Identifying and Fulfilling Business-to-Consumer Station-Based Carsharing Potential Interventions for Dutch Urban Areas in Development through Design Science Research

den Hartog, Thijs W.

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T.W. den Hartog, March 2023

TU/e EINDHOVEN UNIVERSITY OF TECHNOLOGY

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Identifying and Fulfilling Business-to-Consumer Station-Based Carsharing Potential

Interventions for Dutch Urban Areas in Development through Design Science Research

T.W. (Thijs) den Hartog

March 16th, 2023

A thesis submitted in partial fulfillment of the requirements for the degree of:

Master of Science in Innovation Management

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Assessors (Eindhoven University of Technology)

dr.ir. A.C. (Rianne) Valkenburg – 1st Assessor/Supervisor

dr. J. (Jaime) Bonnin Roca – 2nd Assessor/Supervisor

dr.ing. P.J.H.J. (Peter) van der Waerden – 3rd Assessor

Company Supervisors (BPD Ontwikkeling B.V. Regio Zuid)

M.D.J.M. (Martijn) Knapp

M.E.T. (Mireille) Knape

Preface

When I finished my bachelor's degree in automotive engineering in 2020, I knew roughly what the purpose of my professional career would be; contributing to society by innovating in sustainable mobility. Yet I also knew that I did not have the knowledge and skills to make the flying start in this field of work that I strived for. That is why I decided to start the pre-master's program for the master in Innovation Management at the Eindhoven University of Technology. During the following two years of the master program, I learned how to manage projects, processes, and people to successfully implement new products and services. Unfortunately, due to global events unforeseen by me and many others, most of these lessons were learned behind a laptop in a small student room in Eindhoven. Without the frequent (video conference) discussions with fellow student Stan Cosijns, who was a great team mate and sparring partner for many courses and assignments, these two years would have given me many more gray hairs.

After returning from a semester of international experience in Grenoble, I got the opportunity from Bouwfonds Property Development (BPD) Ontwikkeling Regio Zuid to write the master thesis that currently lies before you. Even though this thesis is the product of my own exhaustive efforts, it could not have been completed without the help of some very special people. That is why firstly, I would like to thank all BPD colleagues at the Eindhoven office. Not just for the input in, and feedback on my research project, but also for accepting me as one of their own during these last six months. Most notably, I would like to thank the mobility team for the *De Caai* project, but also Mireille Knape, who was especially helpful in formulating the research problem, and Martijn Knapp, who guided me throughout the entire process and taught me about some of the intricacies (and sometimes struggles) of urban development projects. I would also like to thank again all interviewees, within and outside BPD, who were kind enough to cooperate, and who provided me with valuable insights I could not have obtained in other ways. From the university, I would like to thank Jaime Bonnin Roca, who helped me improve my work in his role as second supervisor. But without a shadow of a doubt most importantly, I would like to express my gratitude to Rianne Valkenburg. Every time I thought I did not need supervision, she proved me wrong by pointing me in the right direction, not just with regard to

methodology, but also with regard to content and writing. Throughout this semester, she has truly shown me what it means to be a supervisor and mentor, for which I am incredibly grateful. Finally, I would like to thank my parents and grandma for supporting me during my entire student life, it would not have been as carefree without them.

Now, without further ado, I present to you my master thesis. Even though it was quite a challenge to write, it has been a thoroughly enjoyable process. So I hope that you like reading it as much as I liked writing it, but above all, I hope that you may learn a thing or two about an important facet of tomorrow's mobility.

Eindhoven, March 16th, 2023

Summary

Keywords: *Shared mobility, Vehicle sharing, Carsharing, Station-based, Urban development, Design science*

Introduction

Present-day large-scale urbanization calls for the development of additional housing and facilities within the borders of cities. However, this densification requires efficient land-use, which in many cities is hampered by the dominant role of private passenger cars that take up considerable amounts of space, in the form of both infrastructure and parking facilities. Hence, vehicle sharing services, or "the short-term renting of vehicles according to the user's needs and convenience", may provide an opportunity, since they can reduce vehicle ownership, and thus the total amount of space used by vehicles in urban areas. That also means that vehicle sharing services pose an opportunity for commercial urban area developers (UADs), who's core business is to occupy a directing role in the profitable development of the built environment, because the space saved on parking facilities can be used on other facilities that add more social and financial value to an area. Yet UADs still have limited knowledge on how to successfully implement and facilitate vehicle sharing services in development projects. Firstly because, in its current form at least, these services are relatively new, and secondly since most of the academic attention has focused on the provider's perspective (e.g. short-term balancing of one-way vehicle demand and supply). But UADs are especially interested in a long-term match between supply and demand of vehicle sharing services to optimize the trade-off between the space being used on mobility and the fulfilling of the mobility needs of an area's residents and visitors. Therefore, the following main research question (RQ) was posed: "How can a UAD facilitate an effective long-term match between supply and demand of B2C vehicle sharing services in to be developed urban areas in the Netherlands?"

Theoretical Analysis

To answer the main RQ, first, the factors that determine the potential demand for vehicle sharing services were identified (sub question 1), since these can give a UAD an indication on how much space should be dedicated to those services. A systematic literature review (SLR) was employed for this sub question (SQ) because it was expected that the knowledge was available, albeit specific and dispersed. The hierarchical overview of potential demand factors identified from the SLR is shown in Figure A.

