MASTER OF SCIENCE THESIS

UX and Service Design for Zbee Based Corporate Carsharing

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Blerand Bahtiri
ABSTRACT

What transportation means corporations choose for satisfying their mobility needs may have an essential impact on the environment. Choosing environmental friendly, alternatives such as battery driven light electric vehicles, would mean drastically contributing to a more sustainable environment. Meanwhile as carsharing solutions, continuously rise in popularity together with other sharing economy business models so do their possibilities to satisfy the mobility needs for corporations either by them implementing their own carsharing service or by investing on external services offered by established carsharing operators. This thesis has investigated and designed for a Zbee based corporate carsharing service, to be used between the affiliates of Vinngroup in Gothenburg. A Zbee is a light electric three-wheeled vehicle. Based on user-centred service design methods, methods suggested for sharing economy solutions, as well as user experience design methods, this thesis identified that users have different individualistic needs in a workplace and prior experiences that affects how they will use the service. In order to satisfy these different needs, it was found, the system needs to provide real-time vehicle and scheduling information for ensuring the users vehicle availability and service reliability, being one of the first requirement from the users. Further the service should provide users with functions that help users through the different use phases that were identified during this work.

The findings found were then presented visually by designing mobile application prototypes and testing them on participants iteratively. The final set of prototypes was further evaluated by using the System Usability Scale, an effective and popular tool for measuring the usability of products and services. This evaluation gave the scores 77.5, 92.5, 90, 87.5 and 72.5, thus this giving a mean-value of 84 and a median of 87.5. All these scores suggests the prototype has high usability.
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<th>Description</th>
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<tbody>
<tr>
<td>CC</td>
<td>Corporate Carsharing</td>
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<tr>
<td>EV</td>
<td>Electric Vehicle</td>
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<tr>
<td>ICT</td>
<td>Information Communication Technology</td>
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<tr>
<td>LEV</td>
<td>Light Electric Vehicle</td>
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<tr>
<td>PSS</td>
<td>Product Service System</td>
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<tr>
<td>PT</td>
<td>Public transpiration</td>
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<td>SNRA</td>
<td>Swedish National Road Administration</td>
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<td>UX</td>
<td>User Experience</td>
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CHAPTER ONE

Introduction

While the world aims for fully autonomous cars on our roads, the accelerating pace of urbanisation is putting pressure on city infrastructures and resources, creating growing transportation crisis in urban areas all around the world. About a decade ago the urban residents reached 50% of the world population and as this percentage is projected to reach 75% by the year of 2050 [1], smart solutions are needed for citizens that expect efficient and seamless mobility in order to save time and create more opportunities in both the private and professional life. Considering that a vast majority of today’s cars are owned and used privately and also that the average cars stay parked at a startling 95% of their time [2], it is of no surprise that cities all over the world are dealing with diverse problems like the excessive amount of land dedicated to parking spaces, traffic congestions, pollution etc. On the other hand, using traditional public transportation (PT) systems with the old concept of fixed stops and fixed timetables may not always be suitable or even appealing for commuters living in dense areas. Research even shows that passengers of PT services are highly frustrated because of the lacking information provided by transit agencies [3, 4].

One innovative mobility approach to the urban area transportation problems is the idea of providing individuals access to a shared fleet of cars, i.e. carsharing. Although having been around for decades with one of the first experiences taking place as far back as 1948 in Zurich [5], the majority of carsharing services before the 90s ended up in failure [5, 6]. This much due to the lack of involved users [5, 6]. Today carsharing services exist in several cities all over the world, in different fleet sizes and in various business models [7].
Moreover, publicly-released data show that by 2013 there were 3.5 million carsharing users worldwide with a total of 69K vehicles in carsharing fleets [7]. One variation of carsharing, identified as a key-player in the targeted change towards more sustainable mobility [8], is Corporate Carsharing (CC) i.e. sharing a fleet of cars within an organisation. For instance, it has been estimated that corporate car fleets account for 16 percent of the total fleet vehicles in France [9], and an estimated total of 60 percent of newly registered cars in Germany [10]. This innovative mobility solution has brought the attention to Humblebee and the other affiliates of Vinngroup.

1.1 Problem statement
The idea behind this thesis derived from Humblebee’s request to investigate how CC services within organisations would affect potential users (i.e., the employees) in urban areas. More specifically, they have shown interest in the Clean Motion produced, light electric vehicles called Zbees for the purpose of offering Vinngroup employees a way of transportation within the city of Gothenburg.

1.2 Objective
The objective of this thesis is to investigate how a CC service, consisting of a fleet of Zbees, should be designed and work in order to fulfill the needs of users of the service. This thesis will attempt to answer the following questions:

RQ1. What are the essential functions of a Zbee-based Corporate carsharing service for users?
RQ2. What aspects affect the user experience of the user when using this service?
RQ3. What user experiences are important before, during and after the usage of a Zbee-based CC service?

Furthermore, the aim is to develop a design proposition by creating a prototype of a mobile application in order to clarify how the user interacts with the service. The proposed design will be tested on chosen participants within Vinngroup.

1.4 Thesis Outline
This thesis is structured into seven chapters, starting with the Introduction in which the reader is explained the objective of this thesis after having introduced the topic by an introduction part, as well as giving the reader a brief outline of this thesis. Chapter two gives a brief background on important parties and components that are directly or indirectly involved in this thesis. Chapter three i.e., Theory, is the section resulting from the majority of the findings in the literature study about carsharing and other aspects related to carsharing. The next chapter, chapter four, explains the method chosen to conduct this thesis. Chapter five presents the results of this thesis. Further, chapter six discusses the results of this thesis while trying to answer the questions put on the objective of this thesis and lastly, the conclusion will sum up the findings and results while giving the reader the concluding thought of the author.
CHAPTER TWO

Background

In order for the reader to understand the idea behind this thesis, it is important to get some background information regarding the different parties that are directly or indirectly involved in this thesis. This chapter will start with a presentation of Humblebee as a company and as an affiliate of Vinngroup. Further, the light electric vehicle Zbee will be presented in detail, giving the reader all the necessary information.

2.1 Humblebee and Vinngroup

Humblebee is a digital studio and one of the 16 affiliates of Vinngroup\(^1\). Together with the other affiliates they operate under the same roof in Gothenburg. Since Humblebee’s formation in late 2012, they have transformed from a purely coding to a service design based company. Today Humblebee builds digital products, services and tools while growing fast in their field. To give a few examples: as this thesis is written, Humblebee is collaborating with Volvo Cars in transforming the automotive industry by conceptualising future products, as well as helping MasterCard with the planning the future of financial services. Other ambitious partners of Humblebee are: Volvo Group, Hultafors Group, Sahlgrenska University Hospital and Stena Metall. The author encourages the reader to find out more about Humblebee at www.humblebee.se as well as about Vinngroup at www.vinngroup.se.

\(^1\) https://www.vinngroup.se/sv/
2.1.1 Headquarters

Vinngroup, including their 16 affiliates, have their headquarters located in central Gothenburg, more specifically Kvarnbergsgatan 2 (see Figure 2.1). Just to give a perception of how central the location is, here are some distances generated through Google Maps:
- 800 meter walk to the city's central station.
- 4 kilometre car ride to Liseberg.
- An approximately 22 kilometre long car ride to Landvetter airport.

2.2 Zbee

As previously mentioned, this thesis will be focusing on Zbee based CC services. Hence, the following subsections will provide with further information about the vehicle.

2.2.1 About the Vehicle

To meet the transportation needs of the twenty-first century, Clean Motion developed Zbee (see Figure 2.2, 2.3, 2.4); a light electric vehicle (LEV). A LEV is defined as a 2-or-3-wheel vehicle powered by a battery, fuel cell, or hybrid-powered with a general weight of less then 100 kilograms. This LEV was released in 2012 and has since then won two prestigious awards, one of them being the World Wide Fund for Nature (WWF) Climate Solver 2013. The Zbee is relatively small but still a secure vehicle which according to Clean Motion’s Facebook page is the only vehicle of its kind having undergone a complete crash test.

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2 https://www.google.se/maps/
3 https://www.cleanmotion.se
4 https://www.levassociation.com
5 https://www.facebook.com/cleanmotionsbee/
Figure 2.2: The Zbee, produced and engineered by Clean Motion.

Figure 2.3: The Zbee with weather protection "doors".

Figure 2.4: The driver seat
The vehicle is equipped with three-point-safety belts and produced by fibre reinforced plastic material securing the safety of both diver and passengers. Furthermore the vehicle is very energy efficient, only using 4 kWh per 100 kilometers with a range of up to 50 kilometers according to Clean Motion.

According to the Zbee electric engineer William Collings, the vehicle was designed to maintain low cost of the vehicle thus being very simple in other aspects, such as comfortability. The Zbee maintains all the functions necessary in transporting passengers from point A to B in an environmental friendly and secure way. Possibilities to improve the vehicle for use and comfortability are many and can be conducted by the owners of the vehicle. For instance, the vehicle currently only can be started with a physical key. According to a study conducted by My Nametags Ltd.\(^6\), it was revealed that the average person loses over 3000 items with physical keys being the most common property to be misplaced, followed by mobile phones, pens and glasses. Implementing a keyless solution could therefore relieve the responsible driver from the burden of remembering where the keys were placed.

### 2.2.2 Zbee Class Versions and Driving Requirements

Zbee is classed as a moped in Sweden and is available in two class versions; a class one moped and a class two moped. The class one moped version has a maximum speed of 45 kilometers per hour thus requiring the driver to obtain a driver license corresponding a Swedish type B-drivers license or alternatively a drivers license corresponding to the Swedish AM-drivers license. The Class two version has a maximum speed capacity of 25 kilometers per hour and does not require a particular license in Sweden, given that the driver is over 15 years of age.

### 2.2.3 Domestic and Foreign Stakeholders

Today Zbee’s are for instance used by the mobile application based taxi service Bzzt, which while this thesis is written is operating in Stockholm\(^7\). Another taxi company that today offers sustainable trips, including corporate services, with Zbees is the Umea based Ume-Eco-Ride\(^8\). Furthermore, the vehicle will be a part of the transportation company Deutsche Bahn fleet, according to Deutsche Bahn\(^9\). Another example of Zbee’s worldwide recognition is their agreement with the newly established Brisbane based e-Motion Concerts Pvt. Ltd. to represent and sell Zbees in Australia\(^10\).

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\(^6\) [https://www.mynametags.com/lost-property/](https://www.mynametags.com/lost-property/)
\(^7\) [https://www.bzst.se](https://www.bzst.se)
\(^8\) [https://www.umeecoride.se](https://www.umeecoride.se)
\(^9\) [https://www.deutschebahn.com](https://www.deutschebahn.com)
\(^10\) [https://www.cleanmotion.com](https://www.cleanmotion.com)
CHAPTER THREE

Theory

This chapter presents the theoretical background relevant to carsharing found during the literature study. Firstly, it will briefly inform the reader about transportation and mobility at an abstract level, explaining how the human need for transportation correlates with for instance spatial structure. Further, given that this thesis is focused on designing for a service based on LEVs, it will look at some studies regarding this type of vehicle as well as regular electric vehicles (EVs). Secondly, it will dive into the core of carsharing explaining and giving some important definitions, followed by a part showing the motives of choosing carsharing as a transportations means. After that, it will go through the concept of Sharing Economy (SE) and how to design according to this concept. Moreover, this chapter will touch upon theory related to Experiences and User Experiences. User Experiences and User Interfaces will also be presented given the authors intentions with this work. Lastly it will look at how carsharing services work, including different decision making processes as well as Fleet Management (FM). Lastly, some usage rules will be presented. All this in order to fully engage the reader and provide a deep understanding of carsharing and the possibilities of it. Please follow the references for more information regarding the information provided in this chapter.
3.1 Transportation and Mobility

3.1.1 Interaction Between Transportation and Spatial Structure

We live in a world dependent by the use of transportation and the innovations that have come from it. In literature, it is believed that the relationship between transportation and land use is essential for understanding the transportation system, where land-use characteristics influence the travel patterns while the transportation-system-provided-accessibility may affect the land use [11]. Based on the "land use transportation feedback cycle" by Wegener et al. [12] an interpretation was conducted to link the spatial structure and transportation, exhibited in Figure 3.1 [13]. Accordingly, human activities, such as working, living, and leisure, is determined by the locations of spatial distribution of land use. In order to reach these different locations where different activities are held, trips are needed to overcome the distances between them. Correspondingly, based on the trips patterns that are made, development will appear in the transportation system that determine the level of accessibility of different locations.

