of the concept is important but also the actual presentation of the concept is very important for the outcome of the discussions and interviews.

As the scope changed so drastically from the original plan to what ended up being this thesis, it was a challenge to get as much information out of the research as possible despite the fact that some research was deleted due to it no longer being interesting for this scope. The impact of this is partly that some methods should have been used differently or even been exchanged with something else. However, the idea of starting off wide with the quantitative study on the present situation did give a good foundation and was a proper start of the research. As this gives much information which partly was hard to forsee as it was such open questions, the early inputs showed to be important for later in comparison. About the importance of deciding what the research must focus on. For example, investigate wether to have a physical mock-up or not as part of the discussion. Here it ended up being only confusing whereas in other studies it may be totally necessary.

6. Conclusions

This thesis was focusing on understanding the users' needs and desires for personalised and connected access systems and also understanding their perception of safety and integrity when accepting collecting of personal data. An outcome of the thesis was the learing that for adopting this technology at a level even more advanced than today, it can be said:
There is a desire for more automated movement patterns, the issue seem to be the trust in it being perfectly functioning without unpleasant surprices. Because if not perfectly functioning, users will lose all or most of their trust to the device. People believe this type of device to occationally fail at carrying out its tasks.

- Sharing data is not a problem. Today people share alot of data and people seem to keep accepting new terms and conditions. People know but prefers to not think about it. It seems to have little to do with age, less than expected early in the project. It is generally claimed that good functionality and seamless usage is more important than data integrity. Since people have said that they are not worried about data collection it seems like the idea of using data collection as an enhancer of functions is very important and of high potential to raise the value of the product. Most likely, in th near future, IoT will be a much more natural part of peoples lives and the accessability will be a normal part of all that; meaning that it will be implicated more naturally in a few years compared with today.
- A smart key which learns the users behaviour seem to be desirable. The idea of it automatically carrying out certain functions seem attractive. Again, however, many persons seem to expect it not quite functioning perfectly and thus creating frustrations. To raise the trust and the feeling of control, it is important to work very much on giving proper feedback for what is happening. A smartphone would be mostly preferred in terms of form factor. People showeded low interest in having a separate product wether it is a wearble wristband or similar, or a token on a keyring similar to an "ordinary" RFID tag. No matter the scope of the research questions, the answers have been very similar; people have been saying they want a smartphone app because "you always bring your phone everywhere no matter what" and it also comes back to keeping track of fewer phsycial items. Some even said that one of the main reasons for this product would be to get rid of things to carry around during the day and thus a smartphone app would be the best solution.
- If designing such an access architechture, it is crusial that the behaviour of the person stays the same or similar as before as well as it is working flawlessly. If not, there might be a feeling of it working "good enough" with the existing solutions. If looking at it, it can be stated that todays solutions of physically locking the home with a key and locking a car with a "dumb"

key fob is concidered good enough. However, again, it is needed some proper long-term tests of such an architechture before really being able to make proper conclusions. It seemed important with many parts of the “jourey” to have corresponding hardware. If this product would be worth using it must be a majority of the locked environments that works together with this product.

- Biggest area of potential adoption (within this study) is cars due to the fact that each person sits in their own space for the whole journey and thus be it more effective with personalisation of various adjustments. It seemed quite obvious that the car sharing users were more interested in the idea of this product compared with the persons owning their own car(s). This means that the publically used enviroments are more of interest. Comparing this with a home environment where things more commonly are desired to be kept in the same ways. If one person leaves a room it might be annoying if the lights go out if someone else is still in that room, for example. If focusing the development of this product, it should be towards privately owned public environments such as shared cars, shared spaces like washing facilities, offices, access to certain pre-paid places such as using it as an event ticket, airport check-ins and other personal accesses of public environments.
- One important question to look further into while developing this type of product is the chicken/egg problem and the complexity versus value of many functions. The timing of introducing a product like this may be important as introducing it too fast may not provide a value raising product as well as a compromised level of reliability but still there is alot of development going on in the world of connectivity and convenient access systems so it is a question of wanting to be first with a risk of presenting a not-finished product versus being one of many providing similar functionalities. If looking at other companies and what may happen when rushing a release compared to finishing properly but being “late” is important as it differ quite alot in terms of success. If looking at for example Apple and their music players as well as smartphones, there are not really any innovations made by themselves in terms of functions, but here the important factor for success is arguably the usability of such a functionality. Also, by being first there will be needed much more investment into research and development in terms of reliable and easy-to-use systems.

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