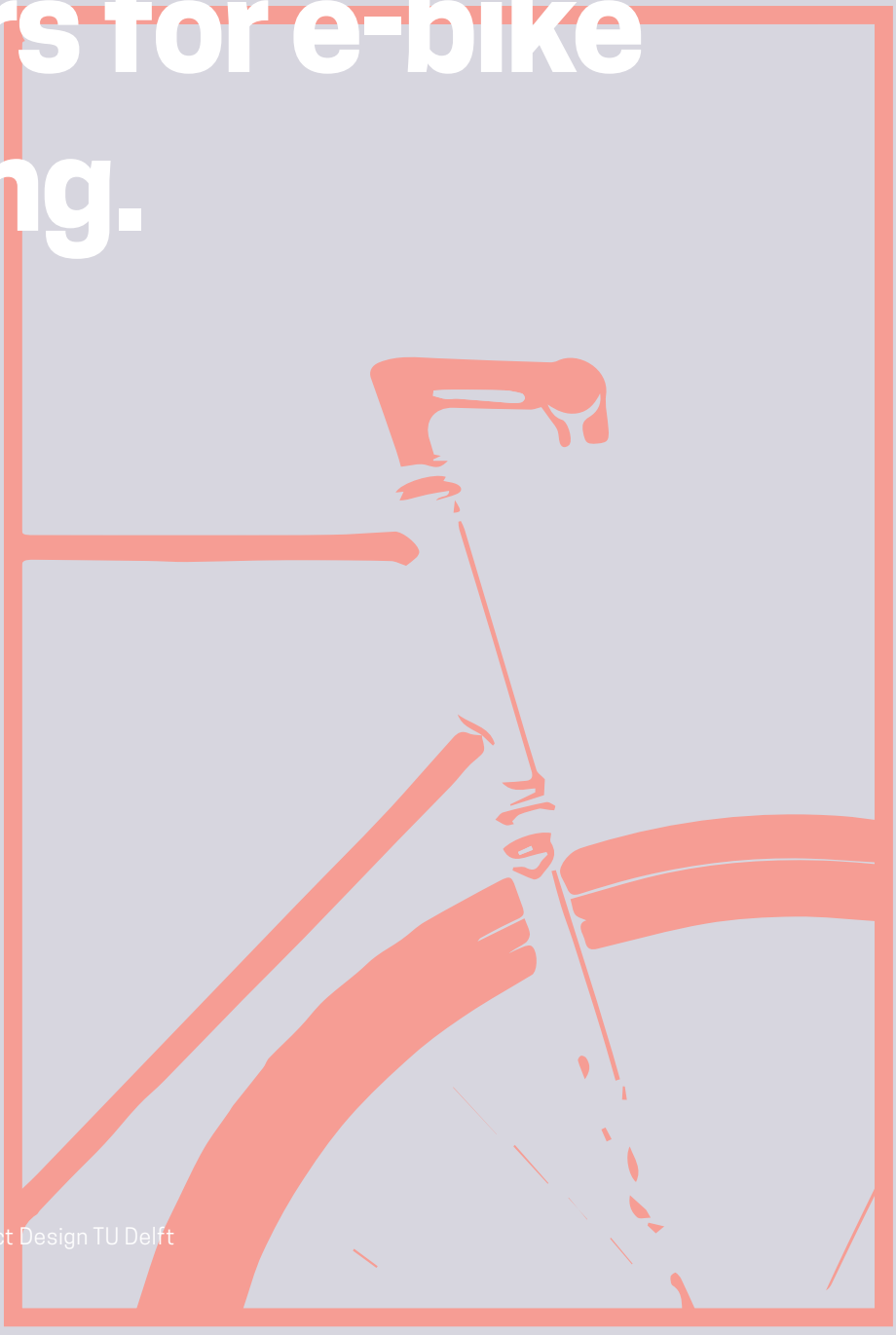
Product-service system adoption: motivational drivers for e-bike sharing.



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Product-service system adoption: motivational drivers for e-bike sharing.
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Executive summary

The global environmental issues are becoming more and more pressing. These issues ask for not only changes on a product-level but also on a system-level (Ceshin, 2013). One of the potential solutions can be to facilitate more sustainable consumption. Sustainable consumption patterns can potentially be created by product-service systems (PSSs). PSSs enable “sale-of-use” instead of “sale-of-product” so these systems satisfy consumers through the delivery of functions instead of products.

Unfortunately, the adoption of PSSs is still limited. Because PSSs are often radical innovations, they challenge existing consumers’ habits (cultural barriers), companies’ organizations (corporate barriers) and regulative frameworks (regulative barriers) (UNEP, 2002; Mont, 2002; Tukker and Tischner, 2006). In combination with that in literature little attention is committed to understand how the process of diffusion takes place (Tukker and Tischner, 2006; Baines et al., 2007). Additionally, there is a shortage of empirical studies focusing on the consumers’ perspective (Mont and Plepys, 2003). Therefore, the purpose of this thesis is to find consumer’s motivational factors, by studying three PSS cases. The PSS cases are bike-sharing systems (BSSs): OV-fiets, Swapfiets and Mobike. The findings support a deeper understanding and stimulation of PSS adoption.

The research is carried out in a qualitative manner, eight semi-structured interviews with experts (who work at the analysed BSSs) and consumers (who uses two or more of the analysed BSSs) are conducted. The gathered data is analysed with the grounded theory (Charmaz, 2007) and diffusion of innovation (DOI) theory (Rogers, 2003). This resulted in twenty-four motivational factors categorized by Rogers (2003) five innovation attributes: relative advantage, compatibility, complexity, trialability, and observability. An overview can be found in Table 7 on page 51.

The research results indicate motivational drivers for consumers which can potentially increase the rate of adoption of BSSs. A new concept is created to illustrate possible design solutions to strengthen a selection of the consumer’s motivational factors. Additionally, the new concept demonstrates a promising future-oriented scenario for electrical BSSs. The new concept: Breeze aims to postpone or replace car ownership.

To conclude, the findings raised in this thesis provide a deeper understanding of the consumers’ perspective on BSSs. The findings suggest what factors are more important to stimulate the rate of adoption. For future research, it is a useful base for a quantitative study to validate consumer’s motivational drivers to use a BSS in the Netherlands. The research findings are also a useful source for a more in-depth research about mobility PSSs in general.

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Figure 1. World's population and thereby consumption levels are still increasing

1. Introduction

The last years, global environmental issues are becoming more pressing. These issues ask for a system change, meaning a radical change in current structures of production and consumption is needed (Ceshin, 2013). The world's population and thereby consumption levels are still increasing (Mont, 2002). Given the size of the required change it is evident that innovations on a process and product-level, despite of this being fundamental and necessary, are not alone enough to achieve the radical change. In other words, if we want to effectively work on sustainability the focus on product-level has to broaden towards a wider systemic approach.

Correspondingly, as proposed by Stahel (1986), to move away from an industrial economy, in which the key value is based on the exchange of products to be consumed and in which the growth is heavily connected to resource consumption, to a functional economy, in which products are mere means of providing functions. In a functional economy the consumer is satisfied through the transfer of functions (e.g., mobility; light; printed reports) instead of products (e.g., cars; light bulbs; printers).

With this in mind various researchers mention the concept Product-Service System (PSS) innovation as a promising business model (Goedkoop et al., 1999; UNEP, 2002; Mont, 2004; Tukker and Tischner, 2006; Baines et al., 2007). Mont (2002) defines a PSS as *"a system of products, services, supporting networks, and infrastructure that is designed to be: competitive, satisfy consumer needs and have a lower environmental impact than traditional business models."* A PSS is not a new business model: multiple examples of PSSs have actually been realized in the last decades by diverse companies (Goedkoop et al., 1999; UNEP, 2002; Mont, 2004; Vezzoli, 2010). In essence, a PSS can potentially separate economic value from material and energy consumption (Mont, 2002; Manzini and Vezzoli, 2003; Tukker and Tischner, 2006).

This potential is further explored in research projects concerning PSSs lowering the environmental impact this have been supported by EU funding (Ceshin, 2013). However, despite all the knowledge gathered, it has to be emphasized that the implementation of this concept is still very limited. Because PSSs are often radical innovations, they challenge existing consumers' habits (cultural barriers), companies' organizations (corporate barriers) and regulative frameworks (regulative barriers) (UNEP, 2002; Mont, 2002; Tukker and Tischner, 2006).

The concept of PSS has been debated in the literature for over a decade, however not much attention has been committed to understand how the process of the diffusion takes place (Tukker and Tischner, 2006; Baines et al., 2007). In addition, there is a demand for research regarding the relation between consumers and PSSs (Halme et al., 2004; Mont, 2004; Tukker and Tischner, 2006; Williams, 2007). The potential for PSS on B2C markets has been widely discussed, however there is a shortage of empirical studies focusing on the consumers' perspective (Mont and Plepys, 2003). Coupled with, PSS discussions often concern environmental or commercial consequences of PSS, rather than how they may be beneficial to individual consumers. This thesis intends to be a contribution to fill this gap. In particular, this thesis analyses three PSS cases, three bike-sharing systems (BSSs) in the Netherlands: OV-fiets, Swapfiets and Mobike. In order to find the motivational factors which contribute to user acceptance and innovation diffusion of such innovations applying the diffusion of innovation (DOI) theory of Rogers (2003). The main research question to be answered is:

What factors motivate consumers to use a bike-sharing system in the Netherlands?

In order to answer the main research question this thesis begins with an exploration of the evolution of BSSs and explains the analysed PSS cases. Next, the research topic PSS is further deepened pointing out acceptance factors and barriers of the adoption of PSS. Hereafter, the framework of Rogers (2003) part of the DOI theory is described this supports analysing the rate of adoption of the analysed cases. The method section explains the qualitative research steps followed up with the results pointing out factors that motivate consumers to use BSSs. Hereafter, a design goal is created striving to design a new, optimised BSS in a consumer-centred manner: including the found motivational drivers. The new concept illustrates a promising future scenario and shows design solutions to strengthen the motivational factors. This concept is evaluated in a qualitative manner. Finally, limitations, future research directions and conclusions are presented.

Figure 2 White bikes: first bike-sharing system started in Amsterdam 1965

2. Bike-sharing systems

Chapter two gives a practical background about bike-sharing systems (BSSs), describing the evolution of its four generations. Learnings are summarized abstracted from academic research. Finally, the analysed BSS-cases in the Netherlands are described and compared to each other.

2.1. The evolution of bike-sharing systems

BSSs exist already for almost 50 years, although the last decade has seen a sharp increase in both widespread presence and popularity worldwide. Plus, worldwide bicycle use has generally increased during the past 30 years (Shaheen et al., 2010). The bike-sharing evolution has been categorized into four key phases also known as bike-sharing generations, see Table 1 for the overview.

1. White bikes (or free bike systems): first bike-sharing generation

In July 1965, the Provos (derived from the Dutch 'provoceren' which means to provoke) which was an organisation heavily involved with environmental issues released its White Bike Plan in Amsterdam. This plan was seen as the solution to traffic problems in Amsterdam's inner city. Fifty bicycles were painted white, left permanently unlocked, and placed throughout the inner city for the public to use freely. These bikes were often stolen or damaged and therefore the White Bike Plan failed soon after its launch.

Despite the short lifespan of the first shared bikes, the concept spread in Europe and led to the first generation of bike sharing. Distinguishing characteristics are, the bicycle usually painted in one bright colour, unlocked and placed randomly throughout an area for free use (Shaheen et al., 2010).

2. Coin-deposit systems: second bike-sharing generation

The second generation of bike-sharing started in January 1995. Bycyklen (City Bike) was launched in Copenhagen, Denmark as the first large-scale urban bike-sharing program in Europe. The program included 1.100 especially designed bicycles that were locked and placed throughout Copenhagen at allocated city bike racks. Bicycles were unlocked wit 20 DKK (Danish krone) coin deposit (€2,68) that was refunded on bicycle return. Bycycklen of Copenhagen is still active.

The main characteristics of this generation are (a) distinguishable bicycles (usually by colour and special design), (b) allocated docking stations in which bikes can be locked, borrowed and returned, and (c) small deposits to unlock the bikes. The second-generation systems are more expensive to run compared to the first generation. In many cases, local governments supported bike-sharing organizations with funding (Shaheen et al., 2010).

Shortcomings of the coin-deposit systems are having no time limit of use which resulted that these bikes are often used for a long time or not returned at all. A big problem is bicycle theft due to the consumer anonymity. Although bike-sharing started as a manner to lower motor vehicle use, Bonnette (2007) indicates that *"both the first and second generation bike-sharing schemes*

provided welcome opportunities to cycle but did not provide adequate enough support nor reliable service to alter motorized transportation choices and influence people to make significant changes."

3. Information technology (IT) based systems: third bike-sharing generation

The third-generation systems integrate advanced technologies for bicycle reservations, pick-up, drop-off, and information tracking. The four main components of third-generation bike-sharing programs are (a) distinguishable bicycles (either by colour, special design, or advertisement); (b) docking stations; (c) kiosk or user interface technology for check-in and checkout; and (d) advanced technology (e.g., magnetic striped card, smartcards). The information technology decreases the bike theft; this was a major shortcoming of the previous two generations (ibid.).

4. Demand-responsive systems: fourth bike-sharing generation

Currently, the fourth-generation BSSs is emerging which is typed as demand-responsive, multimodal systems. Building on the third-generation it emphasizes (a) flexible, clean docking stations, (b) bicycle redistribution innovations, (c) smartcard integration with other transportation modes, such as public transport and car-sharing, (d) technological advances including GPS tracking, touch screen kiosks, and electric bikes, see Table 1 for an overview of the four different generations of bike-sharing systems (ibid.).

2.2. Bike-sharing system's global learnings

Bike-sharing programs have been operating in Europe, America and Asia (limited to only third-generation systems). From the evolution in the past fifty years five key lessons can be found considering: (1) bicycle theft and vandalism; (2) bicycle redistribution, (3) information systems; (4) insurance and liability considerations; and (5) pre-launch considerations (Shaheen et al., 2010).

1. BSSs are sensitive to bicycle theft and vandalism

From the start, bike-sharing programs found out that user anonymity created a system that was sensitive to bicycle theft. Smartcards (third-generation) document personal details as well as bike usage (e.g., time, duration, location, kilometres). This improvement solved previous issues of user anonymity and facilitated bicycle tracking, which reduced bicycle theft and vandalism.

Regardless of these innovations, Vélib' (the biggest bike-sharing program in Europe situated in Paris) reported that since its launch in 2007, 7.800 bicycles have disappeared, and another 11.600 bicycles have been vandalized of the total fleet of 20.000 bicycles (BBC News, 2009). Vélib' bicycles are expensive almost all orginal bicycles are replaced for €400, - per bicycle. While existing technologies, such as Global Positioning Systems (GPS) and radio frequency identification tracking developments, have greatly decreased bicycle theft, such technology greatly increases implementation costs. A different approach is to include membership-based lending process to reduce bicycle theft.

In contrast to Vélib', Hangzhou's bike-sharing system and BIXI in Montreal have experienced relatively low theft and vandalism rates. To control theft and vandalism, Hangzhou's system employs inexpensive bikes (400 RMB which is €53, -). A high density of bicycles—free for the first hour—makes cycling more convenient, which can decrease the need to steal a bicycle. To control the impact of vandalism, BIXI allocates 8% to 9% of its budget to address theft. To date, less than 3% of that budget has been used.

	1st generation: free-bike systems	2nd generation: coin-deposit systems	3rd generation: IT-based systems	4th generation: demand-responsive systems
Component	1. Bicycles	1. Bicycles 2. Docking stations	1. Bicycles 2. Docking stations 3. Kiosk or user interface technology	1. Bicycles 2. Docking stations 3. Kiosk or user interface technology 4. Bicycle distribution system
Characteristics	1. Distinct bicycles (usually by colour) 2. Bicycles located randomly 3. Bicycles unlocked 4. No charge for use	1. Distinct bicycles (colour or special design) 2. Bicycles located at specific docking stations 3. Bicycles with locks	1. Distinct bicycles (colour, special design or advertisements) 2. Bicycles located at specific docking stations 3. Bicycles with locks 4. Smart technology is used for bicycle check-in and check-out (smartphones, smartcards) 5. Theft deterrents are used (e.g. members give personal details) 6. Programs are paid for as a membership service	1. Distinct bicycles 2. Programs may include electric bicycles 3. Specific docking stations that are more efficient (mobile, solar powered, etc.), 4. Improved locking mechanism to deter theft 5. Touch screen kiosks, user interface 6. Bicycle redistribution system 7. Linked to public transit smartcard

Table 1. The components and characteristics of the four generations bike-sharing systems

Overall, emerging fourth-generation models should consider more robust bicycles that require less maintenance and include more effective locking mechanisms that deter theft (Shaheen et al., 2010).

2. Bicycle redistribution

Vélib' manages 20.000 bicycles indicating an important need for bicycle redistribution (i.e., bicycles must be redistributed to key demand locations frequently after use). Vélib' operates with twenty natural gas powered vehicles to transport bicycles from one station to another. As bike-sharing programs grow and cover larger areas, emerging systems must find ways to address redistribution issues. BIXI and Hangzhou are also making use of trucks to redistribute bicycles. In addition, BIXI is redesigning redistribution trucks to include on-board computers that can provide drivers with real-time information on bicycle stations to facilitate a faster and more efficient response to bicycle shortages and station overcrowding.

As cities launch larger programs, it is important that emerging fourth-generation systems incorporate technological improvements for bicycle redistribution (Shaheen et al., 2010).

3. Information systems

One of the most radical changes introduced by third-generation bike-sharing programs is the use of real-time information systems. This enables users to check parking stations, bicycle availability through the Internet and direct messages to mobile phone. Such technologies have to continue improving and to be included in current and future bike-sharing programs to facilitate a more efficient and user-friendly system (ibid.).

4. Insurance and liability considerations

The increase of bike-sharing programs also has raised the question of insurance and liability. For example, helmet use is not obligatory for most bike-sharing programs, which might conflict with insurance liability laws. In 2008, Vélib' reported three fatal accidents, Nextbike also three fatal accidents, while BIXI and Hangzhou reported one. Uncommonly, Hangzhou covers any injury that occurs through their bike-sharing program. At present, the main obstacle for insurance is high cost (ibid.).

5. Pre-launch considerations

Bike-sharing programs around the world agree that successful systems are those that address the specific needs of their users and market segments prior to and after implementation. It is found by BIXI that bicycle availability is not easy to predict. BIXI handles this by using mobile bicycle stations, which can be relocated according to usage patterns. BIXI identified pre-launch marketing is an essential action for successful programs. Hourbike has noted pricing as key to establishing a successful business model. Furthermore, the implementation of incremental usage fees encourages bicycle users to plan short trips to avoid high fees (ibid.).

2.3. Bike-sharing systems in the Netherlands

There are multiple BSSs in the Netherlands, it is chosen to focus on three BSSs which are explored in-depth. The analysed systems are: Swapfiets, OV-fiets and Mobike, these three are chosen because all three are offered in Delft and Rotterdam where the research is carried out. Besides, all three gain more and more popularity and widespread acceptance in the Netherlands. Mobike is quite small in comparison with the other two system however globally they are a big player in BSSs. In the next paragraphs, the three BSSs are explained and compared on their components and characteristics, see Table 2 for the overview.

Swapfiets

Swapfiets started three years ago and grew already to 27.500 subscribers, Swapfiets is mostly targeting students. Swapfiets is active in nineteen cities in the Netherlands, three cities in Belgium and four cities in Germany and is still rapidly growing (Kuijk, 2018)(https://swapfiets.nl, retrieved on November 1st 2018).

Swapfiets is used for every day use and therefore competes with owned bicycles. First, to enter the service is via the website or store. Than, the consumer gets a Swapfiets delivered when and wherever the consumer likes (within the service area), or it is possible to get it instantly in the store. If there is a malfunction (e.g. flat tire) it is possible to contact Swapfiets via several communication channels and they will take care of it within 24 hours. Swapfiets delivers and swaps their bikes for maintenance on location therefore they drive to the specific consumer and their Swapfiets, see Figure 5 for the consumer journey.

Figure 3. OV-fiets (upper image) and Swapfiets (the Original bicycles)

The business model is a subscription model which is monthly terminable and without additional costs like a deposit. The monthly fee differs per city. In Delft and Rotterdam there are two models available, the Original which is a sturdy 'omafiets' (plain bike) with a coaster brake. The costs are in Delft €16,50 a month (or €14,50 a month with student discount) and in Rotterdam €15, - a month and (or €12, - a month with student discount). The second model is the Deluxe 7 which offers also seven acceleration modes and handbrakes. The costs are in Delft and Rotterdam €19,50 a month (no student discount possible). When your Swapfiets gets stolen, Swapfiets arranges a new one. The consumer and Swapfiets will make a declaration. Consequently, the consumer pays €40, - own risk or €60, - for the Deluxe 7, unless they locked their bike incorrectly then they have to pay €350/€450.

OV-fiets

The OV-fiets is founded eighteen years ago and is part of NS for ten years. NS is the Dutch railway organization and responsible for almost all trains in the Netherlands. In 2017, the usage is increased from 2,4 million rides in 2016 to 3,1 million rides and the number of bicycles increased to 14.500 bikes. OV-fiets is available around 300 locations: many railway stations, bus and subway stations, a few city centres and P+R areas (NS, 2018).

The OV-fiets is known of its particular design and the yellow and blue colours. NS aims to improve the door-to-door journey for travellers by offering the OV-fiets, this is one of the three core tasks of NS' Strategy 2016 – 2019 which means there is a high interest for the OV-fiets and optimizing it for their users. NS is interested in collaborations and they mention that municipalities are interested because they want to get rid of all the abandoned bikes scattered over town (NS, 2018).

The business model is pay-per-use, an OV-fiets costs €3,85 per 24 hours. This rate applies for 72 hours after this €5, - is paid extra per 24 hours. The user has to return the OV-fiets to the same place where it is collected, otherwise it costs €10, - extra. The consumer needs a personal OV-chipcard. If you don't have a personal OV-chipcard yet it costs one-time €7,50, the OV-fiets subscription is for free, NS charges €0,01 yearly to verify personal and payment details. All costs are automatically processed via the connected bank account to the personal OV-chipcard. In 2017, there are 7,49 million personal and 6,84 million anonymous OV-chipcards, this card can be used for all public transport in the Netherlands which explains why so many have one ("Feiten en Cijfers", n.d.).