As depicted in Figure 3.1, other external factors may influence the variables, such as for instance technological innovations (e.g. the autonomous vehicle that is predicted to revolutionize mobility) or economic factors (e.g. business may be reduced due to financial difficulties). Furthermore, the depicted variables have different adaptability paces where, for instance, changes in the spatial distribution of land use lead to quick changes in activities at corresponding location while changes in peoples trip patterns may slowly catch up by the transportation system, etc.

Figure 3.1: An interpretation of the famous "land use transportation feedback cycle" model [13] .
This section has shown that spatial structure and transportation correlate with each other, hence gives knowledge of what variables should be considered when designing for a carsharing service at an abstract level.

### 3.1.2 Mobility

Mobility has been an essential aspect in modern civilisation, having been revolutionised by the auto industry throughout the twentieth century and consequently forever altering the way people move and perceive distances. Automobiles have thus received universal appeal for decades, making car ownership equivalent to high status and the car the ideal mode of transportation. According to a four year long study, 65 percent of the total commute trips in Sweden were made by cars [14], compared to a staggering number of almost 90 percent in the USA [15]. These numbers reflect upon the continued popularity of the car and must eventually decrease in order to overcome congestion, pollution and the global climate change that is so often mentioned in society these days.

Although studies show that the standard battery EVs do meet the driving range needs for an average driver [16,17], potential drivers who are used to driving vehicles with combustion engines often show concern and skepticism when it comes to the driving range of EVs [16,18], experiencing something commonly referred to as range anxiety [16]. With the objective to diminish misconceptions like these, a GPS-based virtual EV mobile application was developed during a study where battery information where simulated to show the driver how different types of EVs would perform when driven in similar fashion and similar roads [19]. More specifically, the participants used this application when driving their own cars to gain understanding of how EVs would perform. This study concludes that simulation applications like the one developed could be an effective tool for people in creating engagement and understanding for EVs as well as assessing EVs on a broader sense. In addition, in order to make it easy for the driver to assess the feasibility of different trips, the study encourages using percentage-perspective over kWh and bar-perspective when displaying the battery-level of the vehicle for the driver.

Furthermore, in an attempt to challenge the car norm in Sweden, a study conducted followed three families based in Stockholm during a car-free year, where the authors followed motivational purposes, challenges and behavioural changes of the participants whom had chosen to replace their cars with different LEVs during a period of one year [20]. Further, the authors analysed the positive and negative experiences of the participants and finalised the paper by presenting some opportunities for the Information Communication Technologies (ICT) and services for the purpose of supporting sustainable transportation practices as well as transitions towards other sustainable practices. This study found both practical and emotional motivations for abandoning the car, some of them being: cost-effectiveness, to-increase-physical-exercise and environmental concerns, with environmental concerns being the most common of them. Even though this study was based on households, similarities in human-interactions can be found in business and corporations when it comes to how groups of people interact and work together in sharing a resource that may not always fill the absence of an actual car. Hence, we acknowledge the importance of this study for future research in this field.
3.1 Carsharing

As stated in the introduction of this thesis, carsharing is a several decades old concept and a way of transportation mean that has evolved through the years and regained attention during the last decade [21]. The concept is known worldwide and developed, according to several reports, in multiple countries all around the world [22].

Purchasing and maintaining cars comes with a cost that fewer people are willing to take thus consequently seeking for alternative ways of travel. Looking at it in a economical point of view, it is of course more rational to use a vehicle more intensively then keeping the vehicles demarcated individually and used less than one hour per day [2]. This together with the concept’s wide range of possibilities for individuals and businesses that have different purposes in engaging in such services, does make the concept of carsharing an attractive transportation mean to pursuit. For the purpose of understanding what carsharing really stands for, lets get in to what is defined as carsharing as well as some proposed requirements of such services.

3.1.1 Definitions and Requirements

Though there is no official established definition of carsharing, research conducted presents the following common themes that were found in a number of proposed definitions [23]: (i) membership requirements for users; (ii) users have access to a common fleet; (iii) users are billed in hourly increments; as well as (iv) differs from traditional car rentals. Same study suggests using the definition established by the State of Washington, whom according to the authors, covers all the points mentioned above [23]:

“A membership program intended to offer an alternative to car ownership under which persons or entities that become members are permitted to use vehicles from a fleet on an hourly basis”

The Swedish National Road Administration (SNRA) gives a somewhat similar definition [24]:

“Car-sharing means that a number of persons share the use of one or more cars. Use of a car is booked beforehand, the user paying a fee based on the distance driven and the length of time the car was made use of.”

In addition to defining the concept of carsharing, the SNRA argues that carsharing organisations (i.e. fleet operators) should follow some quality requirements in order to met the demands of society in different areas [24]. They propose the following requirements: (i) an administrator (as a legal entity); (ii) an average of at least 6 drivers per shared vehicle (should be reached during the first year start-up); (iii) adequate accounting practices; (iv) vehicles in fleets should be owned by a legal entity (not necessarily the same as the administrator); and (v) vehicle requirements (e.g. safety ratings and age).
Figure 3.2: Illustration depicting a trip taken by a user driving a vehicle in a two-way carsharing service where the user is obliged to return the vehicle on the same location where the user picked it up.

Figure 3.3: Exemplified route of a trip in a one-way carsharing where the pick-up location and drop off location is not required to be the same.
3.1.2 Models of Carsharing

Personal users and business users are the two distinct user groups that most carsharing operators offer services to [23]. Personal users join a carsharing service as individuals or households with the purpose of using a vehicle just as they would a private owned vehicle. Business users on the other hand, join to offer a way of transportation for their employees by making carsharing vehicles available for them.

Over the years different types of carsharing models have emerged around the world. Typically in literature, four different terms and two different ways have been used to classify and distinguish different carsharing models; a carsharing model can either be “two-way” or “one-way”, and either “non-floating” or “free-floating” [25]. Starting from the beginning, in "two-way" carsharing systems users have to return the rented vehicle at the same location where it was picked up (see illustration in Figure 3.2) whereas in a “one-way” carsharing system there is no demand that the user should return the vehicle at the same location, thus giving the user a choice (depicted in Figure 3.3). Further, in a free-floating carsharing system the user is basically free to pickup and drop of a vehicle anywhere, assuming that it is legal to do so, within a predefined area (see Figure 3.4). Instead, in a non-floating model, the users have distinguished parking spots or locations to pickup and drop of locations (see Figure 3.5). Moreover, reservations are not possible in free-floating systems whereas in non-floating systems, users are able to both make reservations and pick up a vehicle directly and in a more flexible way. The state of practice in one-way systems is renting-based on real-time availability or short term reservations while two-way systems allow users for reservations [25]. Now, based on these defined terms there are different business models that have been recognised and practiced worldwide, e.g. neighbourhood carsharing, campus carsharing etc [26].

3.1.2.1 Corporate Carsharing (CC)

CC, also called business carsharing, is a form of carsharing that mainly enables businesses to reduce or even eliminate private vehicle use for business purposes. It appeals to companies of various sizes and for different reasons. Larger companies might join as an alternative to high maintenance costs of a company vehicle fleet, while smaller companies may use it so that employees have a mobility option other than their personal vehicle while on the job. Some business might even use carsharing as a way to reduce the need for staff to bring a car to work [23].

Carsharing services within businesses can simplify many problems, for instance not having to deal with the hassle of complicated reimbursement and insurance issues when using personal vehicles and taxi services. Factor behind the success of CC services include operational advantages, increased mobility options leading to additional flexibility, as well as effectiveness as a transportation demand management [21].
Figure 3.4: Depicting a trip in a free-floating carsharing where user is required to pick-up and drop off the rented vehicle within a predefined area.

Figure 3.5: Trip taken in an non-floating carsharing model.
To better understand trip purposes and overall opinions towards their services, Zipcar conducted an online survey completed by over 23K active North American Zipcar members, 523 of them identified as corporate members. The study showed that 40 percent of the corporate members surveyed sold or postponed a vehicle due to joining Zipcar, corresponding to 33K vehicles removed across North Africa for business purposes. Further it showed that corporate members biked and took the public transit slightly less often and instead walked slightly more [27].

In another study\(^\text{11}\), conducted by the Swedish Sunfleet, surveying 74 participating companies whom had driven their cars for at least 10K Swedish Crowns, the following results were presented:

- The majority of companies did not join Sunfleet because of environmental aspects
- 91 percent of the companies combine carsharing with other transportation means;
- Only 39 percent of the companies use the services outside of town (other towns);
- More than half (54 percent) have used the carsharing service in between train stations and airports;
- 44 percent of them used private vehicles for business purposes prior to joining the carsharing service.

\(^\text{11}\) https://www.sunfleet.com/
3.1.3 Objective and Motives of Carsharing

Carsharing is seen as having the potential to improve both mobility and sustainability by reducing the number of privately owned vehicles, having attracted considerable attention with multiple implementations worldwide [28,29]. Still, forgoing private ownership can be difficult for individuals, therefore carsharing services will have to provide vehicles that meet users’ needs. The attractiveness of carsharing services, according to Boyaci et al., is determined by the level of service offered and the cost associated with the use of the system where the level of service is influences by the accessibility of vehicle stations by the potential users, and where establishing and operational costs is influences by the number and size of both stations and fleets respectively as well as the availability of vehicles at the “right time” at the “right station” [25].

Motivation has theoretically been regarded to be the basis for all consumer activities, an influencer in the direction, persistency, as well as strength of consumer activities [30]. With the aim of exploring the motives and motivational patterns underlying the use of carsharing, Schaefers conducted laddering interviews on a total of 14 users of a US carsharing provider and proceeded using the collected data for Means-end chain analysis[31]. This resulted in 12 attributes (distinct characteristics of a carsharing service), 15 functional consequences (i.e. qualitative outcomes directly related to the service use), 13 psychosocial consequences (i.e. psychological and social outcomes) and 9 values (i.e. centrally held cognitive elements that consumers pursue with their individual behaviour). These provide qualitative insights into the different usage motives and the resulting motive structures (see Figure 3.7).

![Figure 3.7: Overview of means-end chain elements generated from laddering interviews’ results [31].](image)

12 A qualitative method for investigating individuals' general cognitive structures in decision making [31].
Furthermore, Schaefers proceeded to identify overarching motivational patterns that influence the behaviour of carsharing users, resulting in the findings of four patterns: value-seeking, convenience, lifestyle and sustainability. Another France-based study, send out online surveys to 259 participants in order to figure out there intentions and motivations with using corporate carsharing services [32]. Results showed that effort expectance (i.e. degree of ease associated with use) is the most important dimension in deterring behavioural intentions about corporate carsharing. Moreover, perceived environmental friendliness had only a small effect on behavioural intentions, mediated by performance expectancy (i.e., the degree to which individuals believe that using the system will help them improve their job performance).