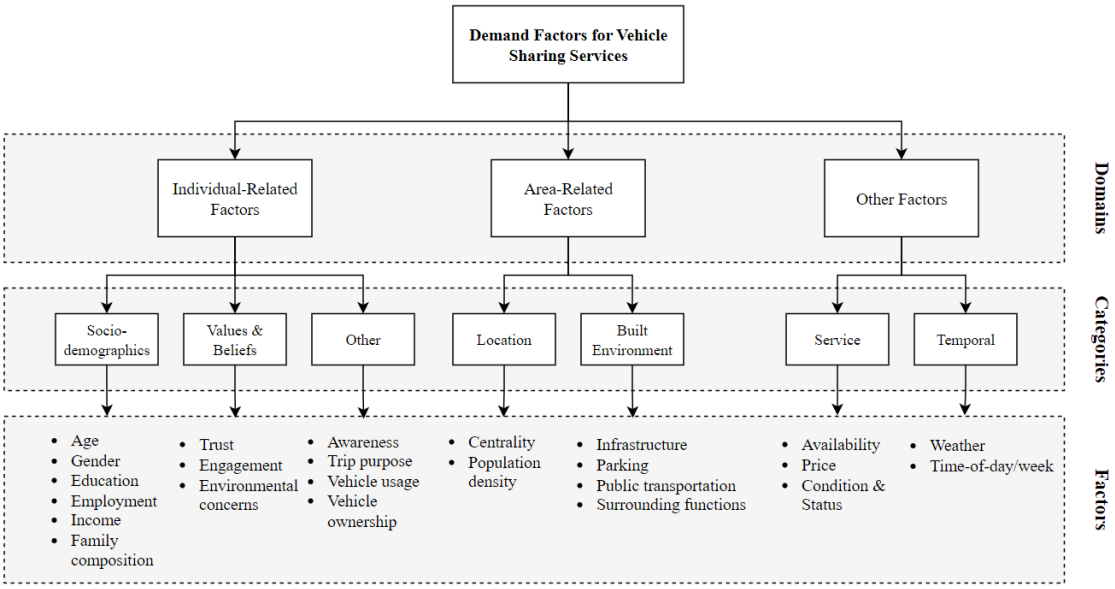

Figure A – Factors determining the potential demand for vehicle sharing services.

The way in which the factors influence the potential vehicle sharing demand depends on the service mode and the Mode-of-Transport (MoT). For example, the area-related factor "parking" has a different effect on free-floating carsharing (FFCS) use than on station-based carsharing (SBCS) use. More specifically, FFCS vehicles, which can be picked up and returned anywhere within a designated service area, are more often used in zones with plenty of on-street parking available. Contrastingly, SBCS vehicles, which always need to be returned to the same reserved parking spot, are more often used in zones with poor or regulated parking facilities, since people do not have to worry whether a spot will be available for the shared vehicle. With regard to individual-related factors, some are consistent across all services modes and MoTs, whereas others are more context dependent. For instance, users of vehicle sharing services are generally highly educated and motivated by environmental concerns, regardless of the service mode or MoT. The age of vehicle sharing users, on the other hand, varies per MoT, with carsharing users being the oldest, and (kick-style) e-scooter sharing users being the youngest.

Empirical Analysis

Even when a certain urban development project has a high potential for vehicle sharing services, it is no guarantee that these services will actually be used. Therefore, it is important that their use is stimulated to ensure they are an alternative to private cars. Methods to stimulate vehicle sharing use over private cars (SQ2) were identified through interviews with twelve experts with various backgrounds (e.g. providers of vehicle sharing services, mobility consultants, and academic researchers). Where the SLR studied several modes of vehicle sharing, the research scope was narrowed to mainly SBCS services in the empirical analysis. Free-floating services were disregarded because UADs have limited influence or control over these services and micromobility (i.e. scooters, bikes, and mopeds) because they have less potential to be an alternative to private cars. To stimulate the use of SBCS services over private cars in

to be developed areas, five adoption barriers need to be overcome. Adoption barriers are those obstacles that may prevent potential users of becoming users of SBCS services. An overview of these adoption barriers and the interventions to mitigate them are shown in Figure B.