The consumer uses a OV-fiets most likely in a city where they arrive by train and do not have their own bicycle, see Figure 5 for the consumer journey. The motivations for using a OV-fiets are evenly divided over business, social and recreational purposes.

Mobike

Mobike was founded in China 2015. Mobike operates in 200 cities and 19 countries around the world including China. Total number of Mobikes operating are 800 million, 200 million registered users and 8,65 million daily active users. The 9th of November 2017 Mobike started in Rotterdam and they are now active in two cities, Rotterdam and Delft. Mobike is recognizable by the orange and grey colours plus the special designed bicycle which differs from the archetypal Dutch bicycle. Mobike is unique compared to the other two systems in having a smart lock and the free-floating parking possibility.

When a user would like to use Mobike they can download the app, upload a minimum deposit of €5, - which is different in each country. From then, you can scan the QR-code with the app and the bike unlocks. You can grab and leave a bike wherever and whenever you want, it is a station-less bike sharing-system. In the app, it shows your profile with total distance (kilometres), total CO2 (kg) you saved and how many calories you burned.

The business model at the moment is pay-per-use: €1, - per 20 minutes in Rotterdam and €1,50 per 20 minutes in Delft, and there is a subscription model €9,90 per month. Consumers can use Mobike in a city where they live or where they arrive by train or car.

Figure 4. Mobike in Rotterdam

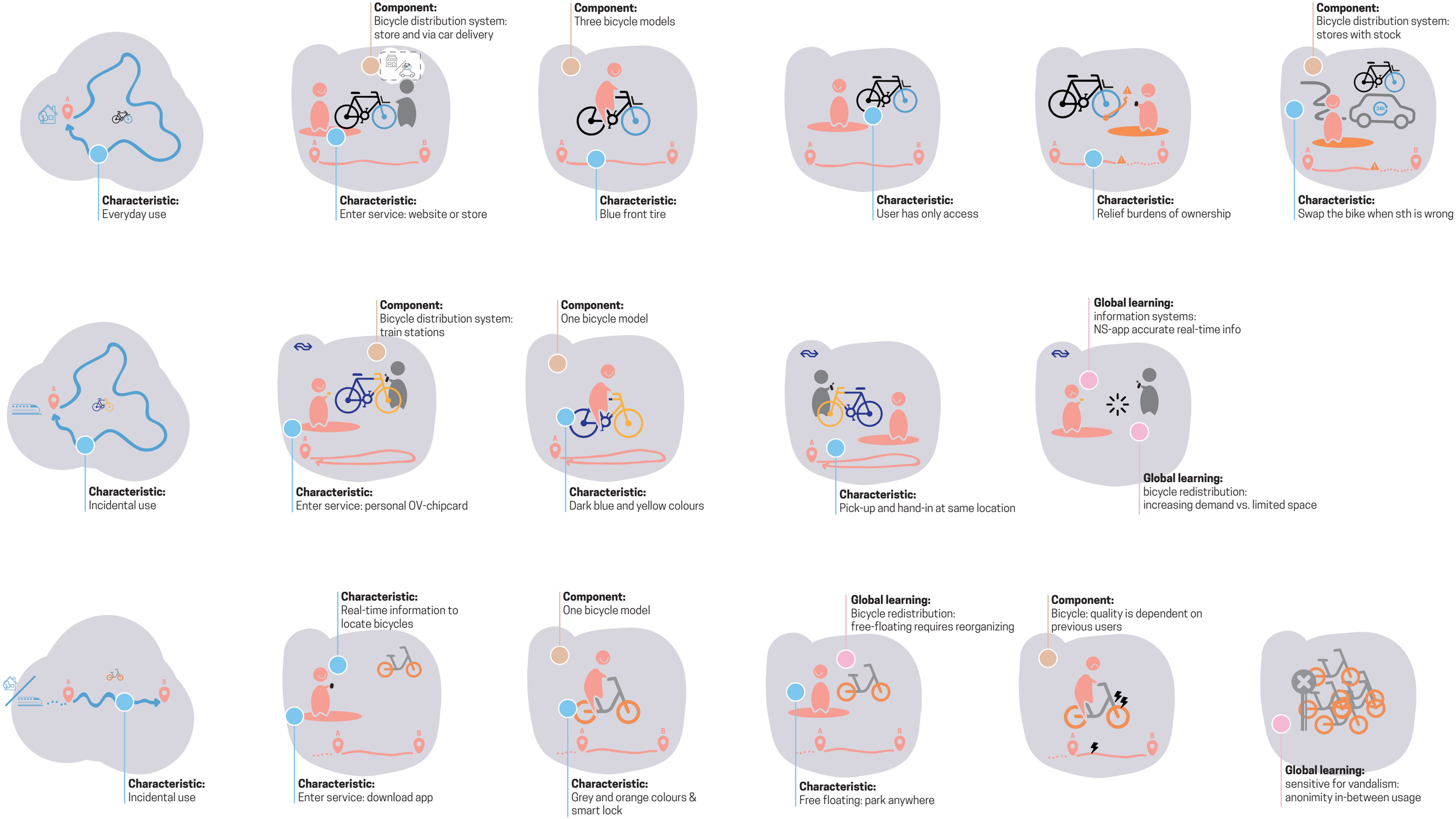


Figure 5. Consumer journeys of Swapfiets, OV-fiets and Mobike

	Swapfiets	OV-fiets	Mobike
Product-service components	▪ Bicycle (3 models) ▪ Stores ▪ User interface technology ▪ Bicycle redistribution system	▪ Bicycle ▪ Pick-up points at railway stations ▪ Personal OV-chipcard ▪ Bicycle redistribution system	▪ Bicycle ▪ Free floating ▪ User interface technology ▪ Bicycle redistribution system
Characteristics	▪ Distinct bicycles: blue front tires and limited frame colours ▪ Three different bicycle offers (one is electric) ▪ Swapfiets comes to the consumer for delivery and maintenance ▪ Application: user interface ▪ Bicycle redistribution system by cars or electrical bicycles ▪ Renting a bike	▪ Distinct bicycles: yellow/ blue colours and one special design ▪ Pick-up point at railway stations manned and docking stations at smaller railway stations ▪ Hand-in at the same point where the bike is picked up ▪ Lock with physical key ▪ User interface linked to NS-app which is used by all Dutch people who use the train ▪ Linked to public transit smartcard	▪ Distinct bicycles: orange/ grey colours and one special design ▪ Free-floating ▪ Smart lock: to deter theft, locate the bikes and access the bikes via a QR-code ▪ Application: user interface ▪ Bicycle redistribution system by external party ▪ No-parking zones ▪ Short term use
Available in…	19 big cities in NL, (e.g. Amsterdam, Utrecht and Rotterdam), three in Belgium and four in Germany and still growing rapidly	+/- 300 locations throughout NL	Delft and Rotterdam
Business model	Subscription model	Pay-per-use	Pay-per-use and subscription model
Price	Original bike: €15, - per month (€12, - student discount)	€3,85 per 24 hours	€1, - per 20 minutes in Rotterdam and €1,50 in Delft or €9,90 per month
Satisfied needs	To have a working bicycle all the time and Swapfiets takes care of all maintenance.	To enable and improve the door-to-door journey for travellers.	Offering a flexible way of transportation because of the free-floating parking.
Target group	Students	Commuters, travellers	Commuters, travellers

Table 2. Three BSSs in The Netherlands: Swapfiets, OV-fiets and Mobike compared to each other.

Challenges of Dutch BSSs: Swapfiets, OV-fiets and Mobike

All three BSSs are fourth generation systems. Comparing the characteristics of the three BSSs, a difference is found in the type use case. Swapfiets is used for every day and therefore competes more owned bicycles compared to OV-fiets and Mobike. The latter two are more likely to have incidental use cases. Furthermore, Swapfiets offers different bicycle models while OV-fiets and Mobike offer one model for all their users. Different models can potentially fit a broader group of users, however OV-fiets and Mobike are mostly used incidentally and most likely functionality is valued more than variation. Differentiation in models makes the redistribution for the provider more difficult.

The accessibility of the BSSs differ each, Swapfiets delivers their bicycles to the consumer or the consumer can pick it up in their stores then the bicycle stays with the consumer as long as the subscription runs. OV-fiets is accessible on most train stations and Mobike is accessible by seeing their bicycles or tracking them on their app, no fixed docking stations but free floating through the city. This influences the (re)distribution system of the BSSs. Swapfiets uses Swapcars to bring their bicycles to the consumer. OV-fiets requires the user to bring the bicycle back to the same point of hire otherwise it will cost extra, in this way there is quite constant and predictable distribution system. Mobike redistributes the bicycles over the service area exploring usage patterns. Mobike is due to the free-floating more sensitive for theft and vandalism considering the low responsibility in between use. In the case of the other two BSSs the last user is responsible for the rented bicycle until it is handed in to the provider again.

Entering the service of the BSSs differ also for each, all three have an application but for different purposes. Swapfiets is contacted via the website for subscriptions and their app is mainly for delivering their service, when consumers experience a malfunction they can directly contact Swapfiets. OV-fiets does not necessarily include an app but it is part of NS and in the NS-app the number of available OV-fietsen is presented (which is not always accurate). It is essential for OV-fiets to have a personal OV-chipcard but this is a low threshold because this card is used for all public transport in the Netherlands. The service of Mobike is entered by downloading their app and making a profile. This app can unlock the smart locks of Mobikes and includes real time information about the location of all bicycles however it does not enable interactive communication with the provider.

Challenges

- Differentiation vs. standardization: different models fit a wider group of consumers however is harder in operational processes for providers.
- Bicycle (re)distribution is a challenge when the bicycles are free floating.
- Placing bicycles on the right places according the (changing) usage patterns.
- Bicycle theft and vandalism increases when there is little responsibility, e.g. anonymity of the person causing damage.
- Getting potential consumers enter the service.

Figure 6. Current consumption standards: consumption and throw-away society

3. Product-service systems

The theoretical background of the research topic product-service systems (PSSs) is given. First, Mont's (2002) definition is used to explain PSSs this emphasizes the sustainable potential compared to traditional product use. Next, PSS's benefits, acceptance and barrier factors are presented followed with the different PSS types. Finally, the concept "sharing" and "access" are discussed to get a clear grip on the used concepts in both a practical context and a theoretical context.

3.1. Definition of PSS

In general, a PSS is an integrated combination of products and services. Products are developed to satisfy consumer demand and are customizable by including services. Thus, a PSS can be seen as a competitive opportunity. In this thesis, a PSS is important for how it is able to alter consumption standards because the emphasis is on "sale of use" rather than "sale of product". PSSs have the potential to be more sustainable compared to traditional product use. It is likely to be more sustainable because consumers no longer need to buy a product to profit from the functionality (e.g. renting a car instead of buying a car) this can mean less products and so reducing the amount of materials used over time. Additionally, PSS providers profit clearly from longer product life cycles while in the case of traditional product providers this is a bit more ambiguous.

> Mont (2002) defines PSSs as: *"A system of products, services, supporting networks and infrastructure that is designed to be: competitive, satisfy consumer needs and have a lower environmental impact than traditional business models."*

Highlighting the differences between products and services in order to get a deeper understanding. Services are intangible, variable, and delivered over time and space. Products on the contrary are tangible and explicit and delivered in one time. Furthermore, a supporting network is explained as a collaboration of different actors and the infrastructure is explained as the capabilities that form the system, for example pick-up points or docking stations can be part of the infrastructure.

3.2. Three different types of PSS

In literature, there are three types of PSS distinguished (Baines, 2007; Beuren, 2013):

1. Product-oriented PSS: mainly products with additional services like maintenance, repair, re-use and recycling. In this case the company is driven to minimize costs for a long-lasting, well-functioning product and to design products thinking about the product end-of-life (re-usable/ easily replaceable/recyclable parts).
2. Use-oriented PSS: selling the use or access to a product that is not owned by the consumer (e.g. leasing or sharing). The company is motivated to maximize the use of the specific product to meet demand and to extend the life of the product and its materials.
3. Result-oriented PSS: selling a result or capability instead of a product (e.g. selling laundered

clothes instead of a washing machine). Companies offer a mix of services where the company maintains ownership of the product and the consumer pays only for the arrangement of agreed results.

To illustrate a use-oriented PSS a comparison is made. Traditionally, a consumer purchases a bicycle, the manufacturer provides the product, sells it to the reseller e.g. bike stores and they sell it to the consumer. The consumer wishes to use the bicycle and it is valued because it provides the consumer mobility. However, the responsibility of ownership lie with the consumer so if the bicycle needs to be maintained or repaired the consumer will have to do so.

Considering a use-oriented PSS, ownership of the asset is not transferred to the consumer. Using the example of Swapfiets, they provides a bicycle and thereby "a mobility solution". Then, Swapfiets takes responsibility of maintenance, repairing and insurance in order to provide the consumer an always working bicycle. In return they are financially compensated as the consumer uses the mobility capability.

In this thesis, the use-oriented PSS type is corresponding to bike-sharing systems and therefore leading. At the moment, use-oriented PSSs can be implemented with current products and technology and can potentially reduce the environmental impact of consumption. Product-oriented PSS is a relative small step from traditional models and result-oriented PSS is the most future-oriented and not directly feasible yet. Use-oriented PSSs is similar to access-based PSSs (AB-PSSs), related to access-based consumption. In use-oriented PSSs a providing company owns products and consumers pay to access these.

3.3. The benefits of a PSS

PSSs can potentially create benefits for the consumer, the provider, the environment and society in several ways. In essence, for the consumer it is a release from the responsibilities of asset ownership. The provider gains an offering of higher value that is more easily differentiated, and to the environment and society at large a potentially more sustainable approach to business, see Table 3.

	PSS benefits	References
Consumer	Flexible and personalized service; quality advantages in products and services; continuous satisfaction.	Aurich et al. (2010)
	Product data collected during use in order to improve the products in different life stages.	Sundin et al. (2009)
Provider	Higher loyalty and trust consumer.	Aurich et al. (2010)
	Innovation potential from the monitoring of product and services while using them.	Tukker and Tischner (2006)
	Reduction of costs and resources; maximization of results; knowledge created during development process are sold as consulting and training services; products reused in combination with several services.	Mittermeyer et al. (2010)
Environment	Reduction in consumption through alternative of product use.	Li et al. (2010)
	Provider responsible for the products and services through take-back, recycling, and refurbishment-reducing waste through the product's life; services planned with the life cycle of the products.	Baines et al. (2007)
Society	Public pressure on environmental issues grows.	Baines et al. (2007)
	Increase the supply of services; new jobs.	Baines et al. (2007); Gao et al. (2009)

Table 3. PSS benefits on four different levels (Beuren et al., 2013).

3.4. Why are PSSs not widely accepted yet?

Considering all benefits and taking into account that the concept of PSS has been openly discussed in literature for over two decades, yet realized ideas by the industry are limited. The majority of researchers (Goedkoop et al., 1999; Manzini et al., 2001; Mont, 2002; and UNEP, 2001) point out the same main barrier to the adoption of a PSS: there is a cultural shift necessary. The consumer has to place value on having a need met opposed to owning a product.

However, consumers may not be enthusiastic about ownerless consumption, and the manufactures may be concerned with pricing, absorbing risks, and shifts in the organization, which require time and money to facilitate (Baines et al., 2007). Plus, for an effective PSS it is likely for a manufacturing organization to be more complex than the existing way of delivering functionality through the supply of a product alone.

Holistic, ownerless consumption offers many advantages and aspiration, but it has its own problems. For instance, research reveals that the multiple use does not automatically lead to less impact on the environment (Krutwagen and van Kampen, 1999). The environmental impact relies on, to a large extent, on the circumstances, schemes and conditions of use. Leasing, for example, can stimulate use of products which otherwise would not be affordable for consumers. Without the option of leasing, the purchase could have been postponed to later date. On the other hand, leasing can facilitate the return of old products (or parts) since the duration of use is monitored and they are returned after the lease has run out, if the purchase option is not chosen. This could strengthen the manufacturers' interest in their own products and could improve the economic conditions for a closed cycle economy. In the following paragraph the acceptance and barrier factors of PSSs are further explored.

3.5. Acceptance factors to the adoption of PSSs

In literature, a number of factors are found as acceptance factors or barriers to the adoption of PSSs. In general, these factors are each other opposite for example a high price complexity is a barrier and a low price complexity is an acceptance factor. This thesis focusses on the motivational factors therefore the PSS acceptance factors are listed. Additionally, important cultural barriers are added, see Table 4.

The barriers to the adoption of PSSs are twofold: there are both cultural and corporate challenges however the focus of this thesis is on consumer acceptance factors. So, an overarching cultural challenge to adoption of PSSs are the fixed behavioural-patterns because "buying products" and

Related to...	PSS acceptance factors	Reference
Service	Low price complexity	Schmidt et al., 2016
	Financial reasons	Mont, 2004; Schrader, 1999
	Perception of fixed and variable costs, insight in total life-cycle costs	Meijkamp, 2000; Mont, 2004; Schrader, 1999
	High perceived relative advantages compared to alternatives	Meijkamp, 2000; Mont, 2004; Schrader, 1999
	High availability of product information	Schenkl et al., 2014
	Communication between supplier and consumer	Mont, 2004; Schrader, 1999
	High reliability of the service providers	Poppelaars et al., 2018
	Relationship between the supplier and consumer. New roles and obligations.	Mont, 2004
	High consumers' trust in the system	Poppelaars et al., 2018
	Low uncertainties regarding risks, costs and responsibility	Mont, 2004
	High availability of products	Tukker, 2015
	High accessibility of products	Pedersen and Netter, 2015
	Low level of altering consumers' habits	Rexfelt & Hiort af Ornäs, 2009
	Low need of learning new skills	Mylan, 2015
Product	Relieves burdens of ownership (e.g. repair and maintenance)	Tunn et al., 2018; Cherry & Pidgeon, 2018
	If the product is mainly used for its functionality, consumers prefer archetypal products	Tunn et al., 2019
	Costly products which are used infrequently are more likely to be successfully offered as PSS	Mont, 2004; Schrader, 1999
	Low fear of accidentally damaging a product	Cherry & Pidgeon, 2018
	Low concern about hygiene	Edbring et al., 2016
	Cultural barriers	
	Consumers desire to own products	Armstrong et al, 2015; Schenkl et al., 2014
	Ownership provides perceived control	Tukker, 2015
	Ownership relates to expression of social status	Santamaria et al., 2016; Armstrong et al., 2015
	Ownership provides emotional value	Santamaria et al., 2016; Armstrong et al., 2015
	PSSs often fail to match the soft, intangible values owned products deliver (next to product functionality)	Tukker, 2015; Cherry & Pidgeon, 2018; Santamaria et al., 2016

Table 4. PSS acceptance factors and barriers

"owning products" is embedded in average day-to-day lives. According to common economists, consumption satisfies basic human needs and improves quality of life. Taking into account restraints of working up capacity of earth and potential limit of natural resources, consumption patterns and levels of wealthy industrialised countries turn into a problem (Mont, 2004).

Like is stated above PSSs have not automatically less impact on the environment, however in this study it is assumed they have the potential to change consumption patterns and therefore lowering the impact on the environment. This also asks for a new or extended supporting network and infrastructure. The relationship between the consumer and the company plays a key role in the design of an effective PSS because it is essential to achieve a solution that responds to consumer wants and needs.

3.6. Sharing vs. access

Use-oriented PSSs sell the use or access to a product that is not owned by the consumer, bike-sharing systems are therefore use-oriented PSSs. It might be confusing that the term bike-sharing systems include the concept "sharing" and use-oriented PSS refer to "access". These two concepts and "ownership" are explained more in detail to get a distinct understanding.

Ownership expresses the relationship between a person and an object which is called "owning", the object is called "personal property" or a "possession" (Snare 1972, p200). Consumers may identify with the product they own, which can become part of their extended-self (Belk, 1988) and can be crucial in maintaining, displaying, and transforming the self (Kleine, Kleine, and Allen, 1995; Richins, 1994; Schouten, 1991). Two of the big differences between ownership and access involve (1) the nature of the object-self relationship and (2) the rules that govern and regulate this relationship. In contrast to the long-term interaction with the object that characterizes ownership, access is a temporary and circumstantial consumption context (Chen, 2008). Access can be characterized as an economic exchange while sharing is typified more as a communal act which potentially creates feelings of solidarity and bonding. Sharing represents *"the act and process of distributing what is ours to others for their use, and/or the act and process of receiving or taking something from others for our own use"* (Belk, 2007, p126). Sharing tends to be altruistic or prosocial while access is not necessarily that, however access is similar to sharing in that both modes of consumption do not involve a transfer of ownership.

The analysed bike-sharing-systems: Swapfiets, Mobike and OV-fiets give access to a bicycle in a temporary and circumstantial consumption context however the length of time the consumer gets access to a specific bicycle differs from each other. The organisations offer an economic exchange: the organisations and product have no altruistic nature and therefore the concept "access" is best applicable. From a theoretical point of view it would be more valid to use "access-based bike systems" however "bike-sharing systems" is widely used and more common and therefore this notion is kept.

Figure 7. Bicycles are widely adopted and owned in the Netherlands

4. Innovation adoption

The diffusion of innovation theory of Rogers (2003), this framework consists of elements influencing the rate of adoption of an innovation. PSSs are in general not widely accepted yet however BSSs in the Netherlands are rapidly growing. Therefore, the qualitative data is analysed using this framework exploring consumer's motivational drivers.

4.1. Diffusion of innovation

Diffusion is the process by which an (1) innovation, is communicated through certain (2) channels over (3) time among members of a (4) social system (Rogers, 2003). These four elements influence the rate of adoption which refers to the relative speed an innovation is adopted. This framework is used to analyse the qualitative data in this research: to point out the motivational drivers for BSS-use.

The existing literature offers more models that predict the use intention and adoption of a new innovation, for instance – Technology Acceptance Model (TAM), Theory of Reasoned Action (TRA), Unified Theory of Acceptance and Use of Technology (UTAUT), Theory of Planned Behaviour (TBP) and more (Taherdoost, 2018). Striking is that all of the mentioned models use more or less the same attributes. The Diffusion of Innovation (DOI) theory (Rogers, 2003) is the most established and more frequently used theory in the field of innovation.

The framework's attributes from the DOI theory have been used by a number of studies (Kapoor et al., 2014) researching the adoption of different technologies, for product and service innovations. The theory originates from 1962 and therefore focussed merely on products however there are also multiple studies done with the DOI theory for service innovations, examples are mobile data services (Gerpott, 2011), environment (Sia et al., 2004), health service industry (Greenhalgh et al., 2004) and many more.