3.2 Sharing Economy: Access Over Ownership

To attain a better understanding of carsharing it is important to go back to the roots of the concept, i.e. Sharing Economy. This phenomenon, also referred to as Collaborative Consumption has been given the following definition by Russell Belk [33]:

“...people coordinating the acquisition and distribution of a resource for a fee or other compensation.”

SE has much due to evolvement of technology and the omnipresent of connectivity, emerged to a clear trend in several market areas where access is seen as more important and desirable then the idea of ownership [34,35]. For instance, the desire to watch a particular movie today does not necessarily mean having to purchase that particular movie itself. Instead, a more common way of getting access to that flick is by subscribing to a video-on-demand streaming service like for example Netflix. In a similar fashion, individuals choose the peer-to-peer service AirBnb to get access to accommodation over making an investment in an ownership of a place and use carsharing services like Sunfleet as a way of travel instead of purchasing a car. SE has even been shown to be of significant importance for corporations in their travel policies. Research conducted, analysing the corporate travel options of over 150 global companies found that by 2016, 87 percent of them either had at the time implemented or were reviewing SE options for their respective travel policies [36].

According to Botsman et al. [37], Collaborative Consumption can be organised into three systems that are reinventing what and how we consume: Product Service Systems (PSS), Redistribution Markets and Collaborative Lifestyle. In this thesis, PSS is the most interesting considering its objective and definition which will be presented in the next section.
3.2.1 Product Service System (PPS)

Tucker et al [38], defines PSSs as:

“...tangible products and intangible services designed and combined so that the jointly are capable of fulfilling specific consumer needs”

The classification of PSS (see Figure 3.8) by Tucker et al ranges from Product-oriented services with a business model generally geared towards sales of products, through Use-oriented services where the product instead is owned by the provider and made available in different forms, to the last main category, i.e. Result-oriented service, in which there is no pre-determined product involved and the focus is instead on the results. Given these categories and their different subtypes (8 in total), CC could either be classified as a Use-Oriented service or Result-Oriented service. More specifically number B4 within the use-oriented type or number B7 i.e. Pay-per-service-unit within the result oriented service. These two types differ in how the user is charged when gaining access to the vehicle where in the use oriented model the user is charged by hour whereas in the result oriented model he/she would be charged by the distance traveled.

The relevant concept presented above takes us in to what is called Smart PSSs, that much due to the advancement of technologies (e.g. ICT, increased connectivity of objects) have evolved from the traditional PSS. Smart PSS is essentially, the integration of smart, connected products with e-services (i.e. services through which providers and users interaction is partly or complexity electronic). Further this solution is brought to satisfy the individual needs of consumers (i.e. users). For instance, a carsharing that connects the vehicles to the internet (i.e. creating a smart product) for the sake of letting users check their availability remotely, while offering an e-service in order to make bookings, is considered to be a Smart PSS.

![Figure 3.8: Main and sub categories of PSS [38].](image)
3.3 Designing for Sharing

Even though Smart PSSs may be beneficial in many aspects for costumers and their needs, there are challenges when designing these systems in order to generate positive experiences for the users. Researchers have discussed the implications in the adaptation of products that are not owned and that are developed based on services, having been used to the idea of single transactions of products that are owned [39,40,41]. Designers should therefore, according to Seomandi, understand the aspects influencing the experience and value in use of Smart PSSs, as they generate the experience of users through the service interfaces and help reach their goals [42]. Therefore lets begin with discovering Experience and User experience, including their influencing factors.

3.3.1 Experience Design & User Experience (UX)

Transitioning from consumption to participation means regulating the way products and services are designed, namely: becoming more focused on human experience rather than the creating of the object itself [37]. SE, according to Botsman et.al, intersects with Design Thinking in several ways, which accordingly is the solving of big problems using systems and experiences by applying the process of intentional creation beyond discrete products [37]. In other words, the design moves from being focused on specific objects to focusing on human experience when using the product, making the user an active participant in the design process. In order to design with the goal of good UX and evaluate UX of a product or service, a definition and understanding what UX consists of, is required [43]. One popular UX definition, given the number of times the article has been cited, is by Hassenzahl and Tractinsky [44]:

“UX is a consequence of a user’s internal state (predispositions, expectations, needs, motivation, mood, etc.), the characteristics of the designed system (e.g. complexity, purpose, usability, functionality, etc.) and the context (or the environment) within which the interaction occurs (e.g. organisational/social setting, meaningfulness of the activity, voluntariness of use, etc.).”

Another interesting UX definition, given its abstract level, was published by the Usability of Professionals Association, which says [45]:

“Every aspect of the user’s interaction with a product, service, or company that make up the user’s perceptions of the whole.”

To clarify the term UX even further, Roto conducted a study which concluded proposing building blocks of UX, essentially a list of components with their respective set of attributes (see Figure 3.9).

Briefly explained these components are: i) Systems: referring to the products, services and infrastructure that are involved in the interaction when using the examined product; ii) Context: referring to external factors such as environmental, social and temporal, of the experience; and last but not least iii) The User: this component refers to the physical and mental state of person using(interacting) with the system [43].

13 https://scholar.google.se/
Interestingly, similar conclusions can be found by Sandström et al regarding service experience which accordingly is the total functional and emotional value of a consumed service [46]. Further, the author means, service experience is individualistically unique to costumers and to the situations in which the consumption is taken place, and that service experience is cognitively evaluated through the value in use.

In sum, the UX is dependent on several aspects, both those that might be controlled by designers, and others that cannot. Valencia et al depicts this very well in Figure 3.10.

3.3.2 Designing PSSs and Smart PSSs

In order to create innovative solutions with added value for costumers (i.e. users), the design process of PSSs involves integrating business models, products and services[48]. More generally put, a PSS is developed in either one of the following cases: servitization (e.g. manufacturing companies add service components to their offerings), productisation (i.e. service companies add products to their service offerings, or when a company is established based on both [49,50,51]. The design of PSSs are based on several aspects that should be taken into consideration by designers, including the context. Traditional PSSs and Smart PSSs do have similarities in their design process however there are important differences too [47].

Valencia et al. defined the Smart Design Process by proposing the design elements of a Smart PSS design process, concluding the design challenges that comes along in the design process as well as giving the roles that might help with the challenges of the design process [51].

Figure 3.9: User experience building blocks [43].
Elements of the design process
Firstly Valencia et al. points out that Smart PSS development requires the involvement of a large number of stakeholders throughout the stages of the design process [51]. Secondly, the ever-growing and evolving characteristics of Smart PSSs requires a continuation of the design, enabling the designers to adapt the value proposition over time. Another element is the creation of multi-touchpoints that integrates smart product(s) and e-service(s); a Smart PSS may be composed of several smart products (e.g. smartphones, connected products etc.) and several e-services(e.g. applications, web platform etc.) thus broadening the design options for the design of how the end-user will interact with the Smart PSS. Last but not least, the design of Smart PSS is highly context dependent where different context may result in the identification of different needs thus leading to different solutions.

Challenges of Smart PSS design
Much based on the elements of the PSS design process above, Valencia et al. suggests the following challenges that may come in the design of Smart PSSs: i) defining the value proposition, ii) maintaining the value proposition over time, iii) creating high-quality interactions, iv) creating coherence in the smart PSS, v) stakeholder management, vi) the clear communications of goals, and vii) the selection of means and tools in the design process[51].

Figure 3.10: User Experience with Smart PSSs [47].
3.4 Designing for Electric Vehicle Fleet Sharing

This section will look at literature that discuss how carsharing services (or vehicle fleet services in general) are built in order to gain knowledge on how these kind of services work. This is an essential section that should affect the UX.

3.3.1 Typology

Just as there are different modals of carsharing services in general, there are some different types of CC services that might be considered as options for a company, based on several aspects including economical, organisational internal structure, size etc. Firstly, on one hand, a company could decide to implement an CC service where the vehicles are owned internally and the whole service is maintained by the company itself, i.e. in-house CC service. On the other hand, a company can rely on a CC service offered by an established car sharing organisation such as Sunfleet in Sweden, i.e. external CC service. Secondly, what policies the organisation implements in the CC service effects how the service will be used. One reported distinction is between so called Service Vehicles and Official Cars, where Service Vehicles are vehicles that are only used for professional purposes and whereas Official Cars are vehicles used both for personal and professional purposes [8]. Further, depending on the shared-use vehicle system model, the vehicle fleet might consist of identical vehicles (i.e. homogenous fleet), or many several different kinds (i.e. heterogenous fleet)[52]. The types of vehicles chosen by the vehicle-sharing provider can play a essential role in the marketing of that service where for instance, vehicles that are considered unique and fun-to-drive have a higher marketing value thus more prone for prospective users to join [52].

Although conducted a while back, considering the advancement of ICT in recent years, study in 2003 explains the fundamental elements of shared-use technology in a generic shared-use vehicle system operation. Accordingly, once the user is a member of the carsharing service (usually though some sort of registration process), the user is ready to make a trip, in which there are various steps in the process [52]: i) depending on whether the carsharing service system allows reservations of vehicles or just on-demand requests, or both, a reservation system can be used to reserve the vehicles; ii) accessing the reserved vehicle can be carried out in several ways, including using using smart cards or lockboxes; iii) during the trip, information may flow between the vehicle and system for both driver assistance and fleet management, depending on the communication architecture developed using on-board vehicle electronics; iv) after a completed trip, trip information is collected (e.g. time, distance etc.) that could be recorded by the system management to perform appropriate functions including accounting and billing in order to best manage the overall system. Incorporating advanced electronics and technology allows for improved functionality with respect to several essential aspects, including vehicle security, user convenience and vehicle management [52]. Furthermore it allows for easier management of service as well as a more user friendly service with increased user satisfaction [53, 54]. During more recent years this trend has grown in to an essential factor for advanced carsharing services all around the world [55]. When investigating several carsharing providers it was evident that the majority of services offered by the carsharing providers were possible due to Information Technology (IT) functions.
Further various of different technologies were identified as being used and integrated in the carsharing services, including embedded system technologies in the vehicle (e.g. Telematic devices, Card-readers, Key-box), user purpose technologies (e.g. Mobile and Wireless technologies), Carsharing Service Provider purpose technology (i.e. back ended enterprise system technology) [55]. See Figure A1 in Appendix A.

With the aim to design a flexible, easily accessible, new generation of vehicle-sharing service that meets the peculiar needs of different type of users, Luè et al. reviewed a number of existing practices concerning traditional and innovative carsharing systems [56]. According to the authors, the best practices can specifically be described by a set of 39 parameters, shown in Figure 3.11. Moreover, concerning electric carsharing services, the authors mention ease of reservation, payment, and use as being significant in the success of such services.

![Figure 3.11: Parameters that describe the best practices of carsharing [56].](image-url)
These parameters may be of great importance when designing future carsharing services, especially conceding services with electric vehicles [56].

### 3.3.2 Fleet Management

Fleet management (FM) is a vital part of carsharing services in order to fulfill the users needs and reach service utilization, thus being an important factor in the user experience of the service. Specially in the case of fleets containing EVs, a study demonstrates, where FM systems have an important role to overcome technology-born restrictions of EVs as they were not able to cover all the users travel needs [57]. It has been concluded that FM processes recently, under the combined influence of growing economic pressure and increasing introduction of digital technologies (e.g. monitoring and track technologies), have entered a phase of rapid change [8]. Furthermore, according to Financial times[14], driver fears of intrusive spying when using telematics (i.e. fleet tracking and monitoring functions) in FM have receded thus making telematics more acceptable then ever.