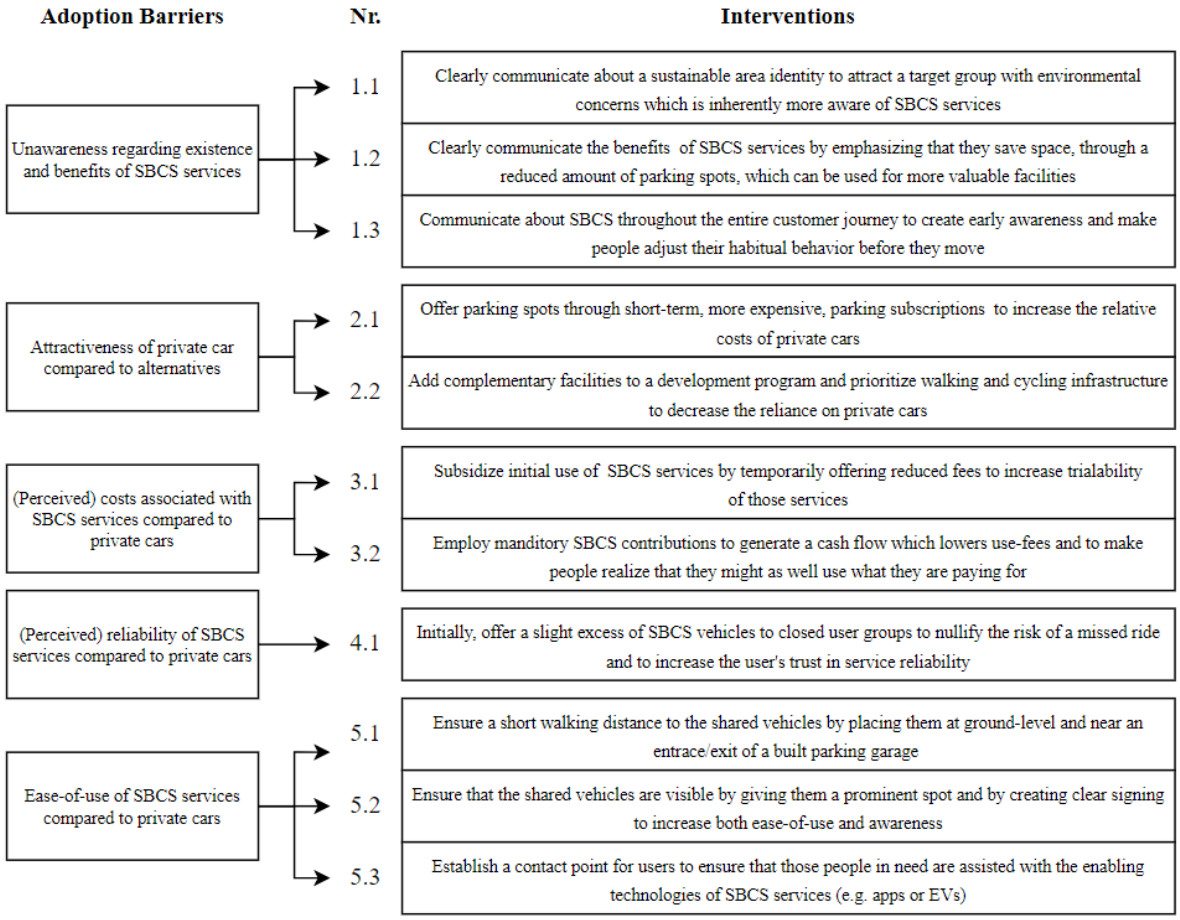

Figure B – Adoption barriers for SBCS services and interventions to overcome them.

The final sub question (SQ3), which concerned methods to facilitate a flexible supply of vehicle sharing services, was also answered using the expert interviews. Facilitating a flexible supply is important because it is likely that the demand for vehicle sharing services will change through time. Not just because the individual readiness to adopt these services may increase as the technology becomes more accepted, but also because the potential pool of users may increase, for example because an urban development project may be finished in multiple stages. The following four interventions were identified that can facilitate flexibility: (1) estimate and reserve an amount of space for shared vehicles based on the amount of shared vehicles per household (around 1/25 for very high SBCS potential to 1/200 for very low SBCS potential), (2) formally determine in contracts the moment when an SBCS provider should add or remove vehicles (quantitative supply), based on acceptable percentage of missed rides and under the condition of commercial profitability, (3) periodically gather feedback from users (e.g. through surveys) to determine what mix of vehicles (qualitative supply) is best for them at that point in

time, and (4) design a built parking garage in such a way that its functionality can be more easily adjusted to different (shared) MoT when needed.

Solution Design and Evaluation

To add practical relevance to the interventions, they were molded into a solution design based on a seven-stage archetypical area development process (ideation-initiative-definition-design-preparation-realization-management). The solution design maps the process of successful facilitation and implementation of SBCS services in urban development projects, including interrelations and sequentiality between some of the interventions. For example, the area-related potential for vehicle sharing services can be determined in the first stage (ideation), because factors such as parking regulation and surrounding functions are already known. The individual-related potential, on the other hand, cannot be determined until the third stage (definition), since it is in this stage that the area is positioned towards a specific target group. Next, based on the combined potential score, an amount of space should be reserved for the shared vehicles in the fifth stage (design), however, the vehicles themselves should not be placed until the sixth stage (realization), when the first people will actually move to the area. Finally, the solution design was evaluated in discussion groups with UAD employees. Probably the most important point of attention was that the area and individual-related potential checks are not always constant external factors, therefore they should be re-evaluated throughout the urban development process.

Discussion

This study demonstrated that, if UADs truly want to contribute to the densification challenge, they should take a more active role in facilitating SBCS services throughout the entire urban development process, instead of offering them as an afterthought when selling houses. Furthermore, compared to existing studies, more specific interventions are presented which are not just focused on the design of the built environment, but also take into account financial and psychological barriers that people may experience. Besides the successful facilitation of SBCS services, the solution design can help UADs to be more prepared in conversations and negotiations with SBCS providers, and can help them convince municipalities of their mobility plans, while relying less on external (and costly) mobility consultants. One limitation of the current study resulted from the fact that the adoption barriers were identified through qualitative expert interviews, as opposed to through quantitative (potential) user surveys. It is therefore recommended that the adoption barriers are specified, verified, and rated on importance using such surveys to increase the validity of the solution design and to tell UADs on which interventions they should focus their efforts for the quickest gains.