First the framework is explained, it is chosen to focus on Rogers (2003) innovation attributes and not on the other three variables: communication channels, time and social system. This decision is made because of the thesis' focus exploring consumer's motivational factors. Communication channels, time and the social system influence the rate of adoption but are considered as more contextual factors instead of consumer's motivational factors. However, it must be acknowledged that these variables do influence each other.

4.2. Innovation attributes

An innovation is an idea, practice, or object seen as new by an individual. Rogers (2003, p36) states: *"The characteristics of an innovation, as perceived by the members of a social system, determine its rate of adoption."* The characteristics are divided in the five attributes of an innovation: (a) relative advantage, (b) compatibility, (c) complexity, (d) trialability, and (e) observability.

Relative advantage

Rogers (2003, p229) explains: *"Relative advantage is the degree to which an innovation is perceived as being better than the idea it supersedes."* Rogers states that relative advantage is one of the strongest predictors of an innovation's rate of adoption. Examples of sub dimensions include economic profitability, low initial cost, a decrease in discomfort, social prestige, a saving of time and effort, and an immediate reward.

This last-mentioned sub dimension explains in part why preventive innovation, like for example more sustainable products, generally have an especially slow rate of adoption or that the sustainable-aspect is not perceived as relative advantage because it is future-oriented. The innovation attribute relative advantage is positively related to the rate of adoption of new innovations.

Compatibility

Rogers (2003, p240) states: *"Compatibility is the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters."* An innovation can be compatible or incompatible with: (1) sociocultural values and beliefs, (2) previously introduced ideas, and/or (3) client needs for innovations. If a new idea is incompatible with the sociocultural values and beliefs, it will not be adopted as fast as an innovation that is compatible. Therefore, compatibility is positively related to the rate of adoption of new innovations.

Complexity

Complexity is described by Rogers (2003, p257) as: *"The degree to which an innovation is considered as difficult to understand and use."* Complexity could be a less important attribute than relative advantage or compatibility for many innovations, but for some new ideas complexity is a very important barrier to adoption like the first home computers. High complexity is negatively related to the rate of adoption of new innovations.

Trialability

Rogers (2003, p258) presents: *"Trialability is the degree to which new ideas or innovations are experimented for a limited time period."* If an innovation can be designed so as to be tried more easily, it will have a more accelerated rate of adoption.

Observability

Rogers (2003, p258) describes: *"Observability is the degree to which the results of an innovation are visible to others."* PSSs consist of two components the product and service, the product can be more visible compared to the service. Observability is positively related to the rate of adoption of new innovations.

Communication channels

A communication channel is the medium by which messages get from one individual to another. Communication channels support the adoption of new ideas. Within these channels a distinction is made between mass media versus interpersonal channels.

Mass media channels are normally the most rapid and efficient means of informing an audience of potential adopters about the existence of an innovation. Mass media enables one or a few individuals to reach an audience of many, e.g. radio, television, newspapers, and so on. Interpersonal channels means face-to-face contact between two or more individuals. Mass media is more capable to raise

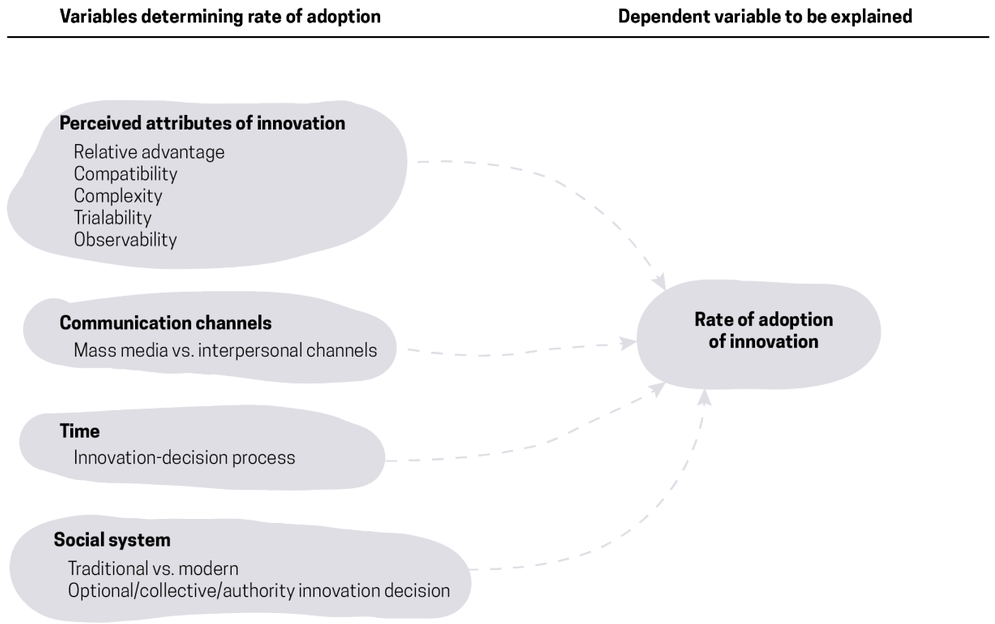


Figure 8. Framework of Rogers (2003): variables influencing the rate of adoption of innovations

more awareness among many however interpersonal channels can be more effective in persuasion of accepting the new idea. Next to mass media and interpersonal communication channels, interactive communication via the Internet has gained more importance for the diffusion of certain innovations nowadays.

Time

The adoption of an innovation takes time, the innovation-decision process is explained in five steps. This behaviour is expressed primarily by dealing with the uncertainty that is naturally involved in deciding about a new alternative to an idea previously of existence.

1. Knowledge: takes place when an individual (or other decision-making unit) is displayed to an innovation's existence and gains an understanding of how it functions.
2. Persuasion: follows when an individual (or other decision-making unit) creates a favourable or an unfavourable attitude towards the innovation.
3. Decision: occurs when an individual (or other decision-making unit) participates in activities that lead to a choice to adopt or reject the innovation.
4. Implementation: follows when an individual (or other decision-making unit) places a new idea into use.
5. Confirmation: happens when an individual seeks consolidation of an innovation-decision already made, but he or she may reverse this previous decision if exposed to conflicting messages about the innovation.

Social system

A social system is defined as a set of interrelated units that are committed in joint problem solving to

achieve a common goal. The members or units of a social system can be individuals, informal groups, organizations, and/or subsystems. The social structure of the system influences the innovation's diffusion in several ways. The system's norms for example; norms are the deep-rooted behaviour patterns for the members of a social system.

Another important influence of a social system are the types of innovation-decisions. These types of decisions have not only an influence but also have the power to shape the rate of adoption. To illustrate, automobile seat belts were installed as an option in the early years. It costed the car owner extra to have them. Then, a federal law passed in the United States (1966) which demanded that seat belts were included in all new cars. This optional innovation-decision became a collective innovation-decision (the law was passed by a consensus of the members of Congress) (Rogers, 2003 p29).

1. Optional innovation-decisions: decisions to adopt or reject an innovation that are made by an individual independent of the decisions by other members of a system.
2. Collective innovation-decisions: decisions to adopt or reject an innovation that are made by consensus among the members of a system.
3. Authority innovation-decisions: decisions to adopt or reject an innovation that are made by relatively few individuals in a system who possess power, high social status, or technical expertise.

4.3. Discussion: DOI theory applied on PSSs

The DOI theory is created based on the diffusion of product innovations therefore it can be discussed if it is applicable for service innovations, as there are differences between products and services. For example, products are tangible and services are intangible in general. The innovation attribute "observability" might be less applicable for services because in most cases a service does not become more visible for others when using it, for example using a mobile banking service is not notable for others.

However, multiple studies applied the DOI theory for products and services yet with some alterations. Related to "observability" Tornatzky and Klein (1982) added "communicability" similar to "result demonstrability" of Moore and Benbasat's (1991) which is the certain extent innovation's benefits are easy to talk about with others and thus make the benefits visible for others. These attributes can be added or merged with "observability" in case of innovations integrating products and services.

Furthermore, Tornatzky and Klein's (1982) added "riskiness" as an innovation attribute. This emerged from the start of the Internet. In an online context the consumer fears of suffering a negative outcome, or losses associated with e-commerce. Because services are more abstract compared to products, this can be an important attribute to include when analysing the rate of adoption for innovations including services.

In this thesis, alterations of Rogers (2003) framework are not included this may result in limitations because the service aspect of a PSS is treated the same a product innovation.

Figure 9. Research is conducted by performing semi-structures interviews

5. Method

This chapter describes the used methods in this thesis: starting to explain the inductive research approach followed up with describing the qualitative research steps. The research consists of semi-structured interviews analysed with the Grounded Theory (Charmaz, 2007), the process steps are clarified one by one.

5.1. Inductive research approach

The used approach in this thesis is exploratory and inductive, the second means that data was collected to build theory. Inductive research is mostly used when the study concerns future context and therefore/or little literature can be found about the topic. Inductive reasoning is a bottom-up method starting from a specific observation, collecting data and looking for patterns, formulating a possible hypothesis and abstract from there to build theory. The opposite of inductive research is deductive research. The deductive approach is based on what is known in theory. The starting point is a theory, formulating a hypothesis, observing and analysing data in order to validate or reject the hypothesis. This been said, it is not often that a research is entirely inductive or deductive. In this thesis, the inductive approach entails elements of deduction.

The empirical applications of PSSs that have been studied are rather limited (Beuren, 2013). Therefore, this thesis focuses on analysing three BSSs with the main research question: *What factors motivate consumers to use a BSS in The Netherlands?* Although PSS systems are not widely accepted yet, the BSS use have grown rapidly in the Netherlands. This growth makes it interesting to explore factors that motivate consumer to use a BSS in the Netherlands, to better understand it success. The data is analysed with the DOI theory of Rogers (2003). This has been an iterative process going back and forth between the data and theory.

Method used for data collection

Semi-structured interviews are conducted with employees of several bike-sharing systems and consumers. The purpose of these interviews is to create an overview of factors which can motivate consumers to use a bike-sharing system.

In a semi-structured interview, the interviewer has several questions in an interview guide, however the order of the questions can be changed depending on the circumstances. The interviewer can ask extra questions when it seems fit. The questions are open-ended questions which mean that the questions do not guide the interviewee to certain answers, but instead the interviewee can answer in their own terms (Bryman & Bell, 2011).

5.2. Qualitative research

The qualitative research involved five semi-structured interviews with experts who work at BSSs, one exception E3 is one of the founders of Felyx an e-scooter share system and also rapidly growing in the Netherlands. It is chosen to include this case because it is a mobility PSS quite similar to a BSS and it is considered this case supports finding consumer's motivational factors. Next, four semi-structured interviews are conducted with four consumers who have experience with two or more of the analysed BSSs. These interviews are analysed with the grounded theory. The steps are more explained into detail in the following paragraphs.

Interviews

The semi-structured interviews are conducted with both experts and consumers. From these two perspectives the main research question is explored. Differences in the data can conclude different understandings and can help the industry to understand the consumer better and to reason drivers that will increase the adoption of BSSs further.

The interviews have been conducted succeeding after each other in a total of four weeks. Between every interview the interview guide is optimised considering the new findings, these iterations support a deeper understanding and exploration of the main research question. See Table 5 for an overview of the interviewees and Figure 10 for an impression of a part of the interview with a consumer.

Interviewee	First name	Company name or profession	Interview duration
Expert 1 (E1)	Melle	Swapfiets	35 min
Expert 2 (E2)	Ronald	Mobike	43 min
Expert 3 (E3)	Maarten	Felyx	35 min
Expert 4 (E4)	Kim	Swapfiets	53 min
Expert 5 (E5)	Sabine	OV-fiets	45 min (no permision to record)
Consumer 1 (C1)	Lotte	MSc Student TU Delft	44 min
Consumer 2 (C2)	Jette	Junior service designer	73 min
Consumer 3 (C3)	Sjoerd	BSc Student Leiden	52 min
Consumer 4 (C4)	Pieter	BSc Student Erasmus	56 min

Table 5. Overview of interviewees part of the qualitative research of this thesis.

Interview stimuli

The interview stimuli that is used is an interview guide, a potential motivation factors list, potential motivational factors cards, an absolute dimension, and future-oriented probe questions. For a more elaborate explanation see appendix 2, an impression of the stimuli is shown in Figure 10.

The potential motivation factors list is created from the first three interviews and literature, the interviewee is asked to pick his or hers two most important factors. This evolved in the cards to avoid steering the interviewee by presenting a list, the interviewee is asked to order the cards on importance. An absolute dimension is created to deepen the understanding of what the two most important factors mean for the interviewee. Finally, the future-oriented probe questions support the interviewee with answering the last question: What would be your ideal BSS? This question is only asked in the consumer interviews.

Grounded theory and data analysis

Grounded theory (Charmaz, 2007) is used to analyse the data gained from the qualitative research. It is often used in semi-structured interview data analysis. In grounded theory, the researcher does not begin with prior hypotheses, these are instead concluded during the data analysis. This corresponds to the inductive research approach of this thesis. The subsequent steps are presented in Table 6, step two till step five are explained in more detail.

Grounded theory process steps	Outcome
1. Collect data	Eight interview transcripts exploring the main research question.
2. Line-by-line coding	Two transcripts coded: +/- 250 line-by-line codes in Atlas.ti
3. Focused coding	Connect DOI theory of Rogers (2003) with line-by-line codes: resulting in focused codes.
4. Examine focused codes	Code all transcripts with the focused codes, this is an iterative process because new findings/patterns can occur which result in new focused codes.
5. Discuss focused codes	Compare focused codes with acceptance and barrier factors found in literature.

Table 6. Grounded theory process steps followed with the thesis' outcome

Step 2, 3 and 4: Coding

Coding is the process of defining what the data is all about. The studying of the data has an interactive nature because there are no fixed codes on beforehand, while studying the data the researcher creates the codes. As a result, the coding process may take the researcher into unforeseen areas and research questions. Coding involves initial coding similar to line-by-line coding and focused coding (Charmaz, 2007). The coding is done with Atlas.ti: qualitative data analysis and research software.

Line-by-line coding

Line-by-line coding means line by line naming each line of data. This way of coding helps to take an analytical viewpoint towards the data. Through line-by-line coding, you begin to build your analysis, from the ground up without taking off on theoretical flights of fancy. Line-by-line codes can differ

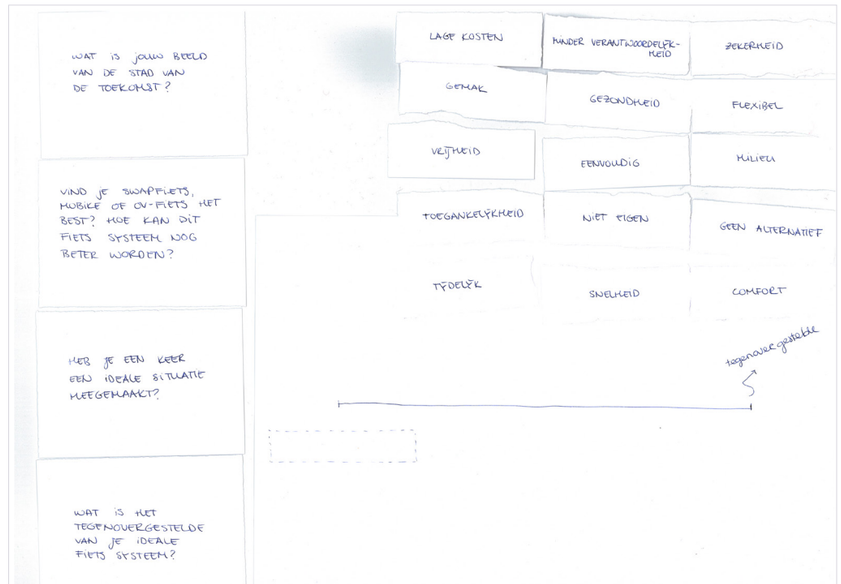


Figure 10. Impression of the used stimuli

widely across a variety of topics, these codes help to break the data into categories and a start to see processes (ibid.).

Focused coding

Focused coding means taking earlier (line-by-line) codes that frequently reappear and use those codes to filter through large amounts of data. Thus, from all initial codes a limited number of interesting line-by-line codes is applied to all gathered data. In order to analyse the line-by-line codes in a structured manner the DOI theory of Rogers (2003) is applied.

This framework distinguished variables which influence the rate of adoption of an innovation. These variables can be reasoned as motivational drivers why consumers adopt BSSs. Rogers (2003) divides the innovation attributes in relative advantage, compatibility, complexity, trialability and observability. These attributes are used as main categories in order to structure the line-by-line codes and concluding the focused codes. All focused codes are presented in a codebook, see appendix 3.

Step 5: Discuss focused codes

After the focused coding, these are linked to the found acceptance and barrier factors in literature. Discussing the results is based on comparing the number of appearance of the focused codes in the transcripts. A high number of appearance is reasoned to have more influence on the rate of adoption. The discussion of the final focused codes, referred in the next chapter as motivational factors, answers the main research question.

Figure 11. Results are concluded from the coded data

6. Results

The following chapter explains the research results. First, the expert's and consumer's findings are compared. Than, the results are discussed relative to the theoretical background of PSSs. Finally, the factors that motivate consumers to use a bike-sharing system are presented.

6.1. Qualitative research

The research results are divided in the results gained from the expert-interviews and the results gained from the consumer-interviews. In this manner, the two researches can be compared to each other. The amount of appearances of the focused codes are converted to percentages because the interview durations differ slightly between the experts and consumers. In this way, a longer interview with more focused codes can be relatively similarly distributed as a shorter interview.

In the previous chapter the method is explained how the data evolved into focused codes. These focused codes are categorized by the DOI theory of Rogers (2003). The innovation attributes from Rogers are taken as main categories, the motivational factors derived from the collected data (these are the concluded focused codes). For example, "relative advantage" is a main category deriving from Rogers (2003) framework and the motivational factor "effort savings" derived from this research as an important factor influencing the relative advantage of a BSS.

The results are presented with a focus on the innovation attributes, the other variables influencing the rate of adoption are communication channels, time and social system. These latter three are briefly discussed on a more general level as it are more contextual and situational variables and indicate favourable conditions. The focus on the innovation attributes is chosen because this thesis strives to explore consumers' motivational drivers. It is important to acknowledge that the variables of Rogers (2003) framework cannot be totally isolated because these variables do influence each other.

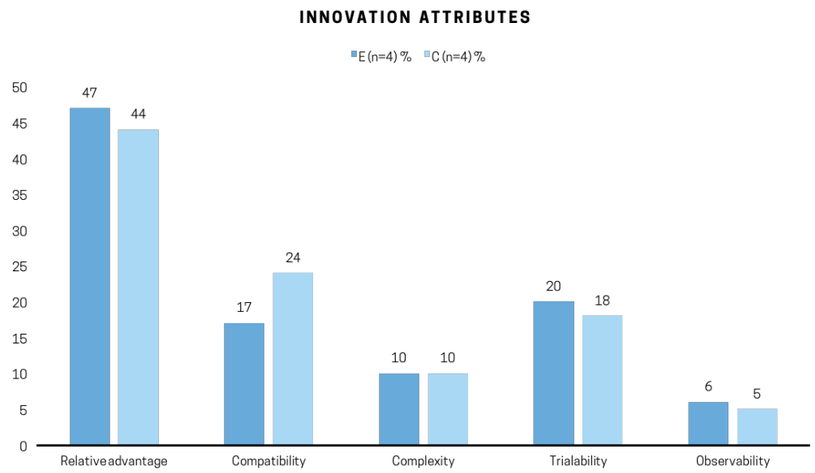
Innovation attributes

The innovation attributes are relative advantage, compatibility, complexity, trialability and observability. The amount of appearances converted to percentages are quite similar between experts and consumers. Meaning the interview guides had equal attention to the attributes. Only "compatibility" is slightly more discussed in the consumer interviews this can be explained due to the focus on consumer experiences which is less in the expert interviews.

The attributes "relative advantage" and "compatibility" score the highest percentages, this aligns with literature. Rogers (2003) states that these two innovation attributes influence the rate of adoption the most and therefore it is assumed that when exploring motivational factors these two attributes appear the most in the data, see Graph 1.

Relative advantage

This attribute presents motivational factors concluded from the data which make the BSS better than other BSSs but also than other mobility options. Because this attribute represents most likely the motivational factors, it is chosen to look more into detail to the data linked to this attribute. This resulted in more detailed division and therefore more motivational factors compared to the other



Graph 1. Representation that expert and consumer interview guide topics are evenly distributed

main categories and their motivational factors. The motivational factors are: effort savings, free of planning, headspace, financial benefits, perceived control, relief burdens of ownership, product quality, temporary use, and time savings. In appendix 3 the codebook is presented: the motivational factors are described and a corresponding quote is included to give a clear understanding of the derived motivational factors.

The percentage of each motivational factor indicate the level of influence they have on generating relative advantage and thereby increasing the rate of adoption. The following Graph 2 lists all motivational factors and shows the frequency of each motivational factor in percentages.

Experts | The research with experts concluded (1) time savings, (2) effort savings, (3) financial benefits, (4) perceived control, and (5) relief burdens of ownership the top five of motivational factors providing relative advantage for the consumer.

Several motivational factors concluded from the expert interviews are excluded due to the lack of occurrence or too low frequency in the consumer Interviews. The excluded motivational factors are: “exercise”, “sustainability”, and “smart lock”. These motivational factors do not contribute to the relative advantage of BSSs from a consumer perspective.

Consumers | The research with consumers concluded (1) effort savings, (2) financial benefits, (3) perceived control, (4) time savings, and (5) temporary use the top five of motivational factors providing relative advantage for the consumer.

Compatibility

Compatibility is the level an innovation is seen as consistent with existing values, past experiences and needs of potential adopters. The motivational factors concluded from the data are ability to match soft, intangible values, accessibility service providers, low level altering consumers’ habits, past experiences, and product fit, see Graph 3.

Experts | The research with experts concluded (1) accessibility service providers and (2) low level altering consumer’s habits as the top two motivational factors supporting compatibility for the consumer.

Consumers | The research with consumers concluded (1) ability to match soft, intangible values and (2) product fit as the top two motivational factors supporting compatibility for the consumer.

Complexity

Complexity is one of the attributes of an innovation which is negative related to the innovation adoption. The motivational factors concluded from the data are: archetypal product, developing new skills and understandings, and ease of use, see Graph 4.

Experts | The research with experts concluded (1) ease-of-use as the most important motivational factor influencing the level of complexity of an innovation and therefore slowing down the rate of adoption.