There are different techniques in the management of fleets that are dependent on variables like the size of the fleet, types of vehicles, autonomy etc. [57]. Same article suggests a functional architecture (depicted in Figure 3.12) for FM systems based on what they call Open fleets (e.g. carsharing services) which according to the authors have the following characteristics that demands an appropriate way of management: service tasks may appear dynamically regardless of time and location (within the region of operation); the fleet size may change dynamically and should not affect the normal fleet operation; fleet operators may have limited control over the fleets; as well as the size of open fleets are conceived to potentially work on a larger scale. Therefore, the proposed architecture takes in to consideration several aspects and components that directly or indirectly affects the user experience of

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14 www.ft.com/
Accordingly, the architecture consist of three layers: the vehicle layer consisting of the fleets vehicles; the fleet coordination layer consisting of components that coordinate tasks; as well as the fleet operator layer which consists of components that are necessary for the normal operation of fleet operator [58].

Briefly summarised, this solution gives the fleet operator through a Fleet tracker, real-time operation- and position states of vehicles in the fleet. Through the Event processing component, changes in the fleet are detected and necessary actions are taken to make efficient decisions by for instance assigning transportation tasks to vehicles. By taking in to account historical data and other external scores, the solution offers future predictions that could elevate mistakes. The presented architecture is encouraged to bee understood as an abstract functional architecture where the components implementation will depend on each particular application domain [58].

Another FM architecture, uses EVs in order to provide mobility but also to gather environmental data (e.g. traffic, weather, parking) and status data (e.g. current position, battery status etc.). The architecture, depicted in Figure 3.13 (see Appendix A7 for a more detailed figure), suggest tablets implement in the EVs to be used as a user frontend for navigation help etc and help though the rental process. Further, the architecture distinguished between changing stations (they call it Electric Vehicle Supply Equipment [EVSE]) owned by the car pool that are suggested to be connected to the cloud service chain and therefore fully controlled, with external charging stations that cannot be controlled by the cloud service chain. Furthermore, as smartphone is proposed to be used for multiple purposes, including perform bookings, give feedback, check for updates, receive notifications etc. All this by using different applications developed for different purposes. Last but not least, the carsharing service is managed by a cloud service chain which is suppose to: administrate the users, vehicles and charging stations; manage bookings, scheduling and billing; provide energy management including charging scheduling and energy flow control; and provide dynamic route planning.

![Figure 3.13: Fleet Management containing EVs](59)
3.3.1 Fleet Decision-making

How decision-making in fleets are conducted by the organisation responsible for the carsharing service (i.e. fleet operators), might affect the users experience the service. Although conducted almost 20 years ago, a study attempted to categorise the decision-making process used by fleet managers in the US [60], which resulted in a distinction of fleets by the decision-making structures within the organisations participating in the study. By taking into account the degree of formalisation (defined as the extent to which rules and procedures guide the fleet decision process) and the degree of centralisation (defined as the number of people involved in fleet decisions as well as their decision-making autonomy) the authors created a fleet decision structure (fleet typology) in which according to their conclusion can be used to formulate effective marketing strategies aimed at introducing new innovations (e.g. EVs) into the market. See the typology in Figure 3.14.

Figure 3.14: Different kinds of Decision-making processes [60].
3.3.1 Usage Rules

Usage rules are obviously essential for keeping the fleet in shape, thus attracting more costumers, and should therefore be implemented in carsharing services, just like any other legitimate business. One example of such set of rules are those initiated by Zipcar\textsuperscript{15}, i.e. one of the biggest carsharing providers in the world. Their rules for using their vehicles are as follows: i) users are obliged to inspect the Zipcar inside and out before driving and report any damage; ii) users are obliged to keep the vehicle clean and keeping their belongings when leaving the vehicle; iii) users are not, under any circumstances, allowed to smoke; iv) the vehicle should always be left with at least 1/4 of fuel; v) users are obliged to return the vehicle on time, or face late-fee charges; and lastly vi) pets need to be kept in a pet carrier at all time. More rules and terms of use can be found on their webpage.

Similar rules can be found in Sunfleets\textsuperscript{16} terms of use and conditions, including a predefined charing fee of up to 6K Swedish Kronor for lost charging cables to electric vehicles.

\textsuperscript{15} www.zipcar.com/
\textsuperscript{16} https://www.sunfleet.com/
CHAPTER FOUR

Method

This section will present the chosen method for coming through this thesis. This thesis follows the human-centred design process created by Hasso-Plattner Institute of Design at Stanford17 (see Figure 4.1), which consists of the following stages (presented more thoroughly in the next sub-sections):

The empathise mode is the first mode of the chosen design process where the objective is to get to know the potential users, to understand them and their needs within the context of this thesis design challenge. This includes physical as well as emotional needs, how their thinking process looks like and what they value as being meaningful.

The define mode is a critical mode in the design process where the goal is to define the challenges that are ahead through gathering and clarifying information gathered from the previous mode.

The ideate mode goes in to the generation of ideas based on the knowledge from previous sections and in the context of the design challenge. More specifically it will generate a wide range of solutions for the detected problems users have.

The prototype mode has the intention to get answers to questions that will result in the best solution for the user by iteratively generating artefacts, starting from simple low-resolution prototypes and ending with more advanced high-resolution prototypes that are closer to the solution.

17 https://dschool-old.stanford.edu/
The test mode consists of soliciting feedback about the generated prototypes from users. This is also an iterative process going back and forth from the prototype mode. The testing is another opportunity to gain empathy got the users that the design is aimed for.

![Design Process Diagram](image)

**Figure 4.1:** Illustration of the chosen design process.

4.1 Empathise
This section presents what was conducted during the Empathise mode in the design process.

4.1.1 Literature Study
First phase in this study was to gather information and knowledge from existing literature about carsharing in general as well as the more specific corporate carsharing type were electric vehicles are used including different aspects related to carsharing. How these system work were looked upon, while also reading about how this concept is related to SE and what is suggested when designing these kind of services. These previous studies and articles were mostly found by searching on Google\(^\text{18}\), Google Scholar\(^\text{19}\) as well as the Umeå University library database\(^\text{20}\).

When searching, the following were some of the terms used: "carsharing", "service design", "usability", "sharing economy" and "fleet management".

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18 [http://www.google.se/](http://www.google.se/)
19 [http://www.scholar.google.se/](http://www.scholar.google.se/)
20 [http://www.ub.umu.se/sok/artiklar-databaser](http://www.ub.umu.se/sok/artiklar-databaser)
4.1.3 Interviews & Meetings
In order to gain insights in prospective users experiences and ideas regarding a potential Zbee based CC service, semi-structured interviews were held. These interviews were one-to-one, from 20 up to 30 minute sessions, held with chosen employees based on their job positions at the Vinngroup headquarters. The interviews were structured in three parts: first part seeking for background and demographic information; second part, looking for information regarding the participants traveling experiences and needs; and lastly, questions particularly designed to gain knowledge on preferences and opinions on a Zbee based carsharing service within Vinngroup. All the questions asked can be found in Appendix B.

Further, expert interviews (also semi-structured) were held with individuals whom had prior experience in driving Zbees. The purpose of these interviews were to gain insights in the user experiences when driving these vehicles and related information that might help when designing a service with a fleet of Zbees. Questions asked on these interviews can be found in Appendix B.

Lastly, a meeting was held with the Zbee electrical engineer William Collings in order to gain further insights on the vehicle. This included asking Mr.Collings questions as well as having a test drive with the vehicle around Lerum, Gothenburg. Moreover, Mr.Collings was kind to answer questions via email during the whole process. See results of the Emphasise mode can be found in section 5.

4.2 Define
In the next phase i.e. the Define mode, the goal is to clarify and define the design challenge based on the information received from the previous phase. The methods used in this phase are based on human-centred service design, and chosen because of the fact that they produce and map information that clarifies and defines problems. The results of this mode can be read in section 5.

4.2.1 Stakeholder Mapping
The define stage started of by defining the different stakeholders in a planned workshop. The workshop gathered 5 participants. Although these did not represent all the stakeholders, the workshop was able to identify the most important stakeholders of a Zbee CC within Vinngroup. The result of this workshop is presented in section 5.

4.2.2 Personas
In order to set a target group that the design will revolve around, two main personas were created. This was done by analysing the results of the semi-structured interviews in the Empathise mode, extracting some of the most common background, travel needs and behaviours traits that revolve around transportation in business.
4.2.3 User Journey

The literature study resulted in knowledge on how carsharing services work. With this knowledge user journey were identified in order to further clarify what the user experiences, through the process of using the service. Further the interviews also contributed to the mapping of the user journey. Firstly the different stages where defined. Within these stages the goal was to define the tasks that usually are there.

4.2.4 Service Blueprint

Lastly in the Define mode, i.e. Service Blueprint, is essential in order to visualise the relationships between different service components that are directly tied to touchpoint in user actions through their journey. Even though this mapping method\(^\text{21}\) can be conducted in different ways and have different visual form, the following key elements are found in every service blueprint: i) Costumer actions - steps, activities, choices and interactions that the costumer performs while interacting with a service; ii) Frontstage actions - actions that occur directly in view of costumer, either human-to-human or human-to-computer; iii) Backstage actions - actions that occur behind the scenes to support the actions occurring in the frontstage; and lastly iv) Processes - internal steps and interactions that support the delivering of the service. The service blueprint was created based on the research found in the literature study as well as using the priorly defined user journey phases.

4.3 Ideate

Based on the knowledge retrieved from previous phases in the design process, the objective of this phase is generating appropriate and effective ideas that will solve the problems defined in the Define mode. The following methods were used in this phase.

4.3.1 Brainstorming Value Proposition

In order to propose a value proposition based on what is being designed in this thesis, the canvas created by Alexander Osterwalder i.e. Value Proposition Canvas\(^\text{22}\) (VPC) was used. The VPC is composed of two parts: the Costumer Profile and the Value Map. The costumer profile consists of three sections which will explain the jobs (both functional, social and emotional) the user is trying to complete, what pains users have when attempting to accomplish these jobs, as well as defining the user gains which explain how users measures the success of a job done and what positive outcomes the users hopes to achieve. The value map, on the other hand, is divided into three sections, explaining how the products and services the relieve pains and creates gains. More specifically, these sections describe what products and services are offered, how they will work as pain relievers for the previously defined user pains, as well as how they will generate gains for the user.

The first part i.e. the costumer profile, was mapped by gathering the insights from the previous work. The second part of the VPC i.e. the value map was created in a planned workshop by holding a brainstorming session for every section in the the value map. Each part was given 10 minutes (i.e. total of 30 minutes). The workshop

\(^{21}\) https://www.nngroup.com/
\(^{22}\) http://alexosterwalder.com/
gathered 4 participants. These participants were firstly given an introduction about the background of this thesis as well as details about the theory of this kind of service and the objective to find a value proposition.

4.4 Prototype and Test

After proposing the value and generating some ideas, the continuation of the design process proceeded to the Prototyping i.e. designing the ideas that iteratively will be put to test. Accordingly the design process goes iteratively between the Prototype mode and Test mode, until a satisfying enough solution has been reached. Ultimately three iterations where accomplished given the limited time. Additionally, the model of finding usability problems by Nielsen et al. was followed, which says that testing should be done on no more then 5 users at a time and doing this iteratively until at least 15 users have been tested in order to discover all the usability problems in a design.

4.3.1 First Iteration

4.3.1.1 Prototyping (low fidelity)

The generation of the first prototype, i.e. low fidelity prototype, was conducted through paper and pen. The objective of this prototype was to show the participants the functionality of the application and thus not focusing on other things, such as aesthetic values. By designing two different way of how navigation is done as well as distinguish how the information about the zbee is displayed, the goal was to find which way continue the design.