Contents

List of Abbreviations

Abbreviation	Meaning
B2C	Business-to-Consumer
BPD	Bouwfonds Property Development *(client company)*
CIMO	Context, Intervention, Mechanism, Outcome
CS	Carsharing
DS(R)	Design Science (Research)
EV	Electric Vehicle
FEDS	Framework for Evaluation in Design Science Research
FFCS	Free-Floating Carsharing
FWCI	Field-Weighted Citation Impact
GHG	Greenhouse Gas
HDI	Human Development Index
MaaS	Mobility-as-a-Service
MoT	Mode of Transport
P2P	Peer-to-Peer
PT	Public Transportation
RQ	Research Question
SBCS	Station-Based Carsharing
SLR	Systematic Literature Review
SQ	Sub Question
STOMP	Walking, Cycling, Public transportation, MaaS, Private car (*translated*)
UAD	Urban Area Developer

Lists of Figures and Tables

To ensure readability of the thesis, all figures, tables, and appendices are numbered according to the section numbering. For example, the first figure in section 4 is labeled *Figure 4.1*. Tables and figures in the appendices are labeled using an *A* before their number.

1. Introduction

1.1. Practical Background

One of the most crucial global challenges mankind faces is a rapidly increasing rate of urbanization. More than half the world's population lives in cities and it is expected that this number will have increased to about 5 billion people by 2030 (UNFPA, 2016). In some countries, high rates of urbanization are already a reality. Take for example the Netherlands, where around 93% of the population lives in urban areas (Ritchie & Roser, 2018). Especially in those countries with high rates of urbanization combined with high population densities, there lies an important challenge in densifying cities. In contrast to urban expansion, the goal of urban densification is to realize more housing and facilities within the borders of existing cities, among other things to limit the pressure on surrounding ecosystems (Broitman & Koomen, 2015). But the densification of cities is no easy task because it is impeded by the en masse use of space by private passenger cars. Not only do these cars require a vast infrastructure when moving, they also require parking spaces when standing still, which is estimated to be about 95% of the time (Kondor et al. 2020). Hence, shared mobility solutions may aid in the densification of cities.

Shared mobility can be defined as "the short-term access to shared vehicles according to the user's needs and convenience, instead of requiring vehicle ownership" (Machado et al. 2018, p.2). In contrast to traditional vehicle rental, these services are focused on short term usage, and borrowing time is usually in the order of hours rather than days (Shared-Use Mobility Center, 2020). It is also useful to make a distinction between shared mobility and Mobility-as-a-Service (MaaS), since these terms are closely related and are frequently (but mistakenly) used interchangeably. MaaS are mobility services and solutions that make use of multiple transport modes which are integrated into a single (digital) platform with a single payment system (Aapaoja et al. 2017). So, where shared mobility concerns the Mode-of-Transport (MoT) itself, MaaS concerns the platform in which an integrated mobility solution is offered, often consisting of multiple MoTs, possibly including shared mobility.

Even though shared mobility may seem like a relatively new concept, its origins can be traced back to the late 1940s. In 1948, the first carsharing (CS) cooperative, *Sefage* (short for *Selbstfahrergemeinschaft*), was launched in Zurich, which remained operational until the late 1990s (Cohen & Shaheen, 2016). Another early initiative was the *Witkar*, launched in 1968 by Dutch industrial designer and politician Luud Schimmelpennink. This was a small electric car that was designed to prevent emissions and traffic congestion in the city center of Amsterdam (Remmerts de Vries, 2017).

1.2. Academic Background

Despite the early nascence of shared mobility, the phenomenon in its current form only started to gain real attention around 2015, which is not just confirmed by an exponential growth of academic publications on shared mobility and carsharing after 2015 (e.g., Castellanos et al. 2021 and Shams Esfandabadi et al. 2022), but also by the amount of members using the services (e.g., Priya Uteng et al. 2019) and the amount of shared cars on the road, as seen in Figure 1.1. It should be noted that the amount of peer-to-peer (P2P) shared cars (vehicles owned by private individuals and used by other private individuals) in the Netherlands greatly exceeds the amount of business-to-consumer (B2C) shared cars (vehicles owned by organizations and used by private individuals). Despite this higher availability of P2P vehicles, they are used far less in the Netherlands (Kennisinstituut voor Mobiliteitsbeleid, 2021).

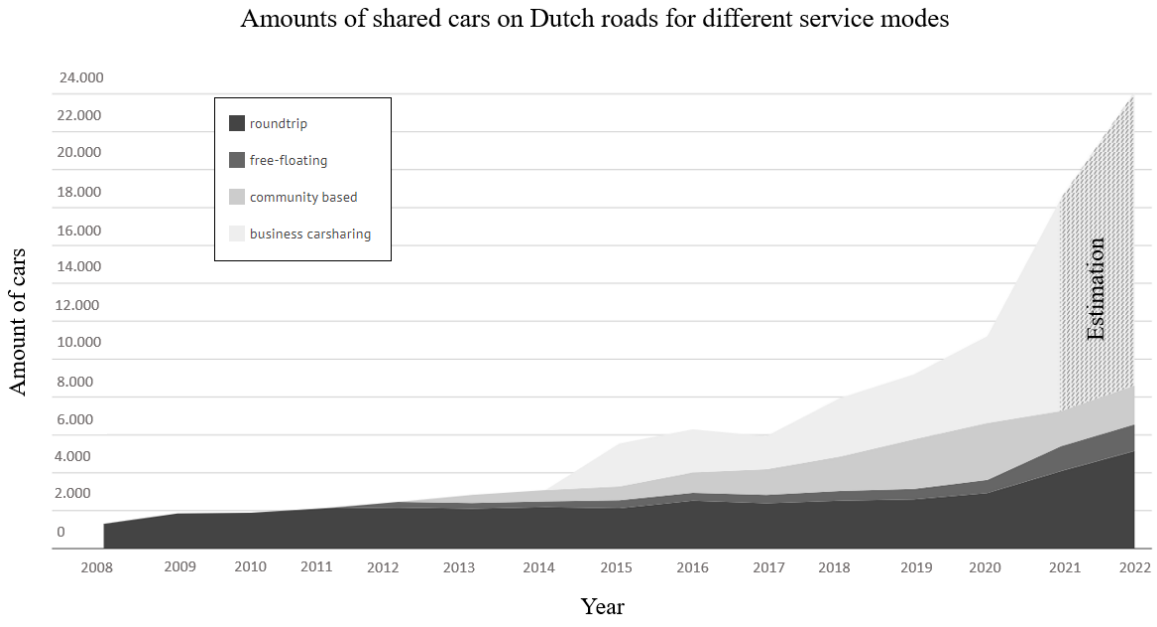

Figure 1.1 – The total amount of B2C shared cars on the Dutch roads has increased exponentially through the last years (CROW-KpVV, 2022a).