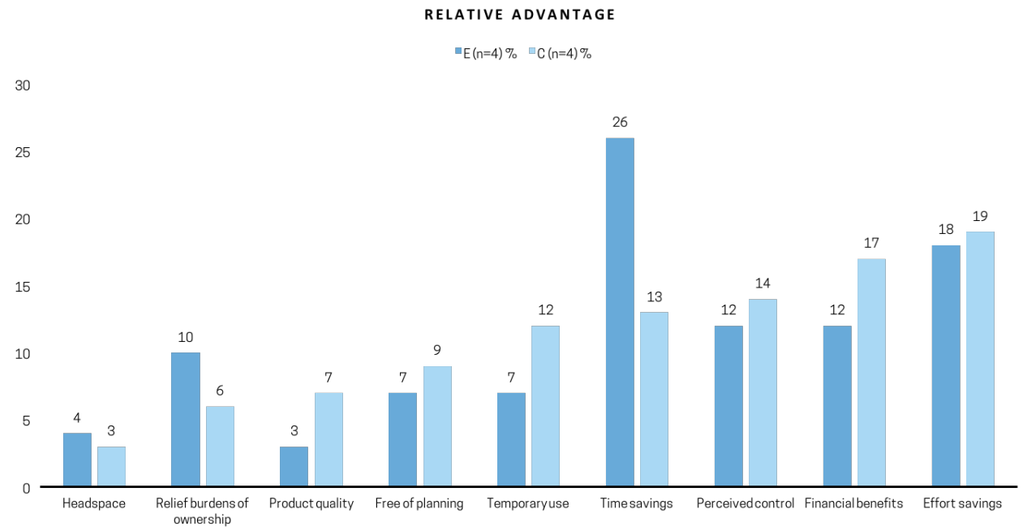
Consumers | The research with consumers concluded (1) ease-of-use as the most important motivational factor influencing the level of complexity of an innovation and therefore slowing down the rate of adoption. The results of the two researches align.

Trialability

Trialability involves the level to which new ideas or innovations are tested for a limited time period. The motivational factors emerging for the data are: accessibility of products, context of use, level of commitment, and price complexity, see Graph 5.

Experts | The research with experts concluded (1) accessibility of products as the most important motivational factor influencing the level of trialability of an innovation. Secondly, (2) context of use is concluded to be important to influence the level of trialability.

Consumers | The research with consumers concluded (1) context of use as the most important

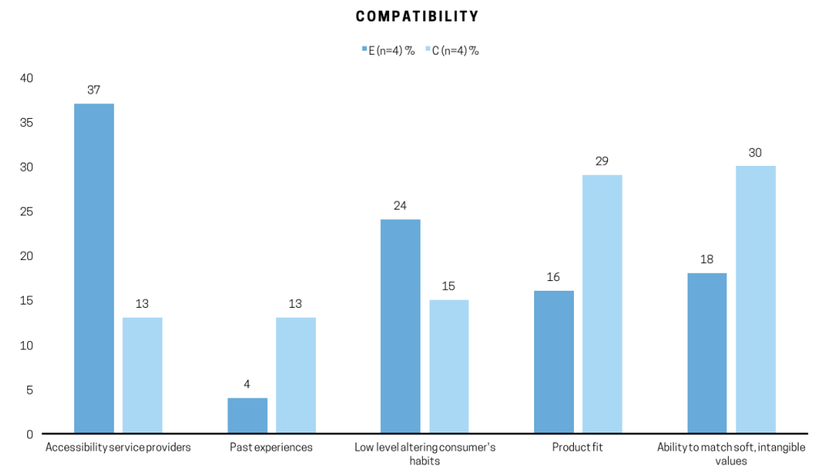


Graph 2. Research results: motivational factors which positively influence the relative advantage of BSSs

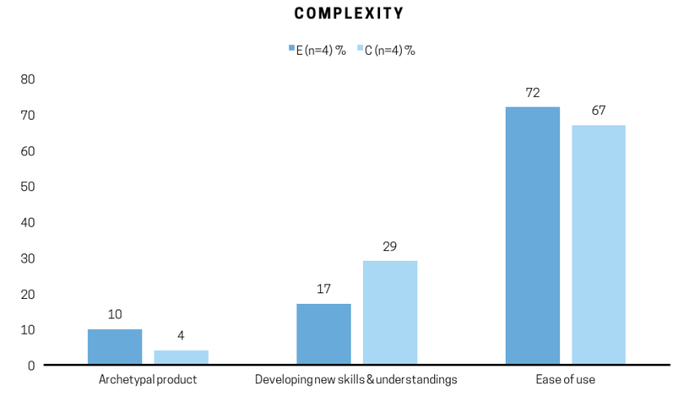
motivational factor influencing the level of trialability of an innovation. Secondly, (2) accessibility of products is concluded to be important to influence the level of trialability. These two motivational factors differ only two percentage which is a small difference.

Observability

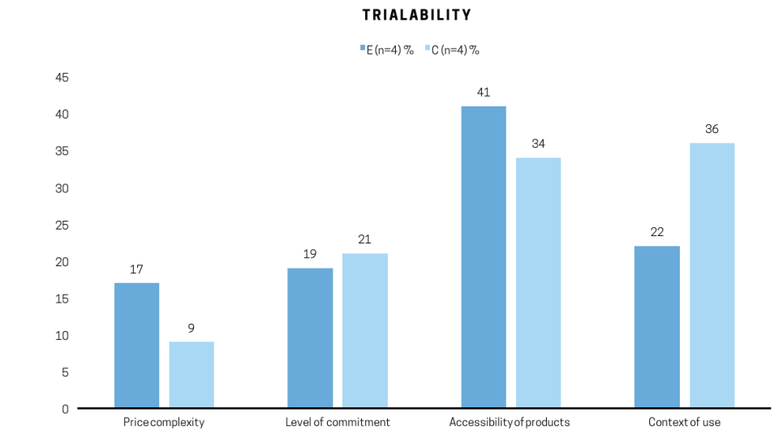
Observability refers to the result of the innovation, if it is this clearly visible for potential adopters. The following two motivational factors derived: word-of-mouth, and recognizable design, see Graph 6.



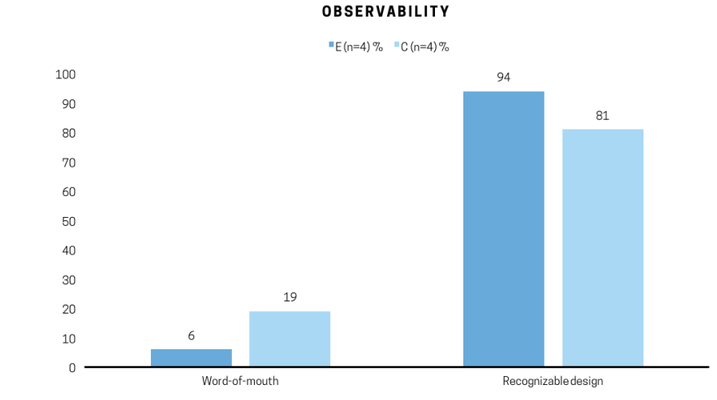
Graph 3. Research results: motivational factors which positively influence the compatibility of BSSs



Graph 4. Research results: motivational factors which influence the complexity of BSSs



Graph 5. Research results: motivational factors which influence the trialability of BSSs



Graph 6. Research results: motivational factors which positively influence the observability of BSSs

6.2. Discussion results

The results of the research presented above are discussed one-by-one linking them with literature. Practical implications are concluded from this discussion which can be found in Table 7.

Innovation attributes

Relative advantage

The motivational factors concluded from the data correspond with examples mentioned by Rogers (2003) concerning relative advantage: economic profitability and low initial cost are comparable to financial benefits, a saving of time and effort is also found as two important motivational factors in the data. Furthermore, a decrease in discomfort matches free of planning, relief burdens of ownership, and product quality. Finally, social prestige and an immediate reward are given as examples by Rogers (2003) these do not directly match a motivational factor however, an immediate reward touches temporary use and time savings. It is likely that social prestige is less applicable because BSSs are a functional means to an end (Ward and Loken, 1988).

The following two motivational factors might be more surprising headspace and perceived control. Headspace means a worry-free state of mind which links to perceived control but focusses more on the mental state. It is reasonable that these two motivational factors are more important for mobility because the goal of travelling is to get from A to B and it is undesirable to be delayed by for example a train that suddenly has a malfunction. Tukker (2015) states that ownership gives perceived control, it is likely this is an essential difference compared to access-based consumption. Enhancing consumer's perceived control can potentially minimize the gap between ownership and PSSs which can be interesting for BSSs specific but also for PSSs in other industries.

Linking these findings with the found acceptance and barriers of PSSs in literature it is interesting to see most factors in literature do not link to the relative advantage attribute, only relief burdens of ownership is found in literature (Tunn et al., 2019; Cherry & Pidgeon, 2018) and positively related to the acceptance of PSS which matches the findings.

Contrasting findings between the two researches are within the motivational factor time savings striking. Seen the results it can be assumed that experts consider this motivational factor as most important for creating relative advantage while consumers consider this as important but effort savings, financial benefits, and perceived control as more important. Besides this, there are relative striking differences within financial benefits and temporary use which are considered more important for consumers than experts assume.

Compatibility

The percentages of the two researches are most opposing within the innovation attribute compatibility. Experts mention the motivational factors accessibility service providers and low level altering consumer's habits most often influencing the compatibility of BSSs. On the contrary, consumers mentioned ability to match soft, intangible values and product fit most often influencing the compatibility of BSSs. Interesting is that these two motivational factors are each other opposites, the first being intangible and more emotional and the latter tangible and very functional.

These differences could be partly explained by the interview guides. The interview guide with consumers focused on their experiences with BSSs and therefore it could be likely that these two motivational factors are mentioned more often compared to the experts, because the experts are

less asked about experiences in the interview guide. Also their perspective as a provider influenced their answers. Nonetheless, it can be assumed that the ability to match soft, intangible values and product fit are the most important motivational factors in order to support compatibility of BSSs for consumers and thereby also increasing the rate of adoption.

Connecting the findings with literature, low level of altering consumer's habits matches findings in literature to be positively related to the acceptance of PSSs (Rexfelt & Hiort af Ornäs, 2009). It is found that consumers desire to own products which is embedded in the norms of society (Armstrong et al., 2015; Schenkl et al., 2014), consumers extract meaning from owning or using products and consumers' relationship with products, and ownership provides emotional value (Santamaria et al., 2016; Armstrong et al., 2015). This implicates the differences between ownership and access-based consumption and the challenge for PSSs. The research points out consumers value a BSS that matches their soft, intangible values but because it is access-based and not owned by the user it can be harder to extract meaning from it. This is in line with other researches that PSSs often fail to match the soft, intangible values compared to what owned products deliver (next to product functionality).

In order to find a deeper understanding of the soft, intangible values within this research all data within this sub-category is again categorised: (a) being an expert, (b) feeling of solidarity, (c) getting in a mood due to others, (d) seeking certainty, (e) making service explicit, (f) showing your identity. The latter matches the findings of Tunn et al. (2019) customization and thereby personalising products in AB-PSSs could lower the barrier to adoption providing intangible and emotional benefits.

Complexity

The motivational factor archetypal product matches literature which states if the product is mainly used for its functionality, consumers prefer archetypal products (Tunn et al., 2019). This motivational factor is not as frequently mentioned but this can be a subconscious preference of consumers. The motivational factor developing new skills and understandings matches literature that a little need of learning new skills is positively related to the acceptance of PSSs (Mylan, 2015). The most frequently mentioned motivational factor is ease of use which is quite straight forward and expected to have the biggest influence on complexity.

There is a relative difference in percentages within developing new skills and understandings, consumers mention this more often which is negatively related to the adoption of BSSs.

Trialability

The accessibility of products matches literature (Pedersen and Netter, 2015) which is positively related to the acceptance of PSSs. Low price complexity (Schmidt et al., 2016) is also positively related to the acceptance of PSSs and matches price complexity. The experts and consumers are considerably aligned in the findings, only consumers mention context of use higher compared to experts. To get a deeper understanding of the context of use, the data is clustered again within this motivational factor: (a) weather conditions, (b) cycle range, (c) available mobility options, (d) type of city, and (e) frequency of visiting a location influence the context of use and thereby the trialability which has a positive influence on the rate of adoption.

Observability

The observability is also quite logically concluded into word-to-mouth and recognizable design both positively related to observability. Noteworthy, recognizable design is most frequently mentioned

and therefore important for the visibility of an innovation but can counteract the motivational factor of compatibility the ability to match soft, intangible values.

Communication channels, time and social system

The DOI theory of Rogers (2003) presents besides the innovation attributes more variables influencing the rate of adoption: communication channels, time (type of innovation decision influences time), and social system. These variables were not the focus of this research but focused codes are concluded within these categories, see appendix 3 for the codebook. Besides these categories also two other categories emerged which are adopters and company risk. In the following paragraphs the insights are discussed in a concise manner.

The category adopters is divided into the focused codes B2B, early adopters and non-adopters. The early adopters of the researched cases are mostly students and starters. OV-fiets is an exception their biggest user group is between 41 and 65 years old. The category company risk is divided into coordination products, counter effects, financial risk, lose reliability service providers, market changes, public opinion, supporting network, and use intensity. Among other things, insights are that the coordination of the products is quite labour intensive. Plus, the users and non-users are important because BSSs are placed in public space and therefore it is more likely a public opinion is created.

Communication channels is divided into marketing communication channels and touch points. Marketing communication channels can be either mass media or interpersonal channels. Swapfiets focusses their marketing campaigns on the introduction weeks of new students who are likely in need of a new bicycle. The touch points of the BSSs are digital and physical. For example, WhatsApp is stated as a desirable touch point by consumers because of its interactive nature. The social system is divided in city liveability, environmental issue, infrastructure, institutional norms, institutional regulations. Finally, the category type of innovation decision is divided in authority and optional innovation decisions.

6.3. Consumers' motivational factors

The main research question of this thesis is answered in this chapter, see Table 7 for an overview of the consumer's motivational factors. These factors motivate consumers to use a BSS in the Netherlands. These are linked to practical implications which will enhance BSS's rate of adoption in the Netherlands.

It can be debated if all found motivational factors are consciously considered by consumers or that some are more subconsciously motivational drivers for the consumer. For example, a recognizable design makes the innovation visible for potential adopters however the consumer is probably not using the BSS because of its recognizable design only. Either way all factors do stimulate the rate of adoption of BSSs.

The findings can be interesting for PSSs in the mobility industry because it is assumed all transport modes have till a certain extent the same purpose, going from A to B. Therefore, it is likely that the motivational factors are similar to each other. Besides, several factors align with previous research about acceptance factors of PSSs. This can indicate it is also interesting for more industries.

Innovation attribute	Motivational factors	Practical implication
Relative advantage	Effort savings	BSSs should save the consumer effort in order to create relative advantage.
	Financial benefits	BSSs should be financially beneficial for the consumer to create relative advantage.
	Perceived control	BSSs should provide the consumer perceived control to create relative advantage.
	Time savings	BSSs should first focus on saving the consumer effort and be financially interesting and then saving time for the consumer.
	Temporary use	BSSs should enable temporary use for consumers in order to create relative advantage.
	Free of planning	BSSs should enable the consumer to be free of planning in order to create relative advantage.
	Product quality	BSSs should offer a product of good quality in order to create relative advantage.
	Relief burdens of ownership	BSSs should relieve the consumer of burdens of ownership in order to create relative advantage.
	Headspace	BSSs should provide the consumer a worry-free state of mind in order to create relative advantage.
Compatibility	Ability to match soft, intangible values	BSSs should try to match consumer's soft, intangible values in order to increase the compatibility.
	Product fit	BSSs should offer a good product fit to the consumer in order to increase the compatibility.
	Low level altering consumer's habits	BSSs should have a low level of altering consumer's habits in order to increase the compatibility.
	Past experiences	BSSs should take into account the consumer's past experiences in order to increase the compatibility.
	Accessibility service providers	BSS's service providers should be easily accessibile in order to increase the compatibility.
Complexity	Ease of use	BSSs should be easy to use for consumers in order to lower complexity.
	Developing new skills and understandings	BSSs should avoid the necessity for consumers to learn new skills or understandings in order to lower complexity.
	Archetypal product	BSSs should include archetypal products in order to lower complexity.
Trialability	Context of use	BSSs should not underestimate the context of use which influences consumers to try the BSS out. This can increase or decrease the trialability.
	Accessibility of products	BSS's products should be easily accessible for consumers in order to increase the trialability.
	Level of commitment	BSSs should have a low level of commitment for the consumer in order to increase the trialability.
	Price complexity	BSSs should have a low price complexity for the consumer in order to increase the trialability.
Observability	Recognizable design	BSSs should have a recognizable design in order to increase the observability.
	Word-of-mouth	BSSs should stimulate word-of-mouth between consumers in order to increase the observability.

Table 7. The motivational factors that motivate consumers to use a BSS in the Netherlands.

Figure 12. The design goal is to postpone or replace car ownership

7. Design goal

The design goal and the chapter hereafter interpret the research results and translate it in design solutions presented in a new concept. First, the solution space is defined, design guidelines are pointed out and discussed this all is synthesized in the design brief.

7.1. Solution space

The main research question is answered, for the five innovation attributes twenty-four motivational factors resulted from the research. All are likely to have influence on the adoption rate of a BSS. However, it is chosen to focus on a selection with the aim to give an impression of how these motivational factors can be designed and enhanced in a BSS, see Table 8.

The selection includes the five attributes with the most frequent mentioned motivational drivers by consumers because these have the biggest influence on increasing the innovation attributes. More motivational drivers are included for relative advantage and compatibility because these two have more influence on the rate of adoption compared to the other three (Rogers, 2003).

Innovation attribute	Motivational factors	Practical implication
Relative advantage	Effort savings	BSSs should save the consumer effort in order to create relative advantage.
	Financial benefits	BSSs should be financially interesting for the consumer to create relative advantage.
	Perceived control	BSSs should provide the consumer perceived control to create relative advantage.
	Time savings	BSSs should first focus on saving the consumer effort and be financially interesting and then saving time for the consumer.
	Temporary use	BSSs should enable temporary use for consumers in order to create relative advantage,
Compatibility	Ability to match soft, intangible values	BSSs should try to match consumer's soft, intangible values in order to increase compatibility.
	Product fit	BSSs should offer a good product fit to the consumer in order to increase compatibility.
Complexity	Ease of use	BSSs should not underestimate the context of use which influences consumers to try the BSS out. This can increase or decrease the trialability.
Trialability	Context of use	BSSs should not underestimate the context of use influencing consumers to try the BSS out.
Observability	Recognizable design	BSSs should have a recognizable design in order to increase visibility.

Table 8. Selection of the motivational drivers that motivate consumers to use a BSS in The Netherlands.

7.2. Design guidelines

The next step is exploring the solution space, the quotes of the succeeding motivational drivers are looked into per innovation attribute. Clear definitions are presented of the motivational drivers. In this manner the practical implications can be complimented with design guidelines.

Secondly, an external analysis is carried out. Competitors are aligned on scales to map their scores on the relative advantage motivational drivers because relative advantage depends on its alternatives. The business models and prices are compared of the competitors. In conclusion, a deeper understanding is created and design guidelines are identified to create an improved BSS with strengthened motivational factors.

Innovation attributes

In the following paragraphs the ten motivational drivers are more in-depth explored. The definitions of them corresponding to relative advantage can be found in Table 9, compatibility in Table 10, complexity in Table 11, trialability in Table 12, and observability in Table 13. All quotes presented in the "quote-clouds" and in the text are translated from Dutch to English.

Relative advantage | Motivational driver definitions

Relative advantage is the certain "amount" an innovation is better than the products and/or services it replaces. The motivational drivers who influence the "amount" are presented with their definitions in Table 9. These definitions are concluded from the corresponding quotes in the research, a selection is used to create several "quote-clouds" to get a better grasp of the motivational factors. The light bulbs indicate design solutions mentioned by the interviewees.

Figure 13 shows clustered quotes for "effort savings", the service can save effort in a way that the consumer experiences no hassle. The product can save the consumer effort by saving energy, for example peddling light and making it easy to carry luggage which decreases the chance on sweating. Past experiences like many stolen bikes influence the perception of "effort savings". Communication can support the consumer to save effort like using WhatsApp. Finally, the situation influences what the consumer sees as saving effort. For example, when it rains consumers make different decisions just like the possible alternatives in a situation influence "how much" a BSS can save them effort.

Financial benefits is clustered in every day use and incidental use, for example a consumer can use OV-fiets once in a while because he or she finds it financially attractive however this changes if the consumer would use it every day.

The consumer perceives control in aspects of ownership like the all time availability or knowing where to find it. A sense of independence also contributes to perceived control, the transportation mode is a means to an end and consumers prefer little risks. For example, not waiting on a bus but start cycling with a bicycle enables the consumer to be the boss of their own time. It is mentioned that the promise of the service supports the perceived control of a consumer more than the exact specifics. Finally, process cues can enhance the consumer's perceived control. For example, seeing the service providers moving due to real-time information.

One of the misconceptions is that more control means offering more options to the consumer. Wathieu et al. (2002) proposes three specific elements that can influence the subjective experience of empowerment: (1) control of choice set composition, (2) progress cues, and (3) information about other consumers. Besides, three well-known mechanisms are pointed out that may cause an aversion to certain kinds of choice set expansions: self-control, regret, and overload. More information about this can be found in appendix 4.