4.3.1.2 Testing (low fidelity)

The testing of the low fidelity prototype was conducted by giving the test subjects tasks related to the: navigation through the application; changing of dates; choosing of vehicles; understanding the conditions of the vehicles; understanding vehicles availability etc. While the test were conducted the subjects were asked to think-aloud while the research observed and noted what was said. The tasks during the test can be viewed in Appendix C.

4.3.2 Second Iteration

4.3.2.1 Prototyping (high fidelity)

This time the prototyping revolved around one design solution, drawn up in Sketch, a vector graphics editor for Apple’s mac OS, developed by the Dutch company Bohemian Coding. Further, more details were added such as colours, symbols, and pictures.

4.3.2.2 Testing (high fidelity)

The testing of the high fidelity prototype was conducted by showing the designed high fidelity images on a MacBook Pro. Firstly an introduction of the corporate carsharing service was given to each participant. Secondly a scenario was painted

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23 https://www.nngroup.com/
24 https://www.sketchapp.com/
out to them that would connect with the tasks that were given them afterwards. The introduction, scenario and tasks can be viewed at greater detail in Appendix C.

4.3.3 Third Iteration

4.3.3.1 Prototyping (interactive)
The objective of the final prototype session was to again redo the design based on the evaluation from the previous iteration, as well as this time creating an interactive prototype that mimics a future real mobile application. This interactive prototype was created by using Adobe XD, a design and prototyping tool developed by Adobe. More specifically the interactive prototype was created by copy pasting what had been accomplished in Sketch to Adobe XD and then linking the different views with each other.

4.3.3.2 Testing (interactive)
Yet another test was conducted, starting with the same procedure as done in the second iteration but this time by also incorporating the well known System Usability Scale (SUS) [61], a scale created for the purpose of measuring the usability of overall systems. The method asks participant to score 10 different statements on likert scale ranging from 1 to 5 (i.e. from "strongly disagree" to "strongly agree") based in how much they agree with the statements. Based on the answers the SUS then yields a number (from 0-100) which represents a composite measure of the overall usability of the system. The SUS was given to the users after they had the chance to interact with the prototype. As it is generally used after the participant has had an opportunity to use the system that is to be evaluated, and before a discussion takes place, the SUS was given to the user after they had finished the tasks they were given (Figure C2 in Appendix C was printed out). Research suggests that a SUS score between 70 and 80 should be interpreted as good usability where as scores below 50 should not pass [62]. Further the authors suggest scores 90 or above should be interpreted as excellent [62].

https://www.adobe.com/se/
CHAPTER FIVE

Results

In this chapter the results of this thesis will be presented, including the findings and the process of the users interviews that were conducted, and the expert interviews as well as the actual design proposition based on the knowledge gained in the previous work.

5.1 Empathise

Following will present the result from the work conducted in the empathise mode of the design process.

5.1.1 Interviews

The following came forward from the interview conducted with the employees of the different affiliates at Vinngroup, at the time these interviews were conducted:

- The majority of the participants owned a private automobile (fuel driven). Nevertheless most of them did not use their private vehicles for work or work related errands.
- The majority of the participants took the PT to business errands and prefer walking when reaching private related errands during work.
- All of them had some sort of experience with SE.
- Very few knew about or had personally driven a Zbee prior to the interview. One participant pointed out that it looks unsafe.
- Those who chose to use their private vehicle to work and during work, usually had other personal errands before or after work that made it of convenience for them to use their private car.
• Two out of the participants did claim that they were happy to lend out their personal car for their colleges if it was not used as long as they could pay for the fuel and keep it clean.
• One participant commented that he would appreciate a smaller type of vehicle when driving in urban areas. The participants felt that his car was too big to drive in cities (the participant drove at this time a Land Ranger).
• When going outside of office for personal errands, for instance eating lunch, most of the participants preferred walking because of the central position of the office.
• Majority of them did not have prior experience to carsharing. Those who had gave positive comments. One participant was an active subscriber to Sunfleet.

5.1.2 Expert Interviews
A total of 5 expert interviews were conducted on individuals with prior experience in driving Zbees. The following can be concluded from the interviews:
• Purposes of using a Zbee according to the participants were: economically-, sustainability- and conventionally-based.
• All participants pointed out that the vehicle is fun and easy to use as well as easy to maintain.
• Majority of the participants drove it for shorter distances, e.g. leaving the kids at school or driving to the train station etc. Few of them reported haven taken longer trips.
• All participants expressed feeling safe with driving the vehicle although this was not the initial feeling for all the participants. Some reported initially being insecure about the security and the vehicles capacity to get to the destination. After using it for a while that insecurity eventually disappeared.
• Two of the participants said that it could be a bit noisy inside the Zbee if the wind-protection doors where not put on and especially if the substrate was of gravel.
• Majority of them experienced reactions from fellow road travellers, mainly positive reactions. Majority of the participants liked getting reactions because they knew they were doing it for a good cause (e.g. sustainability). One participants reported not enjoying the ride when the driving created queues behind the driver.
• Participants who had experience in driving in snowy weather conditions did not like the experience. They reported being cold and that the battery level decreased at a greater speed because of the snowy roads.
• Two participants reported missing entertainment inside the vehicle e.g. music, especially when taking longer rides.
5.2 Define
Following will present the result from the work conducted in the define mode of the design process.

5.2.1 Stakeholder Mapping
The stakeholder mapping resulted in the identification of five main stakeholders that are somehow involved in the carsharing service.

The Vehicle Manufacturers - How the vehicle is designed and equipped plays an essential role in the UX of the carsharing service. Moreover vehicle pricing plays a role in weather there will be investments from the investors.

The Users - The group that use the service will have something to say for the future of the service.

Insurance Provider - Insurance providers play a role in the business of such a service e.g. for the sake of security.

Government - The regulations of various taxes and laws may affect the carsharing service.

Infrastructure - How the carsharing service is managed as well as what technology is used plays a role used to facilitate good UX

Affiliates - The more companies join to the carsharing service, the more users will have access to the vehicles and thus affecting the availability.

Owners/Investors - Owners and investors determine the future of the service, thus their decision making affects the service directly. Their budget also affects future investments in the service.

Only the main direct stakeholders were identified in this session. Other stakeholders could for instance be press/media, various pressure groups and society as a whole.

5.2.2 Personas
Based on the information gathered from the interviews, two main personas were generated in order to gain information as to how the carsharing service will be used to meet the users needs, thus what users the design will revolve around. First one is Eric, a 25 years old java developer and the second persona is Johanna, the busy manager (see Figure 5.1 & 5.2).
Figure 5.1: Visualisation and information about first persona.

**PERSONA 1**

**ABOUT**

Eric is a creative guy with ambitions in life. He likes to travel the world, hang out with friends and play video games. Eric lives alone with his girlfriend in an apartment very central and never really drives a car. Eric is a minimalist and likes to think of himself as very environmental friendly. For instance he avoids eating meat as much as possible in order to reduce his environmental footprint. Eric is in to biking and does that alot, although winters can be a bit rough because of the snow.

**TRAVEL HABITS**

Eric does not own a private car and is not in need of one. His activities throughout the day can most of the time either be reached by foot, bike or by taking the PT. Eric likes to try new things and carsharing has not been an exception, having been a subscriber of Sunfleet and having liked it very much. Eric has very few meetings outside of the office but when he does he usually takes the PT, a taxi, his bike, or walks. He is really interested in how a carsharing service would work in the company and would definetly see himself using it.

**TRAVEL NEEDS**

Eric appreciates services that are easy to use and learn. Booking and searching for trips should not be complicated in any scenario. Saving receipts is a problem Eric experiences when whenever taking a cab to meetings. Solving that would be great. Sustainability is very important.

---

Figure 5.2: Visualisation and information about first persona.

**PERSONA 2**

**ABOUT**

Johanna is a manager and a mother of two kids, living in Gothenburg with her family. She is a very active person with a lot of hobbies and responsibilites thus likes to plan ahead in order to efficiently distribute her time during the week. She like living healthy and is environmentally aware. Among all the responsibilites in her life, at work she more then often has meetings with business partners, both in and outside the office building.

**TRAVEL HABITS**

Johanna chooses to use her private car when traveling throughout the day. She finds it of convinience because of all her activities before, during and after work. Both her and her husband have their own cars. Johanna knows the environemntal issues with cars but this alternative is best for her in order to reach places relatively fast. She would consider leaving her car parked at work and use a more sustainable friendly alternative for meetings, assumming the what is offered is reliable and available when she needs it.

**TRAVEL NEEDS**

Johanna needs reliable, available and affordable transportations means that makes it from A to B in time. Planning ahead should be possible but forgetting to do so should also not be a problem.
5.2.3 User Journey

Ultimately a total of 5 possible stages were identified during the analysis (see Figure 5.3 for an overview). First stage is the initialisation stage in which the users only encounter once in order to gain access to the service. Further the following three stages are the stages where the users has full access to the service functions. The user encounters these three stages every time he/she uses the service. Lastly two more stages were identified: the interruption stage where the user has lost the access and the resumption stage that should help the user regain the access. The interruption stage may occur at any time during three use-stages.

**Initialisation Stage** - Assume that the company has implemented an in-house CC service for their employees. The employee i.e. user, receives information about the CC service (both usage guides as well as information regarding terms of use and conditions) and shows interest in joining. This interest may be based on one or several factors:

- **Mobility needs** i.e. needs are not being meet by the current way of moving from the office;
- **Environmental awareness** i.e. the users sees the opportunity to contribute to a more sustainable way of transportation
- **Curiosity** i.e. the user wants to test if this service will fulfil the needs;
- **Peer pressure** i.e. the user is pressured or convinced by other coworkers to join the service.
- **Affordability** i.e. the user is offered a service that is more affordable for him/her or his/her company economically.
- **Insistence** i.e. the company may demand employees to use their vehicles when meeting costumers or business partners for multiple reasons, e.g. brand their name as an environmental aware company.

Finally the user proceeds to join trough an (in this case) undefined process.
**Pre-Use Stage** - Assuming that the initialisation stage went as supposed, the user is now authorised to use the service and after some time decides to reserve a Zbee for an activity (i.e. errand) outside of office. The user knows when and where the activity will take place. The booking can be done through the booking system accessed either by visiting the web application or by using the service mobile application. The following conditions have to be meet in order for the user to complete the booking:

- **Availability** i.e. there need to be available vehicles at disposal prior to when the users activity takes place;
- **Capacity** i.e. the vehicle possesses enough battery in order to make the two-way trip.

Further, because of what kind of vehicle the service offers (Zbees) and how they sent have any actual doors, the users decision on whether to use the service or not may be influenced by the weather conditions. Moreover, if the user is planning on traveling together with co-workers then only a total of 3 individuals can enter the vehicle at a time. As mentioned in prior section, the Zbee is capable of transporting two passengers in addition to the driver. Finally the user books a Zbee.

In order to prevent of forgetting the time, this service will provide the user with notifications with the purpose of reminding the user of the booked Zbee as well as giving the user the current state of the vehicle (battery and current range capacity). If the vehicle somehow reaches a condition that may affect the booked trip then the user will know this prior to the booked time and take proper actions accordingly. The user is at any time able to change notification settings that suit their own preferences and at their own risk if the user disables notifications.