According to Castellanos et al. (2021), the reason for the increased academic and public attention is twofold. Firstly, around 2015, the concept of the "sharing economy" was rapidly gaining in popularity. This is a more general term to describe a form of collaborative consumption and a shift from owning to accessing products and services. Secondly, during the second decade of the 21th century, the advancement of digital and information technologies (e.g., smartphones and GPS-tracking) enabled a more efficient exploiting of shared mobility business models (Castellanos et al. 2021).

Many of the recent academic publications on the subject have studied the alleged and intended positive impacts of shared mobility solutions. Since one of the main problems of mass private passenger car ownership is the amount of space they require (Martin et al. 2010), researchers have studied whether using these services decreases vehicle ownership. Martin et al. (2010) confirmed that users indeed decrease their vehicle holdings, and that most vehicle reductions are in one-car households which become carless. Gilibert and Ribas (2019) concur with this view and state that especially carsharing (renting cars for short time periods), as opposed to ride-hailing (services comparable to Uber) or ride-sharing (carpooling), has the potential of reducing the total amount of vehicles in cities. These reductions in vehicle ownership can thus reduce the total amount of used space by vehicles. Another purported positive effect of shared mobility solutions is a reduction in greenhouse gas (GHG) emissions. Machado et al. (2018) stated that for ride-sharing, both GHG emissions and traffic congestion could be reduced through higher occupancy rates. However, CS can also cut back GHG emissions. This is a result of a decrease in distance driven after users dispose their personal vehicle and start using CS services (Nijland et al. 2015). Finally, MaaS and shared mobility can help to negate the effects of income inequality. Depending on the frequency of use, they allow people with low incomes to enjoy transport services that are as convenient as private passenger cars at lower costs (Li & Voege, 2017).

1.3. Problem Definition

Because shared mobility, and B2C vehicle sharing services in particular, bring the potential to reduce the amount of space used on vehicles, they pose an opportunity for commercial urban area developers (UADs), who play an important part in the densification challenge. The core business of UADs is to occupy a directing role in the profitable development of the built environment. Hence, UADs have an interest in using scarce urban space as efficiently as possible, not just from a financial point of view, but also from a social and ecological perspective. Even though large-scale parking facilities for private cars may be a financially

viable use of urban space in some cases, they decrease the potential for urban densification and add little social or ecological value to areas. However, simply omitting parking facilities from development projects where space is scarce is not an option, since UADs have an obligation to facilitate the mobility needs of residents and visitors, for example due to municipal legislation on parking standards. Instead, vehicle sharing services could be implemented as a space efficient mobility alternative.

Thus far, academic literature on implementation challenges of these services has mainly focused on the supply-side. For example, an important operational challenge for service providers is the rebalancing of one-way vehicles (e.g. Jian et al. 2016 and Huang et al. 2018). This entails the short-term effort of a provider to move vehicles from high supply areas to high demand areas (Martin, 2022). One of the few publications that does shine light on the implementation and facilitation aspect of shared mobility in the context of the built environment was executed by Dutch research institute CROW-KpVV (2021). They made preliminary propositions on how the STOMP-principle (also known as the mobility pyramid) should be kept in mind when (re)developing urban areas. This Dutch acronym dictates that the most sustainable and space-efficient mode of transport should be prioritized and stimulated, i.e., mobility by foot should come first, followed by cycling, then public transport, next MaaS (which mainly refers to shared mobility), and finally private cars (CROW-KpVV, 2021). An overview of the principle is shown in Figure 1.2.