Time savings is defined as that the BSS use saves the consumer time. Expert three who works at

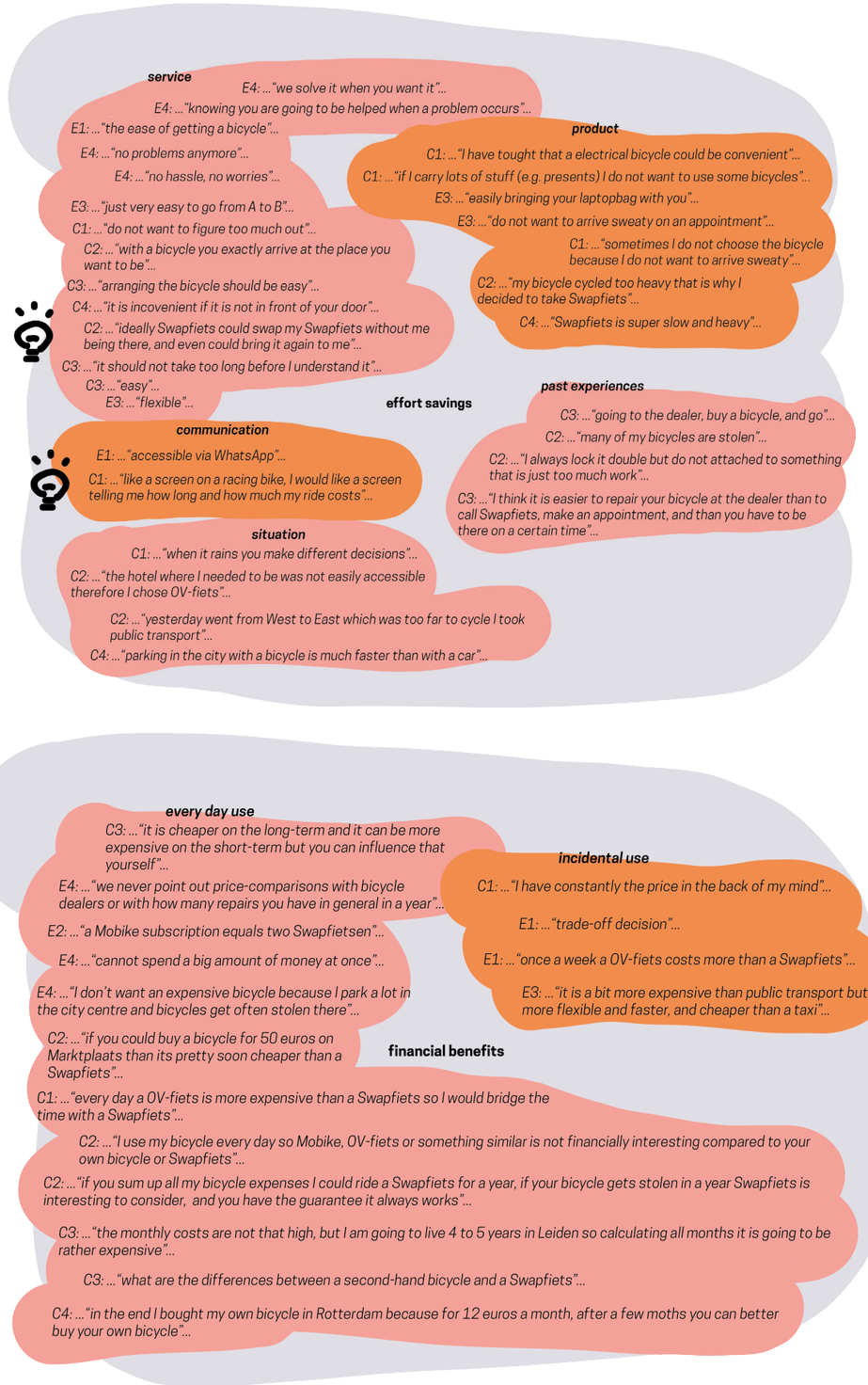


Figure 13. Quote-clouds collected from the research to improve the understanding of "effort savings" and "financial interest"

Felyx states that the scooter is the fastest option within the city to get around. Because a car has to stand still due to traffic lights or traffic jams, need to find a parking spot and all this is less applicable with a scooter. Expert four links time to freedom and people do like it if they gain more freedom and spend time as they prefer. Consumer three considers: *"The choice was between a second-hand bike and Swapfiets, the advantage of Swapfiets is you get immediately a new bicycle if it gets stolen or when something breaks."*

Temporary use is defined as the limited time the consumer uses the BSS which allows a low level of commitment. One of the experts points out that the moment a consumer needs a bicycle is an important opportunity for a BSS. However, the following quote points out that BSSs are not considered to replace ownership yet. Consumer one says: *"I wouldn't enter a Swapfiets contract for undetermined time."* Consumer two states: *"In terms of systems, a combination of OV-fiets and Swapfiets is enough because if I go somewhere I do not have a bike I will use an OV-fiets."*

Motivational driver	Definition
Effort savings	The consumer finds the BSS convenient and easy to use. The BSS can achieve this on product-level like physically saving energy or on service-level offering an hassle-free experience.
Financial benefits	The consumer finds the BSS financially attractive, this is dependent on the usage patterns (incidental use versus every day use).
Perceived control	The consumer experiences the feeling that he or she is independent (empowered) and knows what to expect.
Time savings	The consumer saves time by using the BSS.
Temporary use	The consumer uses the BSS for a limited time which allows a low level of commitment.

Table 9. Relative advantage | Definitions of the five selected motivational drivers

Compatibility | Motivational driver definitions

Compatibility is the "amount" an innovation is perceived as constant with the existing values, past experiences, and needs of potential consumers. The motivational driver ability to match soft, intangible values is further explored in motivational factors of these values: (a) being an expert, (b) feeling of solidarity, (c) getting in a mood due to others, (d) seeking certainty, (e) making service explicit, (f) showing your identity.

Product fit is functional oriented, examples of consumer's needs are robust bicycles, easy adjustments of the saddle and handlebar, possibility to easily carry luggage, light peddling and accelerations.

Motivational driver	Definition
Ability to match soft, intangible values	The level of how the consumer's values and beliefs match with the BSS, for example the BSS matches the feeling of being an expert, feeling of solidarity, seeking certainty, making the service explicit, and helps to show the identity of the user.
Product fit	The level of how the consumer's functional needs match with the bicycle of the BSS.

Table 10. Compatibility | Definitions of the two selected motivational drivers

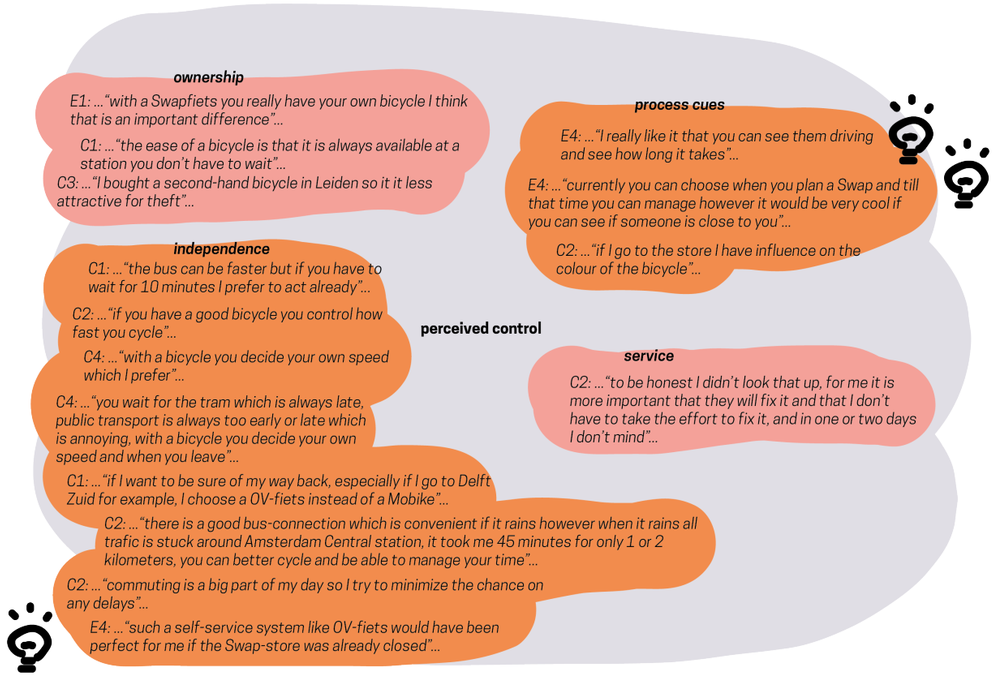


Figure 14. Quote-clouds collected from the research to improve the understanding of the motivational drivers

Compatibility focusses on existing values, past experiences, and needs of potential adopters. This is important of the acceptance of an innovation however the world, its cities and the mobility industry are not standing still. For example, Amsterdam published their plan for 2030 to banish all gasoline and diesel cars (NOS, 2019). These changed regulations will have serious impact on consumer behaviour. Fjord (2018) forecasts that services will integrate across multiple modes of transportation and offer subscription-based payment models, including a set fee across all options. Future payment systems will be integrated, connecting multiple operators and providers. People want unified, seamless transit experiences, and the big winners will be those who provide them by combining and creating mobility services. More information about mobility trends is presented in appendix 4.

Complexity | Motivational driver definition

Complexity is the extent to which an innovation is considered as difficult to understand and use. The motivational driver ease of use can be divided in product- and service-aspects. The product of a BSS, the bicycle is considered easy to understand however the entry moment which leads to actual usage is considered a threshold.

The consumer needs to be aware of the BSS and than be willing to download the app, make a profile and among other things find the pick-up point instead of using other familiar mobility options.

Motivational driver	Definition
Ease of use	The level of ease to use the product and the service of a BSS.

Table 11. Complexity | Definition of motivational driver "ease of use"

Trialability | Motivational driver definition

Trialability is the range to which new ideas or innovations are tried for a limited time period. The context is quite important for potential adopters in order to try a BSS. The context is divided in the following categories: (a) weather conditions, (b) cycle range, (c) available mobility options, (d) type of city, (e) frequency of visiting a location.

Motivational driver	Definition
Context of use	The context influences the choice whether to try bike-sharing systems or not. Context aspects are weather conditions, cycle range, available mobility options, type of city and the frequency of visiting a location.

Table 12. Trialability | Definition of motivational driver "context"

Observability | Motivational driver definition

Observability is the extent to which the results of an innovation are visible to others. This is considered to be positive however if the image of the innovation deteriorated a recognizable design can also be negative.

Motivational driver	Definition
Recognizable design	The bike-sharing system has a recognizable design which makes the BSS eye-catching for potential adopters.

Table 13. Observability | Definition of motivational driver "recognizable design"

External analysis

The external analysis creates an overview of the "mobility PSS" market. Competitors are aligned

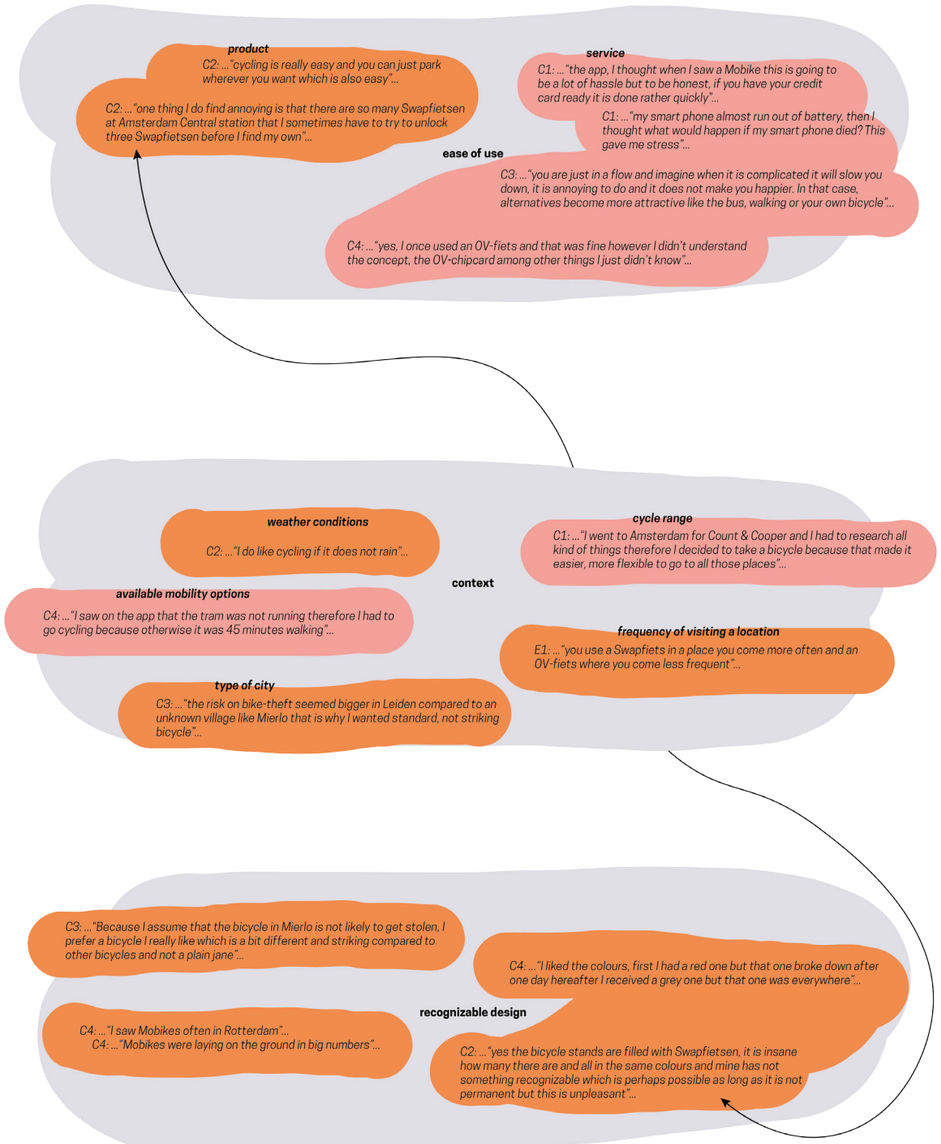


Figure 15. Quote-clouds collected from the research to improve the understanding of the motivational drivers

on scales to map their scores on the relative advantage motivational drivers. Relative advantage is relative because of its alternatives. Next, the business models and prices are compared of the competitors.

Competitors

The decision of a consumer is often one between the multiple available mobility options. Therefore, six sliders are presented rating mobility PSSs in the Netherlands, see Figure 16. The mobility PSSs presented as competitors are: the Original, Deluxe 7 and Power 7 of Swapfiets, Mobike, OV-fiets, Smart X VanMoof subscription, Car2Go, Greenwheels, and Felyx. These are chosen because these mobility PSSs are available in the bigger cities of the Netherlands.

Scale one rated the effort savings on product-level where cars have the advantage over bicycles because they cost the consumer the least energy to drive. Hereafter, Felyx and than the Power 7 of Swapfiets which is an e-bike. Mobike scores lowest because it is a relatively small bicycle for Dutch people therefore it costs the consumer more physical energy compared to the other bicycles.

Scale two rated the effort savings on service-level where the OV-fiets wins because most consumers already have a public transit smartcard therefore the service is very easy to enter and use. Besides costs are handled automatically. Felyx, Greenwheels and Car2Go score lowest because to enter the service the consumer's drivers license needs to be verified. Then Mobike because a deposit is needed these elements costs the consumer relatively much effort (e.g. multiple process steps, hassle).

Scale three rated the financial benefits for every day use therefore the PSSs that have an incidental use-case score low, like Felyx, Greenwheels, Car2Go and OV-fiets. Mobike scores highest because their subscription model costs only €10,- a month which is lower than the other subscription models.

Scale four rated the perceived control for every day use Swapfiets and VanMoof score the highest because the consumer "owns" it for a while, other cannot take it. Hereafter OV-fiets because it has clear pick-up points. The free-floating PSSs score lowest on perceived control because finding one is less certain. Mobike is rated fourth because there are so many of them compared to the other PSSs.

Scale five rated the time savings in an urban area. Felyx and the Power 7 of Swapfiets score the highest because they can go fast and use the bicycle lanes instead of the crowded roads. Next, Greenwheels and Car2Go hereafter the other BSSs.

Scale six rated the temporary use where Mobike scores the highest because it can be used per 20 minutes. Felyx, Greenwheels and Car2Go can be used per minute however three minutes costs approximately the same as Mobike therefore Mobike scores higher. OV-fiets is fourth, because it can be used per 24 hours and than VanMoof and Swapfiets which can be used per month.

Given these points, it is concluded that electrical bicycles save the consumer the most effort on product-level compared to the other bicycles and therefore can compete better with motor vehicles. OV-fiets saves the consumer most effort on service-level because it is automatically linked to the public transit smartcard, so a very low threshold to enter and use the service. Subscription business models benefit the consumer financially more when they use the mobility PSS every day. Plus, subscription business models provide the consumer more control when the PSS is used every day.

Figure 16. Perceptual scales of mobility PSSs

Next, fixed pick-up points provide the consumer with more perceived control compared to free-floating PSSs. In urban areas Felyx and the Power 7 (e-bike) saves the consumer the most time because it is fast and the consumer can park it on the sidewalks. Cars have a disadvantage when parking is difficult in a city. Mobike enables the consumer to use the bicycle temporarily and leave it at arrival, the level of commitment is very low.

Business models

The mobility PSSs have two types of business models pay-per-use and subscription models. The pay-per-use is in most cases per minute and the subscription models per month. The analysed mobility PSSs are listed in Table 14 and Table 15 and can be used for a competitive pricing strategy.

Subscription business model	Price per month	Extra costs	Purchase value for consumers
Swapfiets | Original	€ 16,50 or € 13,50 (student discount)	-	€ 350
Swapfiets | Deluxe 7	€ 19,50	-	€ 450
Swapfiets | Power 7	€ 75	-	€ 2999
VanMoof | Smart X	€ 25	€ 98 (key fee)	€ 898
VanMoof | Smart S	€ 25	€ 98 (key fee)	€ 898
Greenwheels	€ 10 or € 25	€ 225 (deposit)	Volkswagen Up € 11 950 or € 209 private lease Volkswagen Golf (station) Volkswagen Caddy Volkswagen e-Golf
Mobike	€ 10	€ 5 (minimum deposit)	Unavailable info

Table 14. Overview subscription model prices

Pay-per-use business model	Price	Extra costs	Purchase value for consumers
Mobike	€ 1,00 per 20 minutes	€ 5,00 (minimum deposit)	Unavailable info
OV-fiets	€ 3,85 per 24 hour	€ 0,01 (validation costs)	€ 250
Felyx	€ 0,30 per minute	-	€ 2500
Car2Go	€ 0,26 per minute (upward of)	€ 9,00 (validation costs)	Smart EQ fortwo € 26 850
Greenwheels	€ 0,34 per km (variates when having a subscription)	€ 225 (deposit)	Volkswagen Up € 11 950 or € 209 private lease Volkswagen Golf (station) Volkswagen Caddy Volkswagen e-Golf

Table 15. Overview pay-per-use prices

7.3. Design brief

The design brief explains the W5H: Why, Who, What, Where, When and How. After distinguishing the motivational drivers for consumers and exploring them in-depth and pointing out the differences of mobility PSSs in the external analysis. A new BSS concept is designed. In this way, the translation of the motivational drivers are presented in design solutions which stimulate the adoption of BSSs.

The W5H is used to structure a promising future-oriented scenario. Why is the new concept used, who is a promising target group, what is offered, when is it used, where is it used? Finally, how is it realised including the opportunities.

Why?

The new BSS strives for more sustainable consumer behaviour. This is twofold on the one hand stimulating new consumption patterns “sale of use” instead of “sale of product” and on the other hand decreasing the use of polluting vehicles. Because, the car is still the most common used vehicle for work-related distances: 77% car, 10% train, and 6% choose for the bicycle (CBS, 2016).

The average work-related distance is 23 km in the Netherlands. Statistics give that 52% of Dutch employees live within 15 km to their work. From this group 53% uses at least one time a week the bicycle to go to work but 47% does almost never use the bicycle to go to work. Enlarging the distance from 15 to 20 km 59% of Dutch employees live within 20 km to their work (MobilityLabel, 2018).

If you link this to the cycle-range of electrical bicycles there is a big opportunity to replace car use with electrical bicycle use. At this moment, e-bike usage is already growing in popularity for work-related usage (CBS, 2016).

	“normal” bike	Electrical bicycle (25 km/h)	Speed pedelec (45 km/h)
Average cycled distance	3,6 km	5,5 km	-
Max. acceptable distance for work-related traffic	10 km	15 km	-
Max. acceptable distance for leisure-related traffic	10 km	30 km	-

Table 16. Distances comparison of a “normal” bike and a e-bike (CBS, 2016)

Given these points, the new concept aims to decrease car usage for work-related distances. In order to compete with cars the new concept includes an e-bike as the product in the BSS.

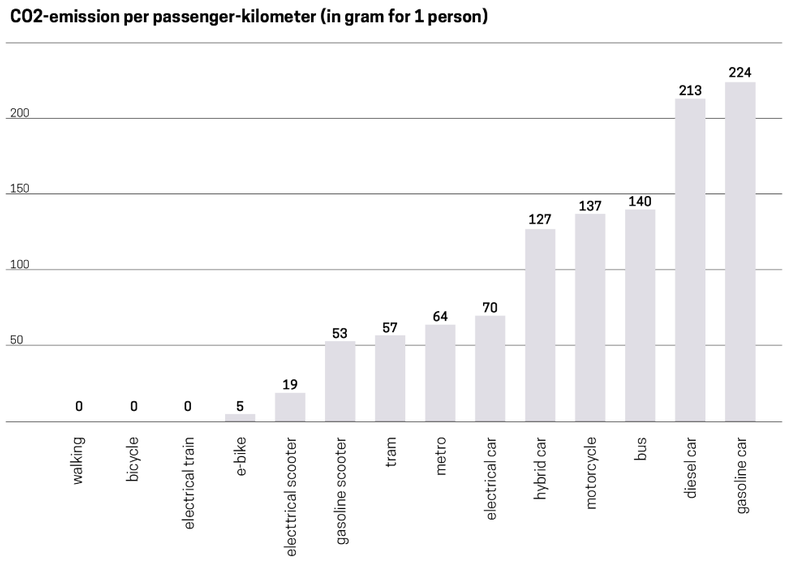
Besides work-related distances, other interesting facts are: of all car trips more than half is for distances shorter than 7,5 km. Finally, there is also an increase in using the bicycle for going to a train station, so the combination of bike and public transport is increasing.

Who?

Looking at car ownership in different age categories there is a sudden increase in the population 25 till 35 years old. Between the age of 30 and 65 years old there are the most owned cars per 1000 inhabitants and these people ride the most kilometres. This is mostly due to these people spend most time on work and family (CBS, 2019).

The population 25 till 35 years old are more and more living in urban areas where the use of an e-BSS can potentially result in more relative advantage. This because travelling in urban areas costs rather much time due to the crowded roads. From another perspective, many cities cope with the air pollution and increasingly saturated infrastructure. They are also interested in sustainable alternatives. See Graph 7 for an overview of vehicle CO2 -missions.

Overall, the new concept targets the age group of 25 till 35 years old living in urban areas to either postpone or replace car ownership.