**Use Stage** - Supposing that what was booked by the user is available with enough battery to make the two-way-trip, the user firstly accepts (through the mobile application) that the vehicle provided to him/her is of acceptable condition then heads for the physical keys to the Zbee (here an undefined process). Based on the weather condition the user makes the choice to either attach the weather protection doors or not. Further, since the user is responsible for returning the vehicle at acceptable condition and with enough battery for the next user, the user has to make the decision weather or not to bring the charging cable along on the trip and maybe charge the vehicle at some external charing station. During the driving the user has real-time information available on the service mobile application e.g. time left of the booking, Zbee battery level, range capacity etc. User is also provided a map over Zbee position and electric charing station positions. Moreover, the user is able to attempt to find lost physical keys, report problems during trip, record additional expenses from the trip as well as canceling the trip before the end of the booking (assuming the user is at designated parking space). Based on what kind of notification settings the user has set on the application, he/she may receive notification(s) for the purpose of reminding that the booking time soon is over.
**Post-use Stage** - Assuming the user made it back on time, the user is now responsible for putting the vehicle on charging mode as well as returning back the keys and other vehicle accessories that were taken. The user will receive a form asking the user to confirm if proper steps have been taken before leaving the vehicle.

**Interruption Stage** - This stage basically covers all the alternative situations that the user can encounter during the pre-use, use and post-use stages that may lead to the user not being able to access the service or being denied access to the service, which in both cases leads to not being able to use the service (temporarily or lasting). The following scenarios may or may not occur:

- **Technological Issues**: Parts of the service may be under maintenance which may cause disturbances in the usage of the application or may not be accessible temporarily.

- **Human Errors**: Users may forget login information or/and lose vehicles keys which may lead to temporarily denied access to the service or to the vehicle respectively. Further the user may not return the vehicle on time or/and may forget to put the vehicle in charging mode leading to inefficient battery-levels, which both may affect the next user planned booking.

- **User Issues**: Not following the terms of use and conditions. This could for instance be not returning the vehicle back on time without reporting or losing keys and charging cables.

- **Company Decision Making**: Future decision makings may affect if the carsharing service exists or not, or weather investments the service grows in any aspect or not. Further, future decision makings may cause the dismissal of employees which leads them not being authorised to use the service. Moreover, decision-making processes may cause delays that could cause problems for users.

- **Vehicle Issues**: Vehicle maintenance may occur that prevents users from booking the vehicles under maintenance, thus preventing full capacity of the service which may affect the users.

- **Fleet Size Issues**: An unsatisfying low number of vehicles in the fleet may cause periods of overbooking thus hindering the service from satisfying all the users.

- **Schedule Fragmentation**: A fragmented booking schedule of a vehicle may lead to future bookings not fitting in that particular schedule, thus preventing full capacity of the service which may affect the users.

**Resumption Stage** - This is what decides if the loss of access is temporarily or permanently. Instances of the resumption stage can be the updating of passwords by the user or finding a lost key etc.
5.2.4 Service Blueprint

Generating the service blueprint gave more insights in how a CC service should or would work between different companies, and what the necessary components are. Firstly and although evident already in the exploration of the user journey, the smartphone is the most common channel throughout the user actions chosen in the service blueprint. Hence, investing in a highly functional and user friendly user interface would be an effective way to address the needs of the users. Moreover, several backstage interactions were identified that are necessary for a corporate carsharing, especially when dealing with EVs. Lastly, the support processes show that these are both external and internal. The blueprint was recreated in Adobe Illustrator, an illustration tool created by Adobe, for the sake of presenting the result on this thesis, see Figure 5.4.

![Service Blueprint Diagram](https://www.adobe.com/se/)

**Figure 5.4:** The result of the service blueprint session.
5.3 Ideate

This section presents the ideation conducted in this thesis.

5.3.1 Brainstorming Value Proposition

Firstly the Costumer Profile of the Value proposition was mapped out by using the information gathered from the previous sections and knowing what users this service is aiming at (i.e. personas) and what contexts these users are usually in while using this service (i.e. user journey). Secondly, a brainstorming session was held to figure out the second part of the VPC.

5.3.1.1 Costumer (User) Profile

Firstly a typical costumer profile in this context is a user wanting to fulfill his/her mobility needs during work. The user is responsible for arriving to the meetings on time and should therefore be prepared to plan days ahead and make bookings accordingly as well as be prepared to make more instant reservations if business meetings suddenly appear. Based on these various jobs (see Figure for more details) the users might experience or perceive some pains while attempting to reach his/her goals. If the user is driving an EV for instance, than the user might experience range anxiety or and experiencing not knowing how and where to charge the vehicle. Another example is when booking a taxi, the user needs to save the receipts in order to get reimbursed for paying the cab with own money. Moreover this process may take days to complete. Or say the user decides to take the PT, it is raining outside, the user has left the umbrella at the office and as a result is now soaking wet. Even worse, while the user is finally standing in the crowded bus a traffic jam appears, resulting in the user being very late to the meeting. These are some pains, some more extreme and some more casual, identified with users attempting to get their jobs done. Next is what the user wishes to gain when accomplishing the jobs. The user obviously wants to be on time to the meetings as well as make the trip affordable for himself and the company. This was briefly explained, please see depicted Figure for further details on the findings.

5.3.1.2 Value Map

Next came the brainstorming session of firstly defining what products and service are offered and then based on the ideate the pain relievers and gain creators that will meet the needs of the user profile.

Most of the pains were met with offerings that worked as pain-relievers. For instance, range anxiety can be decreased by providing users with real-time battery level information for the user. By traveling with a charging cable the user is able to charge the vehicle when the vehicle is standing thus also decreasing the chances of the vehicle shutting down. Further, concerning the PT waiting time, its multiple stops and situations when the PT stations are far away, the Zbees themselves and their designated parking next to the HQ are the main pain-relievers.
Figure 5.5: The results of the user profile analysis and value map brainstorming.
5.4 Prototyping and Testing
Because the design process chosen created iterations between the prototyping and the testing, the work in both of these will be presented in this section.

5.4.1 First Iteration
First iteration generated a proposed low fidelity prototype which then was tested rapidly on 5 participants. The following findings were gathered through the tests:
- Participants preferred the flat-navigation alternative better than the hamburger menu navigation-wise, mostly because they could easily jump between the different views faster.
- Most of them understood the way the design displayed the vehicle conditions and whether the vehicles were on charging mode or not. One participant mentioned that the battery level percentage would not be of any use if the range capacity is displayed next to it.
- Participants preferred having the dates visible at all times during the searching of vehicles.
- One participant questioned whether having weekend days on the calendar would be of any use if the carsharing service’s objective is to offer transportation during working hours.

Figure 5.6: The low fidelity sketches of two different layouts.
5.4.2 Second Iteration

Based on the feedback of the first iteration, following decisions were made for the upcoming mid-to high fidelity prototype (see Figure 5.7):
- Continue future designs on flat navigation model.
- Redesign the calendar to show the date at all time in the scheduling view as well as make the design of it appear weekly and just show working days.

The testing conducted of this design proposition was made on a total of 5 participants, who gave the following feedback:
- Participants missed the availability to quit a booking early thus letting the vehicle be available for the next user.
- Participants mentioned the battery percentage not being very useful if the user does not know what the corresponding range capacity is.
- Participants found that the timetables were to broad and that it was hard to figure out in detail during what times the vehicle were available.

![Figure 5.7: The high fidelity prototype created in Sketch.](image)
5.4.3 Final Iteration

This section presents the final prototype of this thesis as well as the results of the testing. See the prototypes depicted in Figure 5.8, 5.9, 5.10, 5.11, 5.12, 5.13, 5.14, and 5.15.

5.4.3.1 System Description

The final prototype suggestion is based on four main activities i.e. The Schedule, My Bookings, Profile, and Driving Mode. The user navigates between these by clicking on the respective icons on the toolbar, as well as by clicking on the field above the toolbar to open the Driving mode. The Schedule (see Figure 5.8 & 5.9) is where users book the Zbees. Here the user has a calendar in the navigation bar that initially is minimised to only showing the current weekdays with the current day highlighted in blue. Changing the date can be done by choosing one of the other...
days on the week, or toggling between the weeks by swiping right or left on the navigation bar, as well as by maximising the calendar by either swiping down or pressing the arrow below the week. Next to the calendar on the right upper corner of the user interface is the weather information that shows degrees and condition. On the left side is where the user can access information about rules and how the service works. Below the calendar follow information about the different Zbees displayed in cards i.e. containers containing a few related pieces of information. Firstly, each card represents a Zbee that can be distinguished by name (e.g. Zbee One, Zbee two etc.). Further the cards contain information about availability (i.e. whether the Zbee is currently available or not as well as its availability during the day) and vehicle condition (i.e. what the vehicle's current battery capacity is and what that corresponds to distance wise as well as if the vehicle is in charging mode when in available). Further a horizontal timeline can be viewed and scrolled horizontally for viewing availability of the Zbees different hours. The user books the Zbee by pressing the blue “Book” button. Further action options for each vehicle can be accessed by pressing the three dot button on the right upper corner of each card.

The My booking activity (see Figure 5.10) is where users can view their upcoming bookings as well as their sustainable footprint based on the users prior usage of the service. Even here the user has weather information in the navigation bar together with the help/information accessible from the left corner "i" sign. Upcoming bookings can have the most important information about when as well as real-time information about the capacity of the vehicle. User can cancel or/and change the bookings by using the different buttons.

The driving mode activity (see Figure 5.11 & 5.12) has the objective to lead the user through the traveling by offering usable functions. Firstly it shows what Zbee is booked by displaying the name in the navigation bar. Following section shows the remaining time of the booking, followed by a map showing where the Zbee is located at all time during the booking as well as available charging stations throughout the city. Next, again the current vehicle condition is displayed both in battery capacity and range capacity. Further, three buttons are displayed for different functions, enabling the user to find lost keys, add expenses from the trip and report problems. Lastly text is displayed at the bottom to inform the user that canceling only works when the vehicle has been returned to the designated parking station. When the user is there, he or she can cancel (button will appear) (see Figure 5.12).

Last activity in the toolbar is the Profile (see Figure 5.13). Here the user finds important account information and personal information. Other important functions such as changing password can be found here. On the right upper corner the user can find the application settings (see Figure 5.14). Here the user can change the different settings including notifications.

Another view was designed to test the booking process. The booking view (see Figure 5.15) shows how the booking is set and confirmed by the users. For instance, the users has an overview timeline of bookings made during the day while at the same time information on where his/her booking is about to get set. Moreover, here it is assumed that the booking is payed by automatically sending the bill to the users company, but this process is not defined in this design proposition.
When the upcoming booking comes and the vehicle is provided to the user, the user has to accept the condition of the vehicle (see Figure 5.16). When the user returns from the trip the user has to again confirm that proper actions have been taken before returning the vehicle (see Figure 5.17).

![Figure 5.10: View over upcoming bookings.](image)
Figure 5.11: The driving mode. Here the user is not within the designated parking station, and is therefore not able to cancel the booking before the booking is over.

Figure 5.12: The canceling will appear when the user or more specifically the vehicle is within the designated parking station.
Figure 5.13: The profile view

Figure 5.14: Settings view.
**Figure 5.15:** UI showing booking process

**Figure 5.16:** The user has to confirm the provided vehicles condition.

**Figure 5.17:** The user has to confirm that rules are followed.
4.3.3.2 Testing the Final Prototype

The final prototype was tested on a total of 5 participants by just using the questions and guide in Appendix C. The overall feedback from the participants were good and the user understood the concept and the tasks given to them.

Some interesting feedback from this session were:
- Participants liked the fast access to the different tasks by using the toolbar in the bottom.
- Participants understood the real-time information presented overall in the different views.