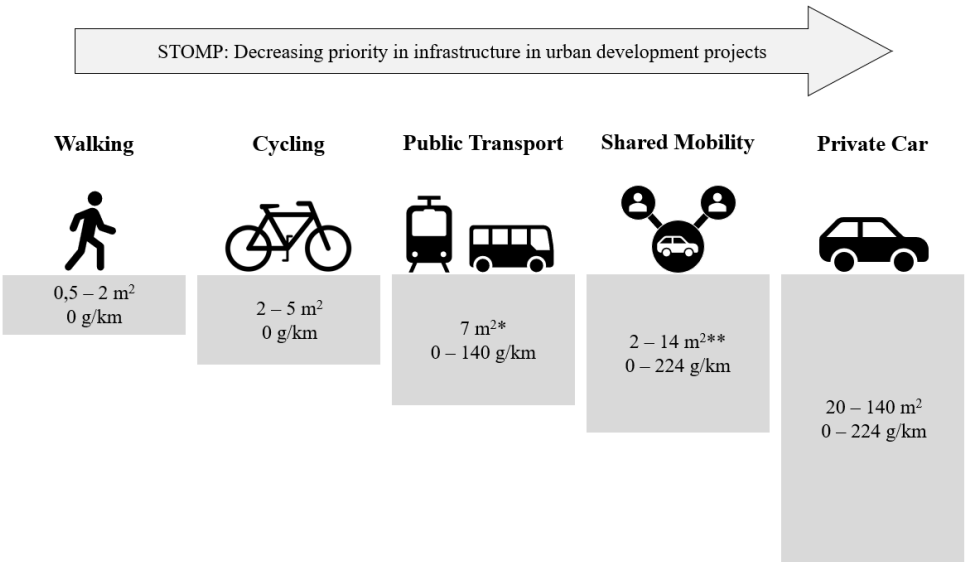

*Figure 1.2 –The STOMP-principle prioritizes space-efficient and low-emission modes of transport (Natuur & Milieu, 2020). *Applies specifically to trams with an average occupancy rate of 50 passengers. **Based on an average of 10 users per shared car (Rottier, 2018).*

The publication mainly suggests that the principle should be applied in urban development in an integral and iterative manner since a dependency exists between the different modes of transport. Another, perhaps more specific, proposition is that parking of private cars should be done at centralized locations which should be located at the outskirts of urban areas (CROW-KpVV, 2021). However, this proposition applies more to the level of entire cities, instead of smaller areas/districts (which UADs generally develop), and is thus more relevant to zoning plans of municipalities. Finally, most of the recommendations from the study concern infrastructure in the built environment such as roads and walking and cycling paths which are mainly the responsibility of municipalities and not of commercial UADs.

1.4. Research Questions

So, even though the study by CROW-KpVV (2021) gives some implementation guidelines on the STOMP-principle, these have rather low direct applicability for UADs and are targeted at a higher level of urban development. Additionally, challenges such as matching supply and demand have mainly been studied in the context of rebalancing (i.e. short-term and from the provider's perspective). However, UADs have an interest in an effective match of supply and demand of shared vehicles at a longer-term. For instance, if supply of shared vehicles greatly exceeds demand, space is wasted on the parking of vehicles which could have been used for applications which add more value. On the other hand, if demand exceeds supply, the mobility needs of residents and visitors are not properly fulfilled. An important remark is that, traditionally, it is not the core responsibility of a UAD to provide the supply of B2C shared vehicles, they can merely facilitate a provider. A final comment that should be made is that the current study is focused mainly on the Dutch built environment, this is because the activities and legislation with regard to area development and mobility varies considerably per country. Therefore, the following research question (RQ) is posed;

RQ: How can an urban area developer (UAD) facilitate an effective long-term match between supply and demand of B2C vehicle sharing services in to be developed urban areas in the Netherlands?

Again, one of the main goals of a UAD when developing an urban area is to make optimal use of the often scarce space. Not just to increase the quality of life of residents, but also to increase the potential financial yields. Since parking facilities for (shared) cars take up large amounts of space, and do not always add much value to an area, it could be argued that they should be kept to a minimum. Therefore, a UAD should get an accurate insight in the demand for vehicle

sharing services before making space available. Even though surveys among (future) residents is a possible method to gauge this demand, it is probably not optimal. Firstly because respondents often have limited knowledge about the features and details of novel mobility solutions (Jain et al. 2017). Moreover, since the target groups and conditions vary for different urban development projects, each new project would require a new, time and money consuming, survey. Hence the first sub question (SQ):

SQ1: Which factors determine the potential demand for vehicle sharing services in to be developed urban areas?

Along with the fact that a UAD should not make more space available than the demand for shared vehicles, the UAD has an interest in stimulating the use of vehicle sharing services over the use of private cars (in accordance with the STOMP-principle). This ensures that the shared vehicles will actually be used and can result in some of the positive impacts of shared mobility in general, e.g., reduction of congestion and GHG-emissions resulting in an increased quality of life of residents. Additionally, Dutch municipalities generally reduce the required amount of parking spots when shared cars are permanently placed in the area (CROW-KpVV, 2022b). Again, when less parking spots are needed, the space can be utilized for applications that add more value to the area. Thus the second sub question:

SQ2: Which methods can an urban area developer (UAD) use to stimulate the use of vehicle sharing services over the use of private cars in to be developed urban areas?

Finally, it is unlikely that the demand for shared vehicle services will remain stable through time. For example, a to be developed area may be finished in stages, which will result in a growing number of residents and a potentially growing demand for these services. What's more, the willingness of individuals to adopt shared mobility solutions may change over time as the new technology becomes more accepted. When the demand changes through time, the supply should follow suit. As mentioned before, supplying the shared vehicles is not the responsibility of the UAD, however, the UAD does have the responsibility to facilitate this changing supply. Therefore, the final sub question is stated as:

SQ3: Which methods can an urban area developer (UAD) use to facilitate flexibility in the supply of vehicle sharing services in to be developed urban areas?

1.5. Report Structure

The current report is structured as follows; in section 2, the methodology section is presented which discusses the overarching research approach and data collection and analysis methods. The specific application and outcomes of the research methodologies are described in more detail in the separate sections. Next, in section 3 and 4 respectively, the theoretical (SQ1) and empirical (SQ2 and SQ3) research results are presented. At the end of section 4, based on the research results, design propositions are formulated. These propositions represent the bridge between theoretical knowledge and practical application. Afterwards, in section 5, the design propositions are used to create a solution design, which can be used by UADs to successfully facilitate vehicle sharing services. To ensure validity of this research product, the solution design is evaluated in section 6. Finally, in section 7, the results of the entire research project are discussed along with implications and recommendations.