Graph 7. CO2-emissions per passenger-kilometer (in gram for one person) (Milieu Centraal, based on numbers of CE Delft, NS and Ecotest)

What?

The new concept offered to the target group is an electrical BSS (e-BSS). The evolution from a BSS with “normal” bicycles to electrical bicycles is a logic next step seen the increasing demand of e-bikes. One of the three sold bicycles is electric at the moment (RAI vereniging, 2018). Research results point out that 70% of e-bike users use their “normal” bicycle less and 40% uses their car less. The latter is the aim of this new concept (RAI vereniging, 2018).

Noteworthy, the e-bike enlarges the cycle range for users however hardly goes faster than a “normal” bicycle because of the maximum speed of an e-bike 25 km/h (CBS, 2016). Linking this to the research results of this thesis it is assumed that consumers prefer effort savings more than time savings which gives e-bicycles a relative advantage over “normal” bicycles.

Many different e-bikes are offered but two different types can be distinguished. Electrical bicycles that have a maximum speed of 25 km/h, the same rules apply as for “normal” bicycles. The second type are speed pedelecs which have a maximum speed of 45 km/h, the same rules apply as for mopeds for example wearing an helmet is obligatory. In 2017, there are 294 000 e-bikes and 4506 speed pedelecs sold in the Netherlands (RAI vereniging, 2018). So, the market for speed pedelecs is rather small however it can enlarge the cycle range significantly.

Where?

The new e-BSS focusses on a target group of 25 - 35 y/o living in urban areas. These people can live in the city centre or in the suburbs. Work-related traffic is from home (location A) to work (location B) and back. The maximum acceptable distance of work-related traffic with an e-bike is 15 kilometres according to the CBS (2016). These numbers are presented three years ago but the popularity is still increasing. So, it is assumed distances of 20 km are acceptable too especially when travel times are similar compared to alternatives. Speed pedelecs can go much faster it is assumed that users find it acceptable to travel 45 minutes / 30 km on these bicycles.

In conclusion, the new concept focusses on usage in the city centre and suburbs. The new concept enables work-related distances with a maximum of 15 - 20 kilometres with an e-bike in urban areas (e.g. Rotterdam). Plus, on work-related distances with a maximum of 20 - 35 km with speed pedelecs in urban areas.

When?

The new concept strives to postpone or replace car ownership therefore it is preferably used every day. Because of the preferred use-case of every day use there is chosen for a subscription business model instead over a pay-per-use business model which is more applicable for incidental use.

7.4. Design goal

The design goal is to postpone or replace car ownership. Therefore, the new concept is an e-BSS targeting 25 - 35 y/o who will use it for work-related distances every day in urban areas. To increase the likeliness of the adoption of the new concept and potentially postpone or replace car ownership the motivational drivers resulted from the research are strengthened.

Correspondingly, the concept strives to postpone or replace car ownership and therefore more products can be included to reach this goal. This links to the desired seamless experience between transport modes.

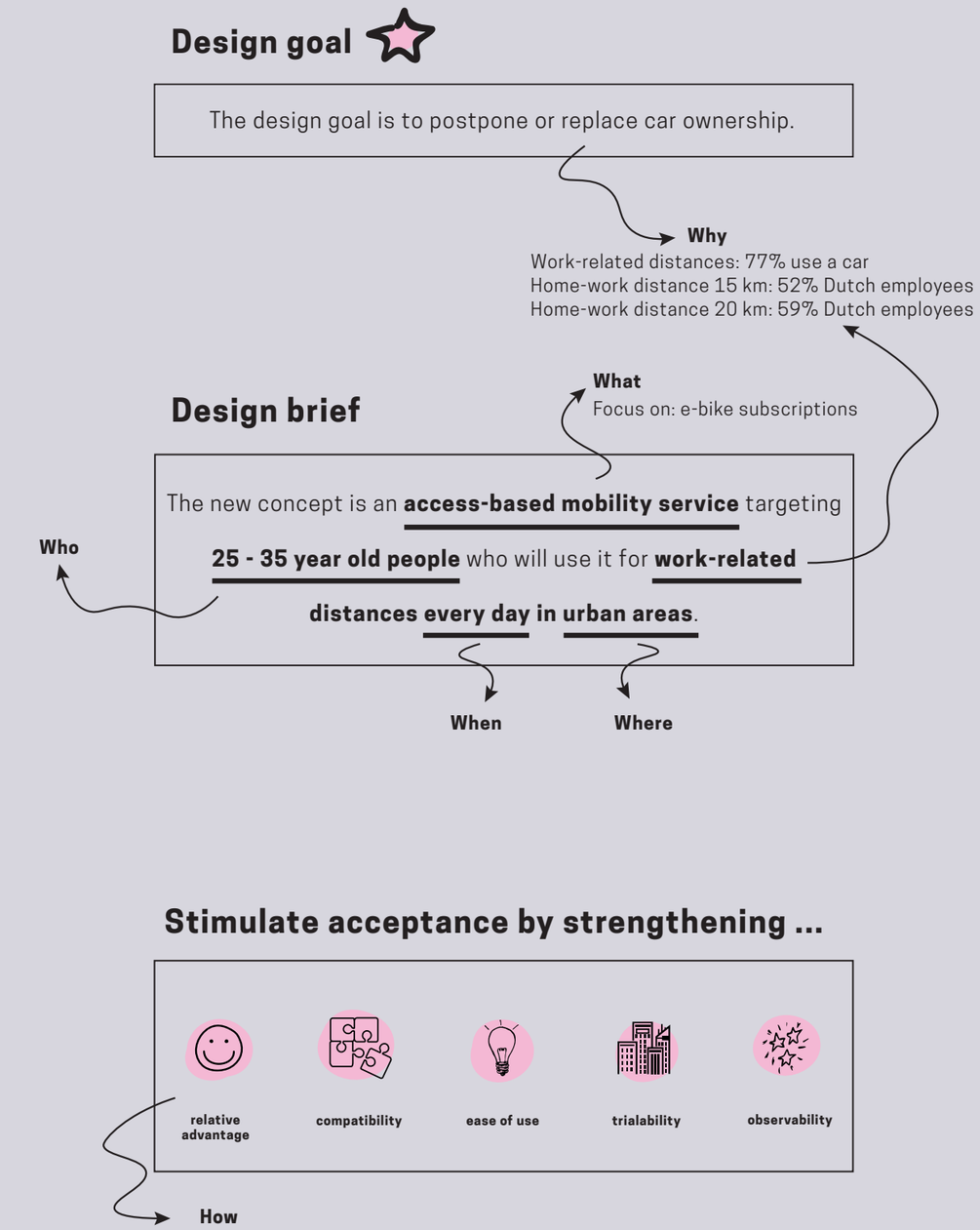
How? – Design guidelines

The solution space is explored and the motivational driver’s definitions are presented. The definitions and “quote-clouds” concluded in design guidelines given in Table 17. These design guidelines result in design solutions which strengthen the motivational drivers. Strengthened motivational drivers increase the rate of adoption and therefore reach the design goal.

In appendix 4 criteria concluded from chapter 2 till 6 for a successful BSS in general are presented.

Innovation attributes	Symbol	Design guidelines
Relative advantage		Effort savings can be enhanced if the product of the BSS saves the user physically energy.
		Effort savings can be enhanced if the service of the BSS enables a hassle-free experience.
		Financial benefits are dependent on consumer's usage patterns and alternatives.
		Perceived control can be enhanced by including (1) control over choice set composition (e.g. reversibility), (2) progress cues, and (3) information about other consumers (Wathieu et al., 2002)
		Time savings can be enhanced if the product of the BSS saves the user time.
		Temporary use can be enhanced if the BSS allows a low level of commitment.
Compatibility		Soft, intangible values can be enhanced by giving the user a feeling of being an expert, a feeling of solidarity, a feeling of certainty, making the service explicit, and if the BSS helps to show the identity of the user.
		Institutions who have the power to change regulations can have high impact on consumer behaviour.
		Product fit can be enhanced by supporting all functional mobility needs of the consumer, e.g. seamless transit experience.
Complexity		Ease of use can be enhanced on product and service-level, especially the service aspect can be a threshold. Increasing the transparency, explicit explanation, and decreasing steps support the ease of use.
Trialability		Context cannot always be influenced however there are moments the context changes for potential adopters, at these moments new mobility options are more likely to be tried out.
Observability		Recognizable design can be enhanced in the product and physical touch points of the BSS. Plus, ways to demonstrate or if it is easy to tell about the BSS are also ways to make the BSS more visible.

Table 17. Design guidelines to strengthen the innovation attributes



8. New concept: Breeze

This chapter explains the new concept which translates the research findings into concrete design solutions and fulfils the design goal. First, the persona's that represent the target group are presented. Next, a scenario is illustrated to show how the new concept is used. Finally, the concept is explained in four main elements: value proposition, consumer relationship, infrastructure management, and financial aspects.

8.1. Breeze

Breeze's products have all the same overarching goal which is postponing or replacing car ownership. Breeze is an access-based (e-)mobility service designed for 25 – 35 y/o who use Breeze's products for work-related traffic in an urban area on daily basis. Because the products are used for work-related traffic Breeze approaches companies to collaborate in travel reimbursement policies. So, Breeze's customers are companies and the company's employees are Breeze's consumers.

The different products strive to fulfil different needs and therefore seamlessly fit different use cases. The subscriptions are reimbursed by the company and monthly terminable. The prices are explained later in this chapter.

- Cruise e-bike subscription €75,- a month
- Speed e-bike subscription €150 a month
- Commute e-step subscription €20,- a month

Temporary accessories

Breeze offers besides the subscriptions one product, the cargo e-bike, pay-per-use for incidental bigger transports. To begin with, this is only available for subscribers for a set fee. Additionally, every subscriber can rent the same product as their subscription for a set fee per day. This stimulates the use of Breeze's products also in leisure time.

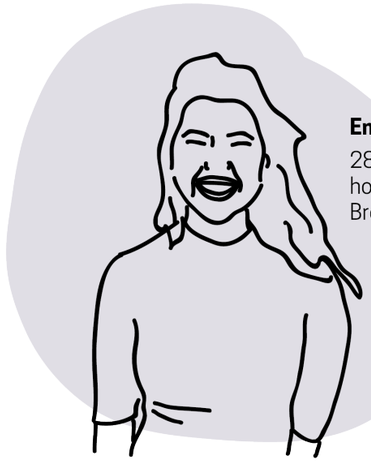
Secondly, Breeze offers temporary accessories. When the subscription is chosen, a set of accessories is offered to buy (so excluded from the subscription) but if the consumer does not need it daily he or she can choose to rent it for when it is needed. For example, a consumer plans a weekend to Zeeland with a friend. In this case, the consumer rents an extra e-bike and extra cycle bags for a set fee.

8.2. Persona's

The target group 25 - 35 y/o living in urban areas are presented by three persona's: Lisa, Emma and Rick are using different products of Breeze. See Figure 17 for an illustration of the persona's.

First, Lisa is 25 years old and lives in the city centre of Rotterdam (Kralingen). Lisa just started working at Quooker located in Ridderkerk. Lisa's home-work distance is 12,5 km, in the morning this will take between 20 - 30 minutes and in the afternoon 20 - 45 minutes by car. Traveling by car means

Lisa
25 years old
home-work distance 12,5 km
Breeze subscription: cruise e-bike (25 km/h)



Emma
28 years old
home-work distance 20 km
Breeze subscription: speed e-bike (45 km/h)

Rick
26 years old
home-train distance +/- 2 km
Breeze subscription: e-step (15 km/h)

Figure 17. Three persona's: Lisa, Emma and Rick for Breeze's different product subscriptions

being stuck two times a day in traffic. Quooker offers their employees a Breeze subscription which enables them to travel by an electrical bicycle. The cruise-option (25 km/h) makes the travel time 30 minutes for Lisa and she prefers to be outside over being stuck in traffic every day.

Second, Emma is 28 years old and lives in Delft and works at the Erasmus University in Rotterdam. The home-work distance is 20 km. This takes 30 minutes till 1 hour by car in the morning and similar in the afternoon this always includes traffic jams. Erasmus University wants to stimulate their employees to travel more sustainable therefore they offer Breeze in their traveling reimbursement policy. Emma considers the cruise-option (25 km/h) and the speed-option (45 km/h) of Breeze. This makes her travel time approximately 50 or 30 minutes. Especially, the speed-option interests her.

Third, Rick is 26 years old and lives in the city centre of Rotterdam. He commutes every work day to Quintel Intelligence in Amsterdam. The distance from home to Rotterdam Central is 1,4 km and the distance from Amsterdam Central to Quintel is 2 km. Rick goes by train because it is the fastest option to go to his work however he would like to make his journey more hassle-free. Sometimes parking and finding your bike can take quit some time at train stations. Next to that, train stations are not the most secure places to park your bike. Besides this, it can also be inconvenient for Rick if he arrives at Amsterdam Central but wants to return from a different station in Amsterdam, like Amsterdam Zuid. Therefore, he looks into a Breeze subscription for an e-step. The e-step connects different public transport modes which can save the consumer effort and potentially makes it more attractive over cars. It also makes owning multiple bicycles unnecessary.

8.3. Scenario

For one of the persona's a scenario is created to illustrate the use of a Breeze subscription. It is chosen to illustrate the scenario for Lisa because it is estimated the cruise-option will be used the most. This reasoning is based on the sales figures of electrical bicycles versus speed pedelecs (RAI vereniging, 2018).

1. *First week of work*

Lisa just started her first week at Quooker. In general organizations have policies considering reimbursing travel costs. Quooker's bicycle policy enables their employees to take a Breeze subscription which is reimbursed by Quooker. In this way, Quooker stimulates sustainable, healthy travelling and makes it easier for employees to travel to work.

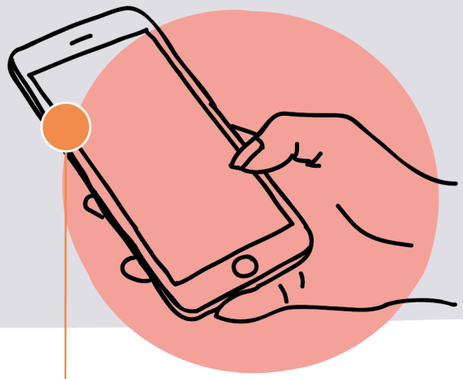
Lisa considers her options, travel times will be similar between a car and an e-bike however a car means being stuck in traffic every day. Besides buying or leasing a car is still quite expensive and public transport is not well connected. Therefore, she chooses for Breeze.

2. *Create profile & pick your product*

Lisa finds the Breeze app on her business smart phone or it is also possible to download the app via the app store. Creating a profile entails filling in personal details like name, address, drivers licence (only obligatory when the consumer would like to use the speed-option) and organization.

Next, Lisa can choose between the cruise-option, speed-option or e-step. This choice is reversible and can be changed per month. The screen presents the options accompanied with the applicable distances, in this way Lisa sees directly which option suits her situation. It is optional to read user's experiences to make a confident choice. The cruise-option (25 km/h) suits her work-related distance

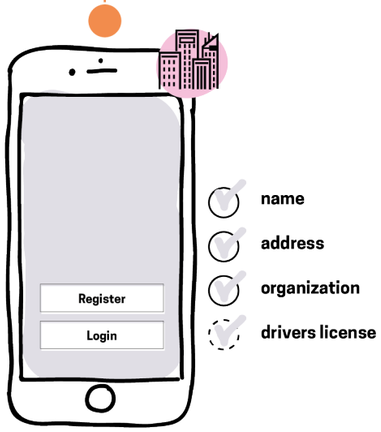
1. First week of work!

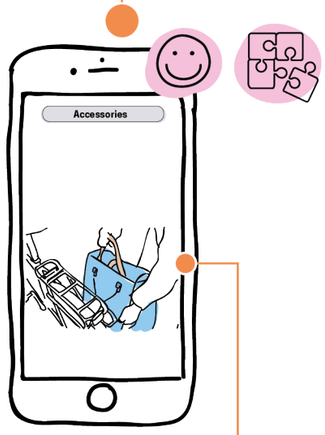


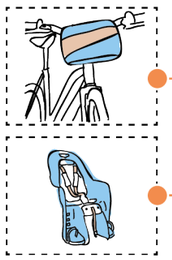
2. Create profile & pick your product

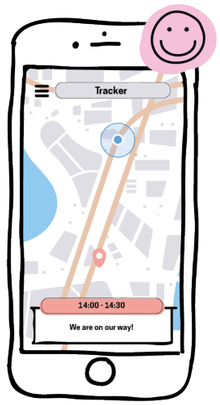
3. Delivered to you

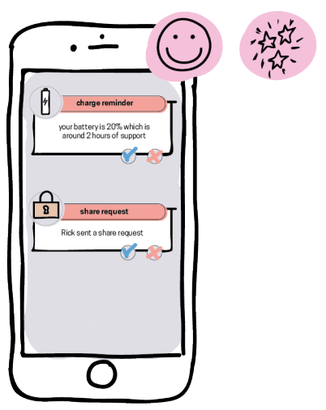
4. Effortless riding through the city!

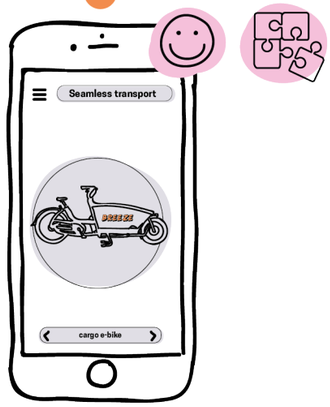












of 12,5 km the best.

In the next screen accessories can be chosen, these are offered for a set fee and are excluded from the subscription. These accessories can be a local offer like a Susan Bijl bag, cycle bags or a child seat that can be attached to the bicycle rack. In this way, the offer is customized and user's gain more control over the needed functionalities. Breeze is created for work-related distances but can also be used in consumer's free time which is not extra charged.

Breeze verifies the profile with the specific organization. The final step is making an appointment for the delivery.

3. Delivered to you & start!

Lisa is waiting at home and can track the delivery so she knows when to expect the service provider. She receives the selected e-bike and Breeze's service provider explains how the e-bike works. The battery is fully charged and is removable to make it easier to charge at home or at the office. The removable battery makes it also less theft sensitive. Lisa can unlock the e-bike by using the app. The smart lock enables tracking the e-bike for the user and the service provider in case they have to pick it up for repair. The phone can be placed in an holder on the e-bike for navigation and for charging the battery, in this case the user does not have to worry about running out of battery.

From this moment, Lisa can start using her cruise e-bike.

4. Effortless riding through the city

Lisa starts using her cruise e-bike for going back and forward to Quooker. The relative advantage of the cruise e-bike over a car is among other things no traffic jams, being the boss of your own time, no sweat, being just as fast as car, flexible, and healthy.

In addition, Breeze takes responsibility for all maintenance and makes sure Lisa has always access to a good quality e-bike. Due to the smart lock service providers can pick it up or fix it without the user having to be at that location. The application supports the user with charge-reminders when the battery runs low. Statistics are optional about the cycled kilometres.

The smart lock can be shared with colleagues, friends and family so when the bicycle is not used it can be borrowed for a few hours. For a set fee, the user can make a reservation for one extra e-bike (the same product as the subscription itself) for example for the weekend. It can be picked up from the store or it can be delivered to a preferred location. Similar for selective accessories or products, like cycle bags or cargo e-bicycles can also be rented per day. This all aims to replace potential car rides with e-bike rides.

5. Breeze: effortless rides

Breeze products aim to replace cars, first focussing on subscriptions for cruise e-bikes (25 km/h), speed e-bikes (45 km/h) and e-steps (15 km/h). The subscriptions can be complimented with temporary accessories that can expend functionalities these can be rented per day. If your situation changes you can switch between the products of the subscription within a month in agreement with the connected company.

In this manner, Breeze builds serious steps towards sustainable, seamless riding and making cars

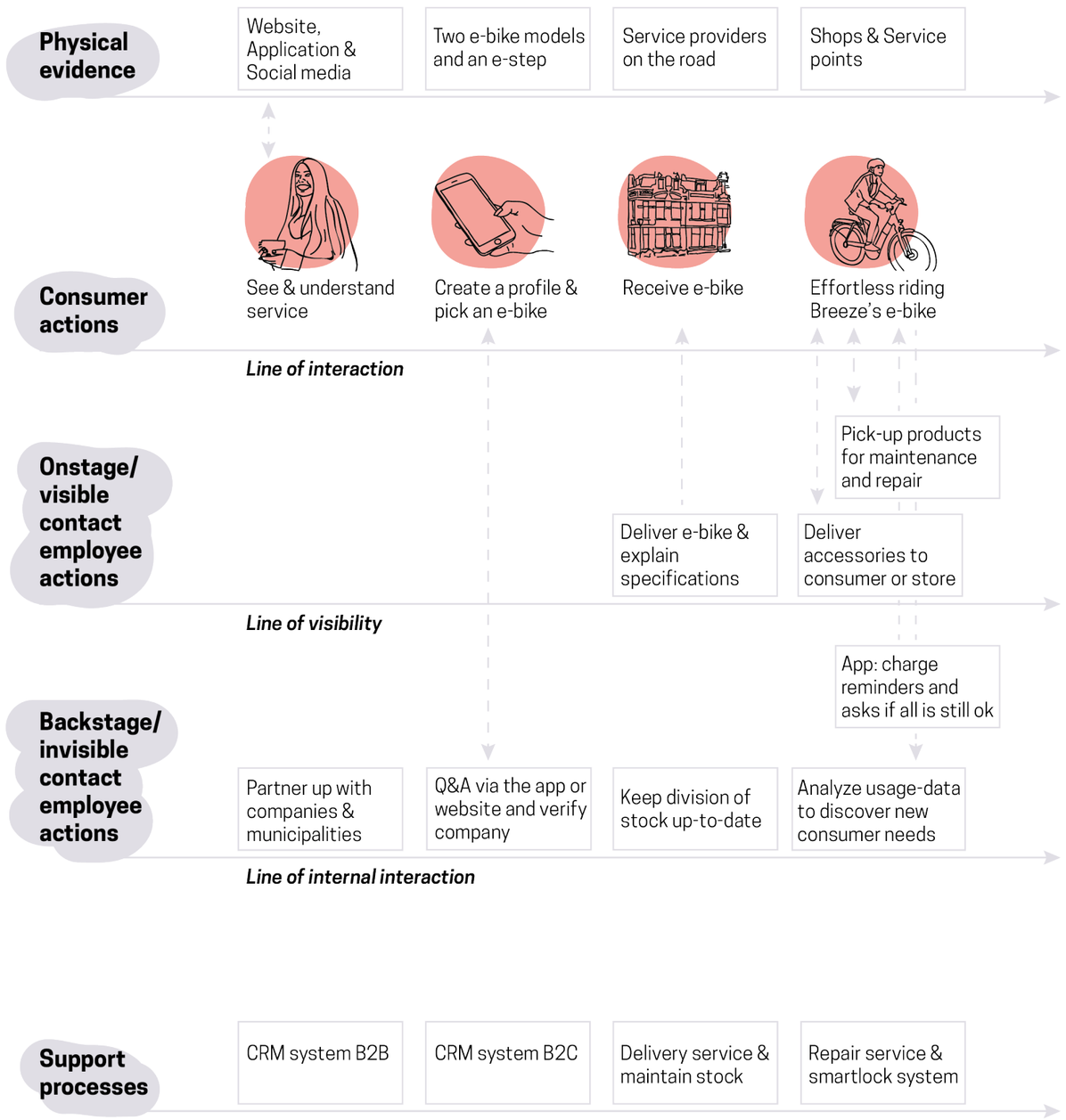


Figure 18. Service blue print of Breeze

unnecessary.