The third and last testing also included the SUS questions given to the participants. The answers received from the participants, which can be viewed in Appendix C, were calculated by following the scoring SUS guide by Brock [61]. Accordingly, the answers resulted in the scores: 77.5, 92.5, 90, 87.5 and 72.5. Thus this giving a mean-value of 84 and a median of 87.5. All these scores lay above 70 which suggests high usability [62].
CHAPTER SIX

Discussion

The literature study has provided material corresponding to a broad range of knowledge, touching multiple areas and components that are to be taken into consideration when designing for a service that is based on the concept of SE. Where the limit goes on presenting literature is undefined and thus other areas that are equally important might have been left out. For instance, because the vehicle is one of the central products offered to be shared in a carsharing service and thus playing an essential role in the UX of the carsharing, one might think of adding literature about the UX in vehicles. In that context, this work chose to instead conduct interviews on individuals with experience in driving Zbees as well as surveying what vehicles attributes that are consider important for satisfying travel needs (see Appendix B). Further, although a lot of studies were found on carsharing in general, there were a limited amount of them based on CC in the context of deploying EVs or LEVs.

Going further, the interviews and expert interviews conducted gave valuable insight knowledge that has been used throughout this thesis and shaped the resulting design proposition. Based on the insights from these interviews and the work in defining the users and their journeys, following prospective user mobility needs can be concluded:

- The users have distinct and individual mobility needs at work.
- The mobility needs are directly influenced by the activity that are required of the user (e.g. business meetings) outside of the office during working hours and indirectly by their job occupations.
- The mobility needs are also highly influenced by activities before and after working hours i.e. activities during leisure time, as well as by the distance between work and home.

Furthermore, the insights from the interviews show that users require the following from a CC service:

- Undertake responsibility for providing availability and reliability: Users want to be insured that what has been booked will be provided to them with enough capacity for them to take the planned two-way trip.
- Provide good user experience throughout the process of using the service.
- Clearly state the rules of the service and the consequences of not following the rules.
- Explain how the service works.
- Provide with functions that alleviates the burden of remembering bookings and endings of bookings.

The expert interviews concerning the Zbee gave important insight on the vehicles anatomy, limits, performance etc. The Zbee is a thrifty and environmental friendly LEV that provides drivers and passengers a fun experience. Nevertheless, having Zbees deploy the fleet of a corporate carsharing service may impose challenges based on the context. First and foremost, the limited range by the capacity of their battery not only does not allow for longer drives, but it also might cause unexperienced users to experience range anxiety. Moreover it has a direct affect on the availability offered by the carsharing service. Second, the limited speed capacity, could lead to the creation of queues on the road behind the driver which in turn might cause users feeling uncomfortable. Although these limits may be true, one should reflect on why the Zbee is used in the first place. Driving longer distances in a LEV might not be a comfortable journey for the driver and passengers involved. Therefore the vehicle is mostly suited for shorter trips and thus a great option for urban driving. Another factor proving the vehicle to be a great companion in urban areas is its practicality considering its small and compact size.

Because the smartphone would be one of the most common way for prospective users to interact with the carsharing service (based on the literature studies, user journey and service blueprint), it was decided that this thesis would present a design proposition in the format of a mobile application in order to visualise how the service would work. Notice, the proposed design is not intended for a specific operative system and the purpose of it is just showing functionality and interaction design intended for use when interacting with the carsharing service. Eventually the design proposition showed, based on the the findings of this thesis, that the following functionality should be provided for a Zbee based CC service:
• **Provide real-time information about every vehicle in the fleet** - Firstly this means distinguishing the different Zbees by name or colours and secondly, present the real time information in an intuitive way. Here the application should present each vehicles current capacity and their availability throughout the day previously chosen by the user. This gives the user a chance to plan ahead while also in advance know if the vehicle booked will be available on time.

• **Provide functions that makes it difficult for users to make mistakes** - Forgetting to put the vehicle on charging mode or to cancel a booking on time leads to an inefficient use of the service which effects all other users. Therefore make it hard for users to forget by providing functions enabling finding of belongings (e.g. the Zbee physical keys), or that reminds the user of actions to be taken, rules and/or upcoming bookings. Further this alleviates the work of the fleet management.

• **Provide relevant and useful, information and functions during driving** - Help the user during their trips by providing real-time information about the Zbee. Further, clearly present functions that are useful during trips such as reporting problems, finding a lost key, or/and recording expenses. Further remind the user of the remaining time as well as provide with navigational real-information for guidance.

• **Provide data that encourages the use of the service (gamification)** - In order to encourage more frequent use of the service, provide statistical data on usage and its equivalent sustainable footprint.

• **Provide with clear information about the terms of use** - Make rules and terms of use accessible at all times in order to reduce possible misconceptions.

• **Provide with information on how the service works** - Provide with guidelines on how the service is to be used. Make these guidelines available at all times.

These guidelines provided above are possible by incorporating ICT into the service/product and having an active fleet management that contributes to a good UX.

### 6.1 Limitations

This thesis was conducted on limited amount of time, which has lead to a limited amount of testings, limited time for further user investigation and. Further the testing environment did not always resemble the environment of real-life use, which may have lead to different outcomes. For instance, one might have used used a mobile device to test the prototypes with instead of a laptop (MacBook Pro).
6.2 Future Work

Future work should develop and test a prototype closer to a finished product in order to gain further insight on how such a service would work in real-life situations. Would the real-time information be enough to increase vehicle availability? Further, how big should a fleet be to satisfy the employers at Vinngroup or any working place in general? Are there any other issues that has not been looked upon in this work? Future work on the development of battery capacity on EVs and LEVs might decrease the range problems of these vehicles and make them even more suitable for fleets in carsharing services. Furthermore future work should focus on whether this kind of service is suitable for use outside of urban areas. How should such a service be designed?
CHAPTER SEVEN

Conclusion

This thesis has investigated, evaluate and designed for a prospective Zbee driven corporate carsharing service within an urban area and with a centrally located base. It has mapped all the possible phases a user could encounter in such a service as well as their resulted user experience. Users of such a service, it was found, have mobility needs during work that depends on activity outside of the office during working hours. Job positions play a role in this equation. Moreover, their mobility needs will also affect the way they book transportation ahead of time.

Because it is assumed that this corporate carsharing service only will be deploying light electric vehicles in its fleet, users whom do not have prior experience to driving this kind of vehicles have been found to develop range anxiety. This calls for information that guides the user during the while process from booking the vehicle to returning the vehicle back at its place.

Because the smartphone is the most used channels in order to use this kind of services according to findings, this thesis proposed a design for a mobile application that would be used by its prospective users. After three iterations of prototyping and testing, the final design proposition was given SUS scores around 80 which says the usability of the prototype tested is very high.
References


Appendix A

Theoretical Illustrations

Figure A1: Classified technologies and relation of devices.[55]
Figure A2: Detailed Fleet Management Architecture [59].
Appendix B

Interviews

B.1 Interview Questions

Background and Demographic Information
Following questions were asked in order to gain insights on background and demographic information:
1. What kind of position do you hold in your company?
2. How old are you?
3. Do you hold a drivers license?
4. Do you own a car?
5. What is the distance between your home and office?
6. How do you get to work?
7. How often (in a week) do you leave the office for external business errands?
8. What kind of transportation do you usually choose to get to business errands?
9. How often (in a week) do you leave the office for external personal errands?
10. What kind of transportation do you usually choose to get to personal errands?
11. Do you have prior experiences to driving EVs?
12. Do you have prior experience in Sharing economy?
13. Ever driven or know of the vehicle Zbee?

Driving Experience and Preference
Following questions were asked in order to gain insights of users perception on the choice of vehicles in such a service, the participants were asked to rate following vehicle aspects based on a likert scale from 1 being "not important" to 5 being "very important":

1. Status encouragement
2. Environmental friendliness
3. Comfortability (e.g. ergonomics, heat etc.)
4. Safety
5. Efficiency (e.g. Speed capacity)
6. Affordability
7. Vehicle size (space)
8. Internal technology (e.g. parking sensors, bluetooth etc.)
9. Connectivity (e.g. GPS, use smartphone to open vehicle etc.)
Carsharing Attributes

Based on knowledge gained from the theory, questions were designed in order to see what prospective users value in a corporate carsharing service. Participants were asked to rate the attributes on a likert scale from 1 being "not important/usable" to 5 being "very important/usable". The following attributes were mentioned:

1. Enabling bookings through different devices.
2. Having key-less accessing for the vehicles.
3. User responsibilities
4. Availability

Corporate Carsharing with Zbees

Lastly two questions were designed to specifically touch on a corporate carsharing service with Zbees:

1. If a similar carsharing service would be implemented within Vinngroup, how important are the following aspects in such a service in order to satisfy you experience: i) the possibility to make bookings from different devices; ii) the possibility of making one-way trips; iii) the possibility of start/open the vehicle without any physical keys;
2. Is there anything else that would satisfy you transportation needs?

B.2 Expert Interview Questions

The following questions were asked in the expert interviews:

1. What was the purpose of driving the vehicle?
2. How often did you drive? Where did you usually drive with the vehicle?
3. Is the vehicle appropriate in all weather conditions?
4. Is the vehicle appropriate for driving urban environments?
5. Did you feel safe, while driving the vehicle?
6. Could you rely on it to take you from A to B?
7. Did you ever feel anxious about the limited battery capacity?
8. Is the vehicle easy to learn manoeuvring and using overall?
9. Is the vehicle easy to maintain?
10. Did you get any reactions from fellow road travellers?
11. Do you have any other thoughts about the vehicle?
## B.3 Interview Results