2. Methodology

This section describes the methodological approach that was employed for the current study. First, a general overview of the research approach and process are discussed. Next, the methods for individual activities (e.g. data collection and analysis) of each research stage are elaborated, however, the included sources for the theoretical and empirical analysis are discussed in their respective sections. Furthermore, the way in which the methodologies were employed is discussed in more detail in the separate sections.

2.1. Research Approach and Process

The overarching research approach of the current study was based on the principles of design science (DS) described in Simon's (1969) seminal work; *The Sciences of the Artificial*. He proposes that knowledge generation concerning man-made (artificial) objects should differ from knowledge generation concerning natural phenomena. Where the natural sciences (e.g., biology, chemistry, or physics) try to explain the world around us, the artificial sciences should undertake to improve existing situations (Simon, 1969). To this end, design science research (DSR) combines the science and design modes to close the existing and persistent gap between theory and practice in organization studies (Romme, 2003). Or, as Cloutier and Renard (2019) state: "the proposal is among others to start from problems that come from the field (relevance) and attempt to provide an artifact […] while meeting the standards and norms of scientific research (rigor)" (p.12). Dresch et al. (2015) concur with this view and state that DSR can result in more actionable research outputs for practitioners. Finally, Vom Brocke et al. (2020) add that DSR has "the potential to contribute to fostering the innovation capabilities of organizations as well as contributing to the much needed sustainability transformation of society" (p.1). So, due to the artificial and practical nature of the current study, combined with its focus on innovative and sustainable technologies, DSR was deemed a suitable research approach.

With regard to the research process, the DS-cycle described by Keskin and Romme (2020) was adopted. Primarily because it combines the best features of three previous DS frameworks, namely van Aken's (2004), Romme's (2003) and Holmström and colleagues' (2010)

frameworks. Furthermore, the DS-cycle is tailored to management students at graduate level and lends itself well for micro-level application (i.e., single research projects) (Keskin & Romme, 2020). The cycle consists of four general and iterative stages, these are (1) *explore*; problem analysis and framing, (2) *synthesize*; research and design synthesis, (3) *create*; creative design, and (4) *evaluate*; evaluation and reflection. In the current study, the second stage was subdivided in two parts, namely a theoretical analysis and an empirical analysis. An overview of the employed research process, including some of the more important activities (which are elaborated in the following sections) is shown in Figure 2.1. The current research project completed a single iteration of the DS-cycle.

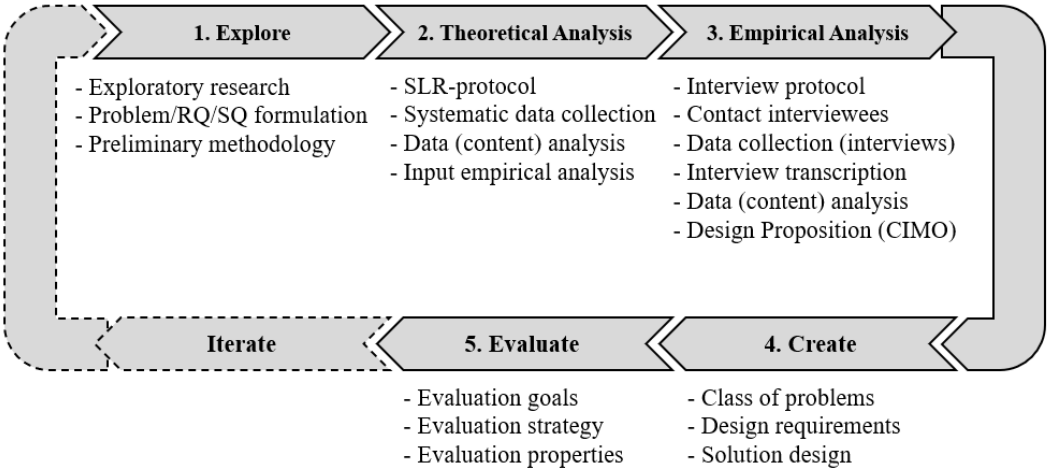

Figure 2.1 – The iterative research process comprised five stages, each consisting of a series of research activities.

2.2. Stage 1 - Explore

The first stage of the study consisted of an exploratory review of the literature after which the problem statement, RQ, and SQs were defined. Since there was not yet a specific RQ, no strict research protocol was followed for the exploratory review. At this moment, it was decided that SQ1 (*Which factors determine the potential demand for vehicle sharing services in to be developed areas?*) would be answered using a systematic literature review (SLR). This method was deemed suitable since it was expected that knowledge was already available on factors that may predict demand for vehicle sharing services, albeit specific and dispersed. Hence, the goal of the SLR was to combine this knowledge and provide a more complete overview of these factors. Additionally, the theoretical analysis would provide input for the empirical analysis of the current study, which treated SQ2 (*Which methods can a UAD use to stimulate the use of vehicle sharing services over the use of private cars?*) and SQ3 (*Which methods can a UAD*

use to facilitate flexibility in the supply of vehicle sharing services?). Since vehicle sharing in its current form is a relatively new phenomenon, much of the knowledge on implementation, especially from the perspective of UADs, is still tacit and decentralized. Therefore, it would be difficult to answer SQ2 and SQ3, which are rather specific, solely with literature. Instead, field experts were interviewed to elucidate these topics. Due to the prescriptive nature of the research question and DS in general, it was chosen to analyze mainly qualitative data during the study.