8.4. Value proposition

Breeze aims to replace car ownership and therefore offers an access-based (e-)mobility service which businesses can offer their employees. Therefore the value proposition is twofold, businesses have an hassle-free way of offering sustainable ways of traveling for their employees. Plus, it is also a healthy way which is in favour for the employee as for the employer. The employee (similar to consumer and user in this thesis) can choose a travel option which is assumed to be the most effortless, fastest and adoptable mobility service which suits changing needs.

To emphasize, Breeze provides the consumer relative advantage because it saves the consumer effort on product and service-level. The e-bike (and e-step) are easier and more flexible products to use compared to a car in an urban area. Especially, when a clear comparison can be made 30 minutes stuck in traffic jams or 30 minutes cycling on an e-bike. Or pointing out the parking prices or the difficulty to park in the city centre with a car compared with the flexibility of an e-bike. The relative advantage is made clear for consumer. On a service-level when something goes wrong the service providers will come to the consumer which makes it more hassle-free than car ownership.

Breeze provides the consumer compatibility because the different products and accessories increase the product fit for the specific use-case. Intangible values can be matched when more people use Breeze and a sense of solidarity is created. Or when the user feels a sense of certainty. Finally, the type of accessories, for example local offers can increase the likeliness that consumers can show their identities.

Breeze provides the consumer ease of use on product-level because most people are used to bicycles this is comparable with cars. On service-level it is easy to use because the consumer can select the product which suits their use-case instead of the overload of offers in car (or e-bike) ownership.

Breeze provides the consumer trialability by focusing on the context of use. Starting a new job organically goes with forming new habits and routines. Furthermore, it is monthly terminable so changes can be made in agreement with the employer or when a new contract is offered. Or in-between Breeze products can be changed per month.

Breeze provides the consumer observability, especially communicability because the smart lock can be shared for short term with friends and family. This decreases car use and increases visibility among potential adopters.

Why not buy an e-bike as an employee? Breeze offers the company and its employees a low level of commitment and low price complexity because it can be used as long as the consumer works for that company. It is important to stress that the target group is at the beginning of their career and highly likely start with temporary contracts. In this manner, the company and consumer has the desired transport mode as long as it is relevant for both.

This value proposition is delivered via certain capabilities. Product capabilities are cruise e-bikes, speed e-bikes and e-steps, cargo e-bikes and accessories like bags and baskets. Plus, interchangeable parts have to be present if repairs are necessary. Service capabilities are service

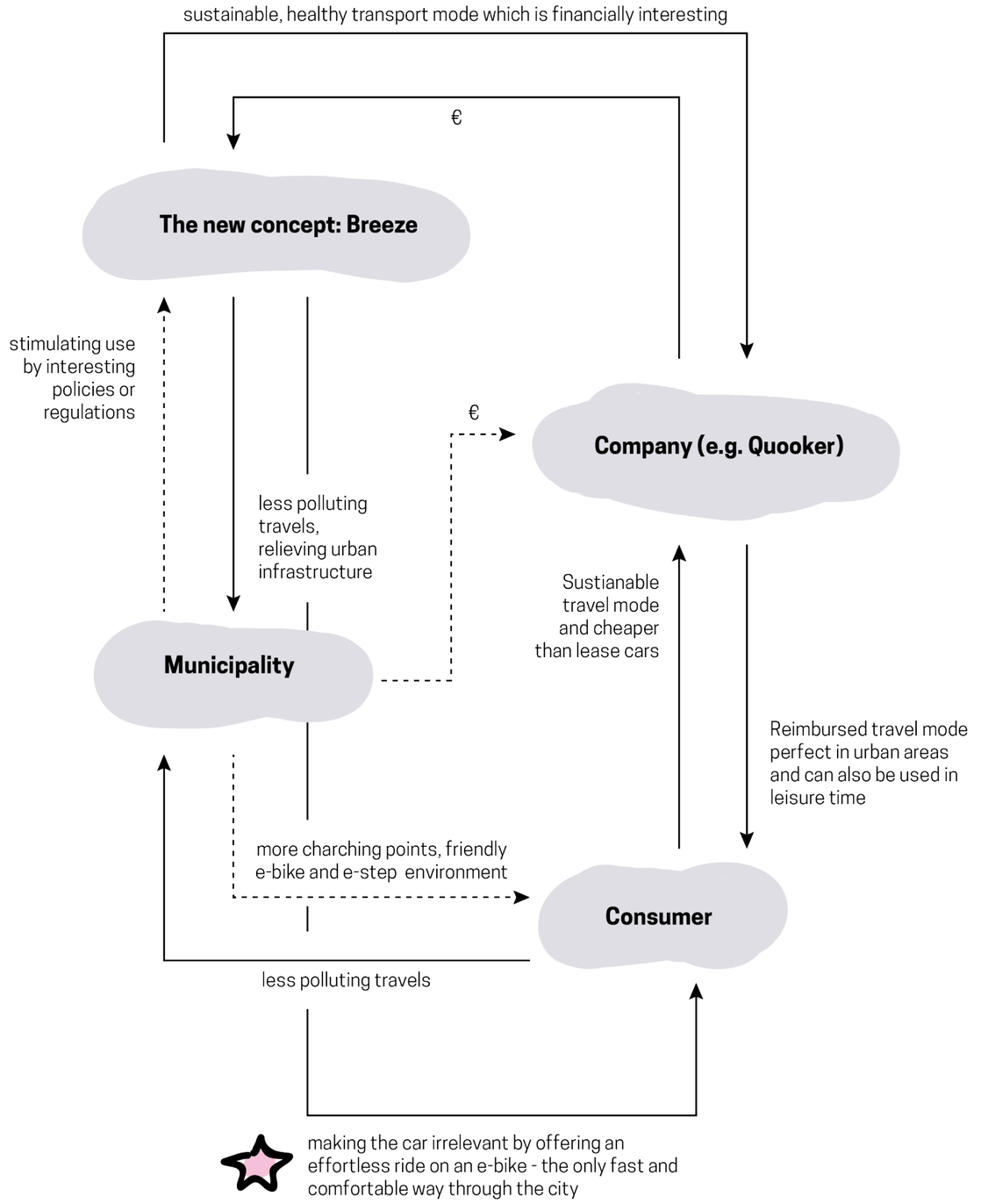


Figure 19. Value exchange system of Breeze

providers, the application, vehicles transporting the products to the consumers, shops and storage in order to offer availability. These capabilities are taken into account for the business plan.

8.5. Consumer relationship

Breeze is a product-service combination reimbursed by the company (Breeze's customer) and used by the employee (Breeze's consumer. Breeze strives for interactive communication with its consumers so it is demand responsive. This does not strive to reach out actively but to be always there when needed.

The service blue print shows an overview of all essential elements that have to be in place to deliver the new concept to the consumer. The service blue print is based on the scenario of Lisa. It shows the line of interaction the consumer has with Breeze's product and service. The line of visibility shows the visible contact with the service providers. Finally, the line of internal interaction are the non-visible actions of the employees. See Figure 18 for an overview.

The line of visibility shows the consumer relationship of Breeze which is visible for its consumers. Entering the service can be done without meeting service providers face-to-face. When the e-bike is delivered this is the first "on stage" interaction with Breeze's service provider. From that point the subscription starts where consumers can interact with service providers in order to arrange temporary accessories they desire or if there is a malfunction a pick-up moment can be arranged. Furthermore, a "backstage" interaction is created with the consumer these are charge reminders to prevent consumers having to cycle without support.

The interactions can be typified as demand-responsive interactions. The consumer is leading in this relationship and is not bothered with pushy interactions. This is a delicate matter because at the one hand as a service provider it is desired to deliver as much as possible service but at the other hand forcing interactions can be experienced by consumers as not helpful and even undesirable.

8.6. Infrastructure management

Three stakeholders are included in Breeze's concept. First Breeze itself, companies who outsource their bicycle policies to Breeze and the consumers. Optional but preferably municipalities are included too because they can stimulate companies to offer sustainable travel options like Breeze. Plus, municipalities can make cities more e-bike friendly and less car friendly by for example creating more charge points and less parking spots for (polluting) cars.

The value exchange system is presented in Figure 19. The dashed lines are optional but desirable to include in the infrastructure management.

8.7. Financial aspects

The financial aspects of the new concept are pointed out in the following paragraphs. First, the financial plan is discussed. Then, the financial benefits are pointed out between a (lease) car and an e-bike.

Financial plan

The financial plan is built up from two main elements: revenue and costs in order to determine the third element profit. The purpose is to estimate what the financial needs are and when financial stability is achieved with the set subscription prices. The pricing strategy is chosen based on the competitors. With this considered as a given factor, the financial plan explores how the price is built up considering the fixed and variable costs.

The financial plan is presented in Table 21, it shows that Breeze is profitable upward of year four. The plan shows that the new concept is feasible and viable. The following paragraphs show the assumptions made to construct the financial plan. The complete excel is presented in appendix 5.

Pricing strategy

The price is based on the competitors in the market, Table 14 on page 62, shows the subscription prices of mobility PSSs. Breeze's cruise e-bike is comparable with the Swapfiets Power 7, which costs €75,- a month. Lease e-bikes, all different kind of models that have a maximum speed of 25km/h, are between €60,- and €100,- with three year-contracts in general (www.leasefiets.nl; www.gazelle.nl accessed on 13 June 2019).

Using a competitor's pricing strategy it is concluded to set the price of Breeze's cruise e-bike at €75,- per month. Speed e-bikes are €150 per month and e-steps are €20 per month.

Product	Subscription fees (per month)	Purchase price products
Cruise e-bikes (25 km/h)	€ 75,00	€ 1.500,00
Speed e-bikes (45 km/h)	€ 150,00	€ 2.000,00
e-steps (15 km/h)	€ 20,00	€ 400,00

Table 18. Breeze's subscription fees per month

Revenue

The revenue consists of the revenue per unit and the amount of sold units. The amount of sold units is based on the estimated market. In order to estimate the market, Rotterdam is chosen as the city to launch the concept. Rotterdam has 194.084 residents in the age group 25 - 45 (Gemeente Rotterdam, 2019), this age-span is bigger than the set target group but the data is not available for 25 - 35 years old.

In the Netherlands, about two of the three people work between 15 - 75 years old (CBS, 2019). This percentage is taken to estimate the potential market of the 194.084 residents. So, this is approximately 130.000 potential consumers.

Market penetration is predicted to be 0,5% year one, 1% in year two, 2% in year three, 3% in year four and 4% in year five. The rapid growth is based on the quite disruptive growth of Swapfiets and Breeze's clear focus on the target group and location. To put it in another way 4% in year five means that Breeze has 5176 consumers in year five. To break this down, Breeze has to gain 1294 new consumers in the fifth year this is approximately five subscribers per (work) day. This is feasible because Breeze targets companies to gain consumers. It is likely that one company takes multiple subscriptions for multiple employees.

	Y0	Y1	Y2	Y3	Y4	Y5
New subscriptions						
Cruise e-bikes (25 km/h)		388	388	776	776	776
Speed e-bikes (45 km/h)		65	65	129	129	129
e-steps (15 km/h)		194	194	388	388	388
Sales in months						
Cruise e-bikes (25 km/h)		2329	6521	13601	21986	31022
Speed e-bikes (45 km/h)		388	1087	2267	3664	5170
e-steps (15 km/h)		1165	3261	6801	10993	15511

Table 19. Sales in months

The total amount of consumers is divided in a ratio over the products of Breeze. It is assumed that 60% of the subscribers take a cruise e-bike, 10% a speed e-bike and 30% an e-step. This explains the division of the new subscriptions in Table 19.

The market penetration forecasts the number of subscribers, in order to calculate this to sales in months it is presumed that every subscriber is equal to six subscription moths. Furthermore, it is presumed that 10% of the subscribers in year one terminate their subscriptions in year two, 5% of the subscribers in year two terminate their subscriptions in year three, 3% of the subscribers in year three terminate their subscriptions in year four and 1% of the subscribers in year four terminate their subscriptions in year five. It is reasoned if the subscribers are unsatisfied they will end their subscription rather early so in their first year. If a subscriber already is subscribed for multiple years it is more likely they are satisfied and continue their subscription. The mentioned presumptions explain the sales in months, see Table 19.

Cost

The costs includes fixed and variable costs. The fixed costs are not determined by the number of subscriptions. Included fixed costs are the inventory in year zero, shop necessities, salaries, financing the loan, and unaccounted costs which is determined on 10% of the fixed costs. The variable costs are depended on the subscription volume. Variable costs entail the number of products, accessories, maintenance this is divided into repairs and battery replacement. Repairs are estimated to cost 10% of the purchase value and battery replacement is needed after 2,5 years. The complete excel is shown in appendix 5.

An initial investment is needed to launch the new concept, this is €1.540.000,-. The products need to be bought before it can be offered in a subscription. The initial investment is financed by a loan and this is processed in the fixed costs (the interest per year).

Profit

Profit is the sum of the revenue and costs, Table 21 presents when Breeze is estimated to be profitable. To gain a better understanding, the revenue and costs are presented per cruise e-bike. In this manner the profit margin can be calculated.

It is assumed that the cruise e-bike lasts for at least five years. The purchase value is €1500,-, the salvage value after five years is €500,-, maintenance is €150 (per year) and the battery costs are €150,- (estimated it needs to be replaced one time in five years). This results in a profit margin of €43,33, this is about 60% of the subscription fee. See Table 20 for the costs per month.

Costs per month (cruise e-bike)	
Purchase	€ 16,67
Maintenance	€ 12,50
Battery	€ 2,50
Variable Costs	**€ 31,67**
Subscription fee	**€ 75,-**
Margin	**€ 43,33**

Table 20. Costs per month per cruise e-bike

This margin is quite high considering the cruise e-bike has a purchase value of €1500 and is repaid in 20 months. This leaves 40 months without variable costs, this ratio is interesting and indicates that the new concept will survive on the long run.

Risks

The business model does bring risks, mainly because of its high initial investment. This is the main barrier for starting this venture and also other access-based mobility services. The advantage is when the investment is made multiple users can use the product, this secures till a certain extent the five years, 60 months, of use.

Business' e-bicycle policies

Another risk is the changing business' e-bicycle policies starting in 2020. First, within a business context using an electrical bicycle was more complicated than using a car. Because if an employee wanted to use an e-bike privately, the employee had to keep track of all cycled kilometres. The maintenance and repair costs can be deducted from the private cycled kilometres. If the employee wants to use a car privately it has a fixed addition which is a percentage (22% or 4% for electrical cars) of the purchase value. So, much easier bookkeeping than an electrical bicycle.

The Dutch government wants to stimulate e-bike usage among employees so e-bikes get a fixed addition too from 2020. This percentage is 7% of the purchase value of the e-bike. For example, an employee has an income of €35000 and can use a company e-bike worth €2000. Per year the addition is €140. With the income of €35000 the employee pays only €59 taxes per year for the e-bike, which is approximately €5,- a month (Rijksoverheid, 2019).

This makes it more interesting for employees to lease an e-bike via their employers. However, employers do not give employees permanent contracts from the start. This is where Breeze comes in and strives to fulfil the (changing) needs of employees. All subscriptions are monthly terminable or interchangeable. This means more flexibility for the employee as for the employer.

	Y0	Y1	Y2	Y3	Y4	Y5
Revenue						
Subscription cruise e-bikes (25 km/h)		€ 174.675,60	€ 489.091,68	€ 1.020.105,50	€ 1.648.937,66	€ 2.326.678,99
Subscription speed e-bikes (45 km/h)		€ 29.112,60	€ 81.515,28	€ 170.017,58	€ 274.822,94	€ 387.779,83
Subscription e-step (15 km/h)		€ 87.337,80	€ 244.545,84	€ 510.052,75	€ 824.468,83	€ 1.163.339,50
Accessories		€ 15.850,19	€ 15.850,19	€ 31.700,39	€ 31.700,39	€ 31.700,39
Salvage value						€ 15.000,00
Total Revenue		**€ 306.976,19**	**€ 831.002,99**	**€ 1.731.876,23**	**€ 2.779.929,83**	**€ 3.924.498,71**
Costs						
Variable						
Bikes						
Cruise e-bikes (25 km/h)		€ 432.252,00	€ 524.026,80	€ 1.077.166,20	€ 1.001.473,44	€ 966.538,32
Speed e-bikes (45 km/h)		€ 109.389,33	€ 116.450,40	€ 239.370,27	€ 222.549,65	€ 214.786,29
e-steps (15 km/h)		€ 47.633,60	€ 69.870,24	€ 143.622,16	€ 133.529,79	€ 128.871,78
Maintenance						
Cruise e-bikes (25 km/h)		€ 58.225,20	€ 110.627,88	€ 218.344,50	€ 318.491,84	€ 415.145,68
Speed e-bikes (45 km/h)		€ 12.938,93	€ 24.583,97	€ 48.521,00	€ 70.775,97	€ 92.254,59
e-steps (25 km/h)		€ 7.763,36	€ 14.750,38	€ 29.112,60	€ 42.465,58	€ 55.352,76
Battery						
Cruise e-bikes (25 km/h)				€ 29.112,60	€ 84.426,54	€ 164.486,19
Speed e-bikes (45 km/h)				€ 6.469,47	€ 18.761,45	€ 36.552,49
e-steps (15 km/h)				€ 4.852,10	€ 14.071,09	€ 27.414,37
Accessories	€ 3.000,00	€ 6.510,12	€ 9.510,12	€ 19.020,23	€ 19.020,23	€ 19.020,23
Total Variable Costs	**€ 3.000,00**	**€ 674.712,54**	**€ 869.819,79**	**€ 1.815.591,13**	**€ 1.925.565,59**	**€ 2.120.422,69**
Fixed						
Inventory						

	Y0	Y1	Y2	Y3	Y4	Y5
Cruise e-bikes (25 km/h)	€ 150.000,00					
Speed e-bikes (45 km/h)	€ 20.000,00					
e-steps (15 km/h)	€ 30.000,00					
Accessories	€ 5.000,00					
Shop						
Furniture	€ 30.000,00					
Tools	€ 20.000,00					
Laptops	€ 5.000,00					
Van/Car	€ 10.000,00					
Rent	€ 16.500,00		€ 16.500,00	€ 16.500,00	€ 16.500,00	€ 16.500,00
Salaries		€ 80.000,00	€ 80.000,00	€ 160.000,00	€ 160.000,00	€ 160.000,00
Financing						
Principal		€ 154.000,00	€ 154.000,00	€ 154.000,00	€ 154.000,00	€ 154.000,00
Interest		€ 77.000,00	€ 69.300,00	€ 61.600,00	€ 53.900,00	€ 46.200,00
Unaccounted (10 % fixed costs)	€ 28.650,00	€ 31.100,00	€ 31.980,00	€ 39.210,00	€ 38.440,00	€ 37.670,00
Total Fixed Costs	**€ 315.150,00**	**€ 342.100,00**	**€ 351.780,00**	**€ 431.310,00**	**€ 422.840,00**	**€ 414.370,00**
Total Costs	**€ 318.150,00**	**€ 1.016.812,54**	**€ 1.221.599,79**	**€ 2.246.901,13**	**€ 2.348.405,59**	**€ 2.534.792,69**
Profit		**€ -709.836,35**	**€ -390.596,80**	**€ -515.024,90**	**€ 431.524,24**	**€ 1.389.706,02**

Table 21. Financial plan Breeze - estimated to be profitable in year four

Cars versus electrical bikes

The new concept aims to postpone or replace car ownership, therefore the costs of owning a car are pointed out. The costs are based on a new car for the first ten years. Fuel and depreciation depend mostly on the amount of driven kilometres. Maintenance and repair depend on the age of the car, insurance and taxes on the type car.

The fixed maintenance costs are for example car washes, cleaning materials, and a membership of an emergency service. The variable maintenance and repair costs are check-ups, repairs and tires.

Costs of a car per month in €				
	City car (A segment)	Subcompact (B segment)	Small family (C segment)	Large family (D segment)
Fixed costs				
▪ Depreciation (excl. interest)	58,-	72,-	127,-	188,-
▪ Motor vehicle tax	19,-	33,-	47,-	57,-
▪ Maintenance	21,-	21,-	21,-	21,-
▪ Insurance	64,-	77,-	93,-	114,-
Total fixed costs	163,-	202,-	289,-	380,-
Variable costs				
▪ Depreciation (excl. interest)	20,-	30,-	39,-	56,-
▪ Fuel	73,-	90,-	109,-	113,-
▪ Maintenance and repair	40,-	44,-	61,-	68,-
Total variable costs	133,-	163,-	209,-	237,-
Total costs per month	**296,-**	**365,-**	**499,-**	**617,-**
Average mileage	9 000	10 000	11 500	11 000
Kilometer price (eurocent)	39	44	52	67
Kilometer price variable costs (eurocent)	17,7	19,6	21,9	25,9

Table 22. Costs of a car per month in euros based on ten years ownership (ANWB by Nibud, 2018)

Also a lease-car has fixed monthly costs for the consumer, in general this is 22% of the purchase value. It depends on the income how much the costs are per month. The monthly costs are not likely to be lower than €200,- a month it will rather be higher.

In conclusion, the consumer can save a significant amount of money using Breeze for work-related distances.

Financial benefits for employers

In the Netherlands, the standard policy for reimbursment is €0,19 per kilometer. In the case that the employer reimburses travel costs, Breeze is likely to be financially interesting. When an employee has a work-related distance upward from 10 km a cruise e-bike subscription is already better priced.