### Background and Demographic Information

### Background Information Table

<table>
<thead>
<tr>
<th>Participant</th>
<th>Position</th>
<th>Age Group</th>
<th>Drivers license</th>
<th>Car owner</th>
<th>Distance to Office (km)</th>
<th>Transportation means (Home to Office)</th>
<th>Business errands / week</th>
<th>Transportation means (Business)</th>
<th>Personal errands / week</th>
<th>Transportation means (Personal errands)</th>
<th>Prior Carsharing experience</th>
<th>Prior UV experience</th>
<th>Prior Sharing Economy experience</th>
<th>Know of / driven a Drone?</th>
<th>Comments from participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Employee</td>
<td>30-40</td>
<td>Yes</td>
<td>No</td>
<td>15 km</td>
<td>Walk</td>
<td>5 times</td>
<td>1 times</td>
<td>Public transport.</td>
<td>3</td>
<td>Yes [Surface]</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>(Car ownership): &quot;I was considering buying a car but</td>
</tr>
<tr>
<td>2 Employee</td>
<td>30-40</td>
<td>No</td>
<td>Yes (Bike)</td>
<td>10 - 15 km</td>
<td>Public transport</td>
<td>1 times</td>
<td>1 times</td>
<td>Public transport.</td>
<td>1</td>
<td>Yes [Surface]</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>&quot;Since our office is located on central,</td>
</tr>
<tr>
<td>3 Employee</td>
<td>30-40</td>
<td>No</td>
<td>Yes (Bike)</td>
<td>10 - 15 km</td>
<td>Public transport</td>
<td>1 times</td>
<td>1 times</td>
<td>Public transport.</td>
<td>1</td>
<td>Yes [Surface]</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>&quot;I usually use my own car for personal errands, but it's too big to drive in the city.&quot;</td>
</tr>
<tr>
<td>4 Employee</td>
<td>18-29</td>
<td>Yes</td>
<td>No</td>
<td>10 - 15 km</td>
<td>Public transport</td>
<td>1 times</td>
<td>1 times</td>
<td>Public transport.</td>
<td>1</td>
<td>Yes [Surface]</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>&quot;The only time I actually drive a car is when I visit family back home. Then I borrow the car from a friend.&quot;</td>
</tr>
<tr>
<td>5 Employee</td>
<td>18-29</td>
<td>Yes</td>
<td>No</td>
<td>1.5 km</td>
<td>Public transport</td>
<td>1 times</td>
<td>1 times</td>
<td>Public transport.</td>
<td>1</td>
<td>Yes [Surface]</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>&quot;I usually walk to work.&quot;</td>
</tr>
<tr>
<td>6 Manager</td>
<td>30-40</td>
<td>Yes (Bike)</td>
<td>Yes (Private)</td>
<td>1.5 km</td>
<td>Bike / Private car</td>
<td>1 times</td>
<td>1 times</td>
<td>Private car / Public transport</td>
<td>1</td>
<td>Yes [Surface]</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>&quot;I choose my own car as a transportation mean to work and to meetings is because I need it throughout the day and therefore I find it convenient.&quot;</td>
</tr>
<tr>
<td>7 Manager</td>
<td>30-40</td>
<td>Yes (Bike)</td>
<td>Yes (Private)</td>
<td>10-15km</td>
<td>Private car</td>
<td>3 times</td>
<td>3 times</td>
<td>Private car / Public transport</td>
<td>3</td>
<td>Yes [Surface]</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>&quot;I have my private car mainly because I have to get to the station after work.&quot;</td>
</tr>
<tr>
<td>8 Manager</td>
<td>30-40</td>
<td>Yes (Bike)</td>
<td>Yes (Private)</td>
<td>15 km</td>
<td>Private car</td>
<td>3 times</td>
<td>3 times</td>
<td>Private car / Public transport</td>
<td>3</td>
<td>Yes [Surface]</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>&quot;My car is too big to be driving in cities, I would appreciate a service that could offer vehicles that are suitable for driving in urban areas.&quot;</td>
</tr>
<tr>
<td>9 Manager</td>
<td>30-40</td>
<td>Yes (Bike)</td>
<td>Yes (Private)</td>
<td>10-15km</td>
<td>Private car</td>
<td>3 times</td>
<td>3 times</td>
<td>Private car / Public transport</td>
<td>3</td>
<td>Yes [Surface]</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>&quot;I've been lending my car to colleagues when I have not been using it for meetings. (Dress) very practical to drive around in the city, and fast.&quot;</td>
</tr>
<tr>
<td>10 Manager</td>
<td>30-40</td>
<td>Yes (Bike)</td>
<td>Yes (Private)</td>
<td>15 km</td>
<td>Private car</td>
<td>3 times</td>
<td>3 times</td>
<td>Private car / Public transport</td>
<td>3</td>
<td>Yes [Surface]</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>&quot;I never need a car personally, everything is so close to home. For longer trips when I choose the PT.&quot;</td>
</tr>
<tr>
<td>11 Employee</td>
<td>18-29</td>
<td>Yes</td>
<td>No</td>
<td>20 km</td>
<td>Walk</td>
<td>2 times</td>
<td>2 times</td>
<td>Public transport.</td>
<td>2</td>
<td>Yes [Surface]</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>&quot;I usually walk to work rather than changing the PT. Sometimes can take more time with all the delays.&quot;</td>
</tr>
</tbody>
</table>

Figure B1: Results of interviews regarding background information.
Driving Experience and Preference

Figure B2: Feedback from the second part of the interviews.
Carsharing Attributes

[ CCS SERVICE ]: How important are the following functions & attributes in a CCS service to satisfy your needs in business related trips?

<table>
<thead>
<tr>
<th>Attributes &amp; Functions</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Comments from participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Booking through different devices</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Key-less accessing</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>6</td>
<td>5</td>
<td>&quot;I think key-less accessing is really important for me as a potential user. The whole process would not be as smooth if I have to pick up and leave physical keys every time I book a vehicle&quot;</td>
</tr>
<tr>
<td>Offer one-way trips</td>
<td>3</td>
<td>7</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>&quot;Would be incredible, but I reckon it would be an expensive solution&quot;</td>
</tr>
<tr>
<td>User Responsibility</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Availability</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>12</td>
<td></td>
</tr>
</tbody>
</table>

Figure B3: Third part.
# Zbee based Corporate Carsharing

<table>
<thead>
<tr>
<th>Participant</th>
<th>Would such a service be relevant to you?</th>
<th>What would encourage you to choose to use this service over your usual way of transportation means at your work errands?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>“Yes I can save myself using it, especially if its overall easy to use”</td>
<td>“One thing that I really don’t like with taking a taxi is the long process of getting refunded for the trip. I have to remember saving the receipts and it takes 2-3 working days to get my money back. Another thing that would encourage me to use it if I would receive information of how much I have contributed to energy-saving and sustainability, I think that would make me wanna choose this service even more”</td>
</tr>
<tr>
<td>2</td>
<td>“I personally don’t have a lot of business errands outside of the office so maybe not a regular user but I would definitely try it.”</td>
<td>“Sustainability is important to me so that would encourage me to choose the service, but I think usability would definitely be the biggest factor if I would consider using it. It has to be easy to use all around, no complicated situations.”</td>
</tr>
<tr>
<td>3</td>
<td>“Yes I would use it to meetings”</td>
<td>“If cars were available”</td>
</tr>
<tr>
<td>4</td>
<td>“Would not be a regular user since I have so few meetings”</td>
<td>“Easy to book, drive and feel secure in it”</td>
</tr>
<tr>
<td>5</td>
<td>“I generally don’t like driving in big cities, so I would probably not use it as much. Also, I don’t think I need it since I have so few meetings.”</td>
<td>“I would be encourage to use it if it is easy to book, park and return!!”</td>
</tr>
<tr>
<td>6</td>
<td>“Yes, I would definitely think this service would be useful for trips within 15km range, and I can see myself using it.”</td>
<td>“My biggest concern is if this vehicle is suitable for driving in different seasons. I recently bought an electric bike but don’t use it in winter. So solving that problem would encourage me to choose this service over my usual taxi ride.”</td>
</tr>
<tr>
<td>7</td>
<td>“I doubt it. Me and my company would not be the target group. This because the majority of us drive our own cars to work, and I think car owners prefer their own car over other vehicles. Another thing is that most of our customers are located outside of central Guthenbacg which I think would be far away to make a trip with a zbee comfortable or even safe. I’m also not keen on it.”</td>
<td>“If I had to use this service, then I see availability as the most important question. I have to be able to trust that this service will get me from A to B without worry”</td>
</tr>
<tr>
<td>8</td>
<td>“Yes, I would be interested.”</td>
<td>“I don’t plan months ahead, so I wanna be sure that I can rely on the service. I expect available vehicles, fully charged and serviced that would secure that I can get where I wanna go and proceed the day as I do today. I like that the Z bees are environmental friendly and that would encourage me to use it as well as to show our partners that our company strives for a sustainable environment”</td>
</tr>
<tr>
<td>9</td>
<td>“Yes, I would definitely use this service”</td>
<td>“My car is pretty big and not really suitable or sustainable for urban driving. I think this service would encourage me to use it since it sustainable and practical for driving in dense areas”</td>
</tr>
<tr>
<td>10</td>
<td>“Yes, it would be a practical solution for many of my meetings.”</td>
<td>“Firstly the service has to offer an easy way to book the vehicles. I also feel there should be clear rules of how long you can keep a vehicle peer booking. If I use it for a while and then return it to the office, will it still be available for the next user or does it have to be recharged. This I think plays a major role on whether I would use this service. Of course the financial aspect is also important”</td>
</tr>
<tr>
<td>11</td>
<td>“I’d rather take a walk if my meetings are close enough. For longer trips I prefer my own car.”</td>
<td>“I need my own car throughout the days anyways so this wouldn’t change my habitat”</td>
</tr>
<tr>
<td>12</td>
<td>“Yes, if it takes me faster from A to B”</td>
<td>“It has to be easy to use and affordable. Service should provide clear instructions on how to book the vehicles, how long I can keep one peer booking, how to maintain the vehicle (for instance how and where to change oil). One problem that we so often encounter when booking the conference rooms in our office headquarters, is forgetting when the booking time has passed. This results in frustration for the person who has booked the room after you and he/she has to knock on the door to remind the ones sitting in the room that the time is over. Reliability is also important, will there be enough vehicles available for me to trust that there is a vehicle there when I book it and can I trust that it will take me to my destination.”</td>
</tr>
<tr>
<td>13</td>
<td>“Yes I would be interested”</td>
<td>“A good user experience throughout the process would definitely encourage me to choose this service. Everything from booking, to accessing, to reporting problems and invoice. I would also like a comfortable solution when driving in rain or snow.”</td>
</tr>
<tr>
<td>14</td>
<td>“I definitely think I would use it. Much depends on how the policies look like for the usage.”</td>
<td>“I would like to know the rules of this service. It should not complicate things. If these criterias are met then it is definitely something I would use”</td>
</tr>
<tr>
<td>15</td>
<td>“If its a car available at any time outside the office and its even sustainable and fun to drive then of course I would chose to use it.”</td>
<td>“Clear information on how the service works and easy to use. The sustainable friendliness of the car is definitely a big plus but if its too complicated then walking works fine.”</td>
</tr>
</tbody>
</table>

Figure B4: Results of interviews regarding background information.
Appendix C

Tests

C.1 Low Fidelity Prototype Test
Following tasks were included in the tests of the lo-fi prototypes:
• Explain what you perceive about each view.
• How do you navigate through the app?
• Can you see what vehicles are provided?
• Which vehicle would be the best choice to book right now?
• What is your overall opinion about this app?
• Is there anything missing?
Lastly the participants were asked to choose between the two design proposals.

C.2 High Fidelity & Interactive Tests

Introduction
The participants were given the following introduction (in Swedish):

“Your company has access to a carsharing service, shared with the other affiliates in Vinngroup. The carsharing service has Zbees, a moped-classified electric vehicle with a maximum speed capacity of 45km/h and maximum range of 50 kilometers when fully charged. The service offers bookings from multiple devices and this is a mobile application prototype that I’m about to show you.”

Moreover, Figure B1 was shown while the introduction was given.

Figure C1: Picture shown while giving the introduction.
Scenario
The following scenario was given to the participants prior to asking them to perform any tasks:

“You have a business meeting taking place in about 1 hour and you chose to use the corporate carsharing service to get there. Today is the 7th of December and the meeting takes place 10 kilometers from the office. Did that make sense?

Tasks
Following tasks were asked for the participants to be performed:
1. How would you find out how the service works and what rules there are to apply?
2. Based on the scenario you heard, How would you go through with booking a Zbee? Tell which Zbee you would chose and why?
3. The Zbees do not have doors thus the weather can play a huge role. Do you get any information regarding the weather?
4. If the meeting was to take place next week, how would you go through with booking a Zbee then?
5. How do you go by to find out the bookings you have already made?
6. You decide to book Zbee number one, how would you proceed to book the vehicle?
7. Your Zbee is wanting, you grab the physical keys at the reception and go start the car. The mobile application has a driving view. Can you find it?
8. What kind of information do you get in this view (driving view)? (Explain)
9. How would you disable the notifications of upcoming bookings?
C.3 System Usability Scale (SUS)
The following figure was printed out and given to the participants of the third test conducted (see Figure below).

Figure C2: The System Usability Scale likert questions given to participants in the third iteration.[61]
C.4 Results from SUS

1. I think that I would like to use this system frequently

2. I found the system unnecessarily complex

3. I thought the system was easy to use

4. I think that I would need the support of a technical person to be able to use this system

5. I found the various functions in this system were well integrated

6. I thought there was too much inconsistency in this system
7. I would imagine that most people would learn to use this system very quickly.

8. I found the system very cumbersome to use.

9. I felt very confident using the system.

10. I needed to learn a lot of things before I could get going with this system.