Compared to lease cars and public transport Breeze's subscriptions are expected to be cheaper. Breeze does not necessarily want to compete with public transport. The e-step even wants to ease the connection between multiple mobility providers. But Breeze does want to compete with cars. For both, the company and the consumer it is expected to be economically more interesting compared to alternatives.

Figure 20. New generation has potentially stronger values towards sustainability

9. Evaluation

This chapter includes an evaluation of the new concept. The evaluation is carried out in a focus group and in this session the design goal and the design solutions are discussed. In conclusion of this thesis limitations are discussed, future research directions are suggested and the main conclusions are presented.

9.1. Evaluation new concept: Breeze

The new concept is evaluated in a focus group. This session is built up in two parts, first discussing the design goal and second discussing the concept more into detail in order to assess the included motivational drivers.

The recommendations concluded from the evaluation are partly already included in the new concept presented in the previous chapter. The scenario evaluated during the focus group is presented in appendix 6 and an impression is given in figure Figure 21. The design goal and selected motivational drivers are still the same only the design solutions to strengthen the motivational drivers can be altered due to the recommendations.

Focus group

The focus group consisted of four people two females and two males. Three participants are twenty-five years old and one twenty-six, employed and with an industrial design background (Integrated Product Design, Design for Interaction and Strategic Product Design), see Table 23. The participants are selected because of their experience in designing new concepts from a consumer centric perspective and because they can identify themselves with the target group. The session is completed in two hours.

First, a brief introduction is given about the research and the scenario is explained. A hypothetical situation is created by asking the participants to assume their home-work distance is between 5 – 15 kilometres. The design goal is discussed and probed by three statements. The three statements are (1) if the distance between my home and work is between 5 – 15 kilometres I would use Breeze, (2) I will buy a car between this moment and my 35th birthday, and (3) Amsterdam's action plan clean air is the future: making the city emission-free and banishing gasoline and diesel cars.

Secondly the ten selected motivational drivers are shared with the focus group. Then, the scenario is step-by-step discussed and assessed on the motivational drivers. The goal was to test if the design solutions within the new concept do strengthen the selected motivational drivers or not.

Participants	Gender	Age
P1	Male	25
P2	Male	25
P3	Female	25
P4	Female	26

Table 23. Participants focus group for validation session new concept

Results

First, the design goal is evaluated and this is rather positive reviewed. However, it is important to high light that transport modes are highly dependent on the use case. In general, the favourite transport mode within this focus group for work-related distances is the bicycle (or walking) however arriving sweaty at work is mentioned as a major disadvantage. The bicycle is preferred over a car but among other things the weather is mentioned as unpredictable, for example rain jeopardizes the willingness to use a bicycle and the new concept.

Statement 1: If the distance between my home and work is between 5 – 15 kilometres I would use Breeze.
Discussing the first statement, two confirmed and two are more hesitant. P2 is already using Swapfiets and would prefer the new concept for a distance between 5 – 15 km. P3 would want to use it but directly mentioned how the bicycle would look like, preferably not too heavy. P1 said no because the 5 – 15 km distance is too little for an electrical bicycle especially for his age. The participant stated that he would prefer to buy a nice bicycle which cycles pleasantly however that costs between €800,- and €1000,-. The purchase value of an electrical bike is rather high considering this plus arriving sweat-free this participant would want to use the concept nonetheless. P4 is a bit sceptic about everything turning into subscriptions. If all use turns into subscription models than the monthly costs become quite high perhaps even too high. Besides there is value in owning products for example paying five years for an e-bike can be quite expensive and in the end, you do not own it so you cannot sell it.

It is mentioned that in general all transport modes have monthly costs, for example cars and public transport have fixed monthly costs. Different from music and movies which Spotify and Netflix transformed into subscription-offers with fixed monthly costs.

It is assumed by the participants that companies will reimburse partly the use, examples are shared of €0,19 per km. If that is the case, the new concept becomes more desirable. It is concluded that the new concept has to partner with companies this is a must.

Statement 2: I will buy a car between this moment and my 35th birthday.
The second statement resulted in two participants stating they will and two participants state that they won't buy a car before their 35th. Reasons in favour for buying a car is not specifically to drive in urban areas, but to get to places outside an urban area. P1 starts working in Friesland which is not well connected with public transport and therefore needs to buy a car. P3 is surfing weekly and therefore a car is needed to get to the beach and to transport the boards. At the moment, she is dependent on her friend who owns a car and the participant prefers to go whenever she wants to which means buying car. Car-sharing is discussed but these two are not convinced yet because they do not believe it is cheaper than buying a low-priced car.

The other two participants do not think they will buy a car because it is expensive and they do not need it that often. For example, going to work is faster with public transport than a car. When they do need a car, they can borrow one from family or friends. In both statements costs are important in the decision process.

It is mentioned that accessories could fulfil functionalities what normally a car fulfils, like a "bakfiets", a cargo bike that can be used for going to the beach with a surfboard or a weekend away to Zeeland. Another example is the ability to use bags that can be attached to the bicycle carrier.

Temporary adjustments that can be made not only at the moment the e-bike is selected but during the whole use-period. P4: *"Per context we want something else nowadays."* Additionally, it can be interesting to make a second e-bike available for a set fee to be able to make trips with someone in the weekends.

Informing the focus group about an EU funded project focusing on sharing electrical cargo bikes they responded positively. This concept strives to prevent buying a second car for families living in the city.

Statement 3: Amsterdam's action plan clean air is the future: making the city emission-free and banishing gasoline and diesel cars.
Statement three resulted in a consensus, all four think it is the future banishing gasoline and diesel cars out of cities. Probably electrical cars won't get lower priced that easily, P1 thinks ten years is too short. In that case, cars worth between €1000 and €20.000 are banned and those users cannot afford an electrical car. Interesting alternatives are electrical bicycles.

P3 mentions he already dislikes riding through the city with a car he prefers a scooter because it is much faster just like an electrical bicycle. Besides, e-steps are mentioned as interesting especially when you are commuting because of the lightweight and small size. Electrical foldable bicycles can be interesting for commuting too however an e-step is smaller which can be more convenient in the train.

In conclusion, the participants would like to use the concept if their work-related distance is between 5 – 15 kilometres and they live in a city. The work-related distance can be bigger than 15 km because it is estimated an electrical bicycle can have a bigger cycle range. The potential to postpone car ownership is questioned but it is assumed the new concept is preferred to use in urban areas over a car. Overall, the bicycle is the favourite transport mode for work-related distances. The adoption of the new concept will increase when policies like Amsterdam will banish gasoline and diesel cars when electrical cars are still rather expensive.

Concerns derived from the session are where do I leave the e-bike in the middle of the city because of the sensitivity of theft and vandalism? Where do I charge it? It is recommended to explore these aspects further when developing the new concept.

Design solutions for motivational drivers
Scenaria step 1: first week of work!
[Trialability: context of use] The entry moment of the concept included in the on boarding process is a fitting occasion. The participants mentioned they all received a bicycle option of their companies and that this is the moment a new employee decides how they are going to travel to work.

[Complexity: ease of use] The animation explaining the service when you open the app is not necessary. An explanation should be present somewhere because of the smart lock however if someone downloaded the app it is likely that person already knows something about the service. P3: *"We are also the generation who just want to try it, right?"* So, it is concluded this design solution is not making the new concept easier to use.

Scenario step 2: Create profile & pick your product

[Relative advantage: perceived control] Making the profile, the first design solution is choosing between the two e-bike models the added user's experiences strive to give more perceived control. This is invalidated. P2 does like to read reviews of other users before buying products. The others do not think it enhances the ease of use. P1 states the two models are quite different therefore used in different situations. Next to this, the prices difference will be quite high because the price differences between such electrical bicycles, 25 km/h versus 45 km/h, are significant. Probably, when a new consumer enters the service he or she already knows which model they prefer for their situation. It is recommended to focus more on specifications and the use case. For example, for 7 – 15 km the best option is the "cruise model" and for 15 – 35 km the best option is the "speed" model.

It is questioned if 15 km is really the maximum distance users would want to ride with an e-bike. P1 who worked several years in a bicycle store mentioned there is only a selective target group for electrical bicycles with a capacity of 45 km/h. This target group do like to cycle and buy such a bike because they will cycle quite some distances, so this is a wider cycle range than the "cruise" model. So, it is concluded the "speed" model can better be presented in a different scenario or persona.

[Compatibility: ability to match soft, intangible values] The local offer is validated and it is recommended to add more accessories. P4: *"Veloretti has a nice way of offering their basic model and choosing between some alterations."* This enhances the perceived control and the customization. These can be offered for set fees excluded from the subscription.

Scenario step 3: Delivered to you

[Relative advantage: effort savings] The function tracking the e-bike and service providers is validated, this will enlarge the relative advantage of the concept.

Scenario step 4: Effortless riding through the city

[Relative advantage: effort savings & perceived control] The optional functions like statistics about the cycled kilometres, new routes and weather pop-ups are validated. Not specifically for these functions but more for the ongoing connection, it is concluded that it is a nice feeling the service providers are present and at your disposal. This can also be reached by a physical store which can be visited any time. Other recommendations are charge-reminders so you won't run out of battery and service-reminders like is everything still okay?

Scenario step 5: Smart lock for an ultimate experience

[Relative advantage: time savings] The smart lock is validated this feature enhances the relative advantage. Recommendations are automatic locking if the user forgets it or that you can share your lock with friends and family if they want to borrow the bicycle. P3: *"Just like making a hotspot. You can receive a message of a friend or family member and that you can approve or not to lend your e-bike."* This will also enhance the trialability and observability of the new concept. Plus, there needs to be a charging option because your smart phone needs to have battery for the use of the new concept, preferably connect-free.

[Relative advantage: temporary use][Compatibility: product fit] The seamless service is validated this is going to be the norm in the upcoming years and will provide users with relative advantage and make it more compatible for potential adopter's lifestyles.

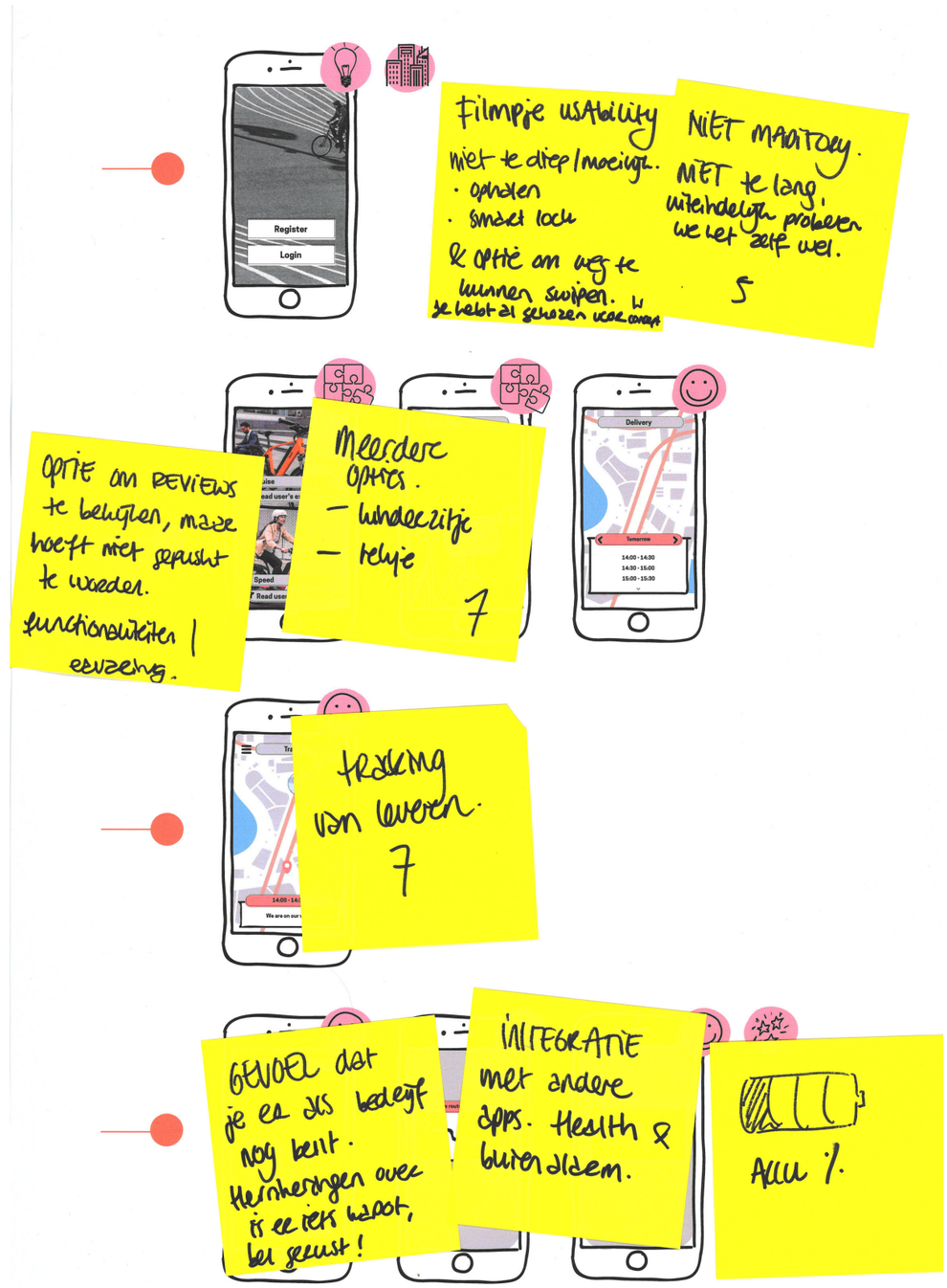


Figure 21. Impression of results of focus group evaluating the design solutions of Breeze

Discussion

The new concept's design goal and its included design solutions are evaluated in a qualitative manner. The qualitative focus group results has its limitations. First the advantages are discussed and next the limitations are pointed out.

Qualitative research enables the researcher to gain a deeper understanding of the situation or participants. The used statements stimulate a discussion about the design goal, whether or not the new concept would replace or postpone car ownership. This discussion gives deeper insight in the participant's reasoning. Plus, advantages are that uncertainties about the new concept can be discussed and clarified. Assessing the design goal and the design solutions are more likely to be improved with qualitative input than with quantitative input because participant's reasoning is limited presented in quantitative research.

The limitations of the qualitative focus group is that a group of four participants does not represent the target group. As a qualitative research is more about exploration and descriptive of a (hypothetical) situation, quantitative research is more about facts and numbers. Therefore, it is concluded that qualitative methods are more applicable to evaluate a new innovation. Quantitative methods are more applicable to validate wide-spread adoption of a new innovation.

Furthermore, limitations are that the motivational drivers concluded from this research are not validated in a quantitative manner yet. It is assumed these motivational drivers influence the rate of adoption. When these are validated this can result in alterations in the new concept. Next, the participants of the focus group assumed they have a work-related distance of 5 - 15 km, this is a hypothetical situation for them. It can result in less trustworthy conclusions because the hypothetical situation is not a familiar situation for the participants. Finally, the participants do not own a car yet so this can make them more open-minded about alternative modes of transports.

Recommendations & challenges

The discussion highlights limitations of the evaluation and therefore it is recommended to execute a quantitative study to validate the motivational drivers. Plus, it is recommended to illustrate clear scenarios (for example with A/B testing in a quantitative manner) if the target group would prefer the e-bike over the car. When this is validated the new concept has validated a strong value proposition however still several challenges can be pointed out.

Breeze's service includes all maintenance and repairs of their products, this means picking up and delivering the products to their consumers. Because of the bigger cycle range of the two e-bike models the service areas are rather big. This challenges the response rate of the service. A solution can be to arrange maintenance days at the companies in order to efficiently maintain the fleet. It is desired to set-up a system which keeps track of the products and its number of malfunctions and repairs. This can give Breeze an idea of when and what happens with the products to optimize its products and to estimate service-demand.

Another service element is the fulfilment of the consumer's changing/temporary needs. At this moment, the concept offers accessories in stores to pick it up and also via the app which can be delivered to the consumer. However, if this is frequently used the delivery option can be too challenging. This needs to be explored. A solution can be more stores, so pick-up becomes more convenient. Unmanned locations/pick-up points can be interesting, for example a Breeze-box which

can be opened with the Breeze-app and in this way you can grab a cargobike. Finally, interesting to explore can be offering spare battery's in "vending machines" like Gogoro does for its e-scooters (www.gogoro.com). This service element is considered as important because it covers different use cases for the consumer which makes it more and more one seamless travel solution. This differentiates also from the other mobility PSSs and makes it more competitive with cars.

The challenges considering the product is among other things the expense. Electrical bicycles are quite expensive which makes the investment quite high. However, there is evidence that e-bikes are growing in popularity, regulations are changing and also the government wants to stimulate employees to cycle. Besides, Swapfiets is growing rapidly which shows an interest in bicycle subscriptions. So, not only a challenge but also a big opportunity to build a network of interested stakeholders.

Another challenge considering the products, speed pedelecs (45 km/h) do have different regulations than e-bikes (25 km/h) this is considered as a challenge for Breeze because it has to be up-to-date of all regulations. This product is also "newer" for potential consumers so the threshold may be higher to try this out. To minimize this challenge it is advised to start with a small batch to extract learnings from it and lay the main focus on the cruise e-bike subscriptions.

Finally, the e-steps involve the most risks compared to the other products because it is not commonly used in the Netherlands. This means not many regulations and policies are explicit about the use. Abroad, for example Paris does face problems with shared e-steps. The shared e-steps in Paris are free-floathing and have an incidental use-case, the e-steps are used on the road, cycle lanes and also on the sidewalks. In-between usage there is high anonymity which gives the user a feeling of low responsibility. The new concept can expect some hesitation from a desired stakeholder: municipalities. However, an e-step subscription means no anonymity. The consumer is responsible for the product and therefore it does not result in nuisance in public space. Finally, Breeze strives for clear regulations with the municipality and wants the e-steps only on the cycle lanes. A difference with foreign countries is that the Netherlands has a good infrastructure of cycle lanes, therefore roads and sidewalks are not necessary to be used. Finally, Breeze offers an e-step with a top speed of 15 km/h which is an average cycle speed.

9.2. Limitations research

The research of this thesis resulted in an overview of consumer's motivational drivers to use a BSS in the Netherlands. Research takes the following limitations in and these should be taken into account.

First, there are no mixed methods used so no triangulation is achieved. The convergence of different methods can result in more accurate, comprehensive, and objective representation of the studied object. The drawbacks of the qualitative study can be researcher's misinterpretations because of personal biases and perceptions. A wider quantitative study can potentially compensate these drawbacks.

Secondly, the DOI theory (Rogers, 2003) is applied in analysing the gathered data. It is discussed that this theory is based on product innovations. Many studies applied this theory analysing the innovation attributes of service innovations however other studies also used alterations of the framework when analysing services. No alterations of the framework are included in this research so the service element is treated the same as the product element. To explore the service-element

more Tornatzky and Klein (1982) added “communicability” and “riskiness” as an innovation attribute, which is advised to include in follow up studies. To see if other factors can be concluded concerning the service element of a PSS.

Finally, the number of consumer interviewees is ideally higher to get richer data. This can result in alterations or new factors that may influence the BSS usage.

9.3. Future research

Future research directions complimenting this thesis can be a quantitative study validating the motivational drivers, this study can be focused on different target groups. An interesting group would be the target group of the new concept which is the population between 25 - 35 living in urban areas. Secondly it would be interesting to research correlations between motivational drivers for BSSs and context factors because it is expected that the use case influences the relative advantage of BSSs. These findings create a deeper understanding of potential adopters and what drives them to use a BSS. This can help in stimulate more sustainable consumption patterns BSS specific but also learnings for PSSs in general.

Future research directions for PSSs can be researching more successful PSS-cases, this results in a better understanding and the ability to do cross-case analyses. Furthermore, research can focus on different aspects. In this thesis the focus is on the consumer but an interesting direction can be studying management, aiming to raise successful transition steps from “sale-of-product” to “sale-of-use”. Finally, more research is desirable about concrete (measurable) PSS’s environmental benefits compared to ownership. This can stimulate PSS’s adoption and thereby sustainable consumption patterns.

Noteworthy, at the moment many climate and environmental strikes are initiated by kids from primary and high schools in the Netherlands but also in more European countries. This can indicate a change in values and potentially a new generation who is more likely to adopt new innovations driven by sustainability.

9.4. Conclusions

The aim of the research presented in this thesis is to find the motivational factors stimulating consumers to use BSSs in the Netherlands. In summary, the analysed cases are Swapfiets, OV-fiets, Mobike and Felyx. Nine interviews are conducted with experts and consumers, eight are transcribed and analysed with the Grounded Theory (Charmaz, 2007) and DOI theory (Rogers, 2003). This resulted in twenty-four motivational factors categorized by the five innovation attributes of Rogers (2003): relative advantage, compatibility, complexity, trialability and observability. The twenty-four motivational factors can be found in Table 7 on page 51.

Contrasting findings between experts and consumers are found considering the motivational factor “time savings”. It can be concluded that experts assume this to create most relative advantage while consumers rate “effort savings”, “financial benefits” and “perceived control” as higher.

Additionally, contrasting findings between experts and consumers are found within the innovation attribute compatibility. Experts mention “accessibility service providers” and “low level of altering consumer’s habits” most frequently while consumers mention “ability to match soft, intangible values” and “product fit” most often. These findings point out the difference between access-based consumption and ownership. Consumers are likely to extract meaning from owning products and these needs are more difficult to fulfil with access-based products.

Furthermore, the trialability of BSSs is assumed to be sensitive for the context of use. This motivational factor is divided into: weather conditions, cycle range, available mobility options, type of city, and frequency of visiting a location. Considering complexity and observability the findings are aligned.

Additionally, a selection of the motivational drivers are included in an illustrative new concept: Breeze. This illustrative concept implicates how the motivational drivers can be translated and strengthened in a new BSS to stimulate the rate of adoption. A future-oriented scenario is presented where an electrical BSS is proposed for work-related distances to postpone or replace car ownership.

To conclude, the findings raised in this thesis provide a deeper understanding of the consumers’ perspective on BSSs. The findings suggest what factors are more important to stimulate the rate of adoption. For future research, it is a useful base for a quantitative study to validate consumer’s motivational drivers to use a BSS in the Netherlands. The research findings are also a useful source for a more in-depth research about mobility PSSs in general.

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