2.3. Stage 2 - Theoretical Analysis

2.3.1. Data Collection

As mentioned before, the data for the theoretical analysis, relating to SQ1 (*potential demand factors for vehicle sharing*), was gathered using an SLR. According to Tranfield et al. (2003), SLRs, compared to traditional narrative reviews of the literature, have the potential to reduce bias by "providing an audit trail of the reviewers decisions, procedures, and conclusions" (p.209). Furthermore, selection and inclusion bias can be limited in systematic reviews by setting clear and appropriate inclusion criteria (Williams et al. 2021). For the current study, the SLR process described by Williams et al. (2021) was adopted. This is a five stage process consisting of;

1. Planning the review (writing a protocol)
2. Identifying potentially relevant studies
3. Selecting studies and gathering knowledge
4. Analyzing and synthesizing information
5. Reporting the process and findings

Since the current study had a limited time frame (six months), and since the study also consisted of an empirical analysis, using multiple databases would have resulted in too many articles for analysis. Therefore, Elsevier's Scopus was used as the only database to identify literature for the SLR, this platform includes abstracts and citation statistics about both Elsevier and non-Elsevier content (Elsevier, 2022). One of the main reasons for using Scopus was its multidisciplinarity, because it was expected that not all literature on vehicle sharing was captured in a single research domain. Scopus includes literature in the fields of business/management, social sciences, and environmental sciences. Furthermore, since research in the area of shared mobility is still developing (Liao & Correia, 2020), not just published articles were consulted. By also considering conference papers, book chapters, and gray literature, saturation of the data was ensured while at the same time limiting the publication

bias (Williams et al. 2021). The final reason for using Scopus is that it can be readily accessed through the researcher's university.

With regard to the search strategy, a keyword search combined with a snowballing method was used. This entails that first, keywords were identified based on SQ1 and the exploratory review of the literature. Next, a search query with Boolean operators was specified including synonyms gathered from a thesaurus (Dictionary.com, 2020). After articles had been selected using the inclusion criteria, the snowballing (backward and forward) method was applied. Backward snowballing is the pursuing of references in the selected articles which are relevant to the research question. Forward snowballing, on the other hand, means that papers are identified by examining which following studies cite the previous study. Even though this method can be time consuming, it is recommended by Tsafnat et al. (2014) to ensure saturation. An overview of the full SLR-protocol is presented in Appendix 2.1.

2.3.2. Data Analysis

Despite the fact that the theoretical data would be analyzed separately from the empirical data, it was preferred to have similar methods of analysis. This was to ensure that the results could be more easily compared and merged. According to Keskin and Romme (2020), grounded theory is often used to analyze data gathered in "emerging knowledge domains". Even though shared mobility could be classified as such a domain, Delve and Limpaecher (2021) state that grounded theory relies on the analysis of real-world data, which means that is it not as suitable for SLRs. Content analysis, on the other hand, provides researchers with "a systematic and objective means to make valid inferences from verbal, visual, or written data in order to describe and quantify specific phenomena" (Downe-Wambolt, 1992, p.314). Therefore, content analysis was found suitable to analyze the data from both the SLR and the empirical analysis. One of the main advantages of content analysis is the transparency and replicability which follow from the coding scheme. However, according Bell et al. (2018), the researcher must be aware that a content analysis "can only be as good as the documents on which the practitioner works" (p.290). Therefore, the stringent inclusion criteria mentioned above were set in advance and complied with during execution.

For the SLR, a conventional content analysis, as described by Hsieh and Shannon (2005) was employed. This type of analysis is especially appropriate when the available literature on a research phenomenon is limited. One of the main elements of a conventional content analysis is that the codes and categories are formulated inductively and refined throughout the coding

process in an iterative manner (Hsieh & Shannon, 2005). Furthermore, a hierarchical coding structure was employed to cluster and organize the categories. Finally, the data was coded manually. Even though electronic coding may save time in larger studies (Basit, 2003), for the current, relatively small-scale study, it was not viable. Even more so since the researcher had no prior experience with electronic coding.

2.4. Stage 3 - Empirical Analysis

2.4.1. Data Collection

The data for the empirical analysis (SQ2 and SQ3) was collected through interviews with experts. Since expertise in the field of shared mobility can originate from vastly different types of experiences, it was difficult to pre-define specific criteria for what defines an expert. Therefore, the following broad criterion was set:

Having multiple years of relevant first-hand experience in researching and/or implementing vehicle sharing services in the Dutch built environment or urban development projects.

The main methods of identifying potential interviewees were through the professional network of the client company, by consulting publications in the research field (including gray and legislative literature), and by employing the snowballing technique (i.e. via previous interviewees). To gain information from multiple perspectives and to prevent bias, it was aimed to interview different types of experts. In total, five broad categories of experts were formulated. These were: (1) urban developers with prior experience in implementing vehicle sharing, (2) consultants in the field of (shared) mobility in the built environment, (3) (local) government policy advisors, (4) academic researchers, and (5) vehicle sharing service providers. In order to prevent collecting data which was too narrowly focused, it was strived for to interview at least two experts in each category. Data collection was stopped when a point of data saturation, as defined by Saunders et al. (2017), was reached. They prescribe that a researcher should stop collecting information and start analyzing when they "begin to hear the same comments, over and over again" (p.1896). It should be noted that the interviews are not presented in the reference list and that in text citations are anonymized, in accordance with the interviewee's wishes and the 7th edition of the APA manual (Merkus, 2021).

Since it was expected that not all interviewees had similar experiences, due to their different backgrounds, a fully structured interview format would have been too confining. Additionally, structured interviews are more suitable for quantitative analysis (Bell et al. 2018), which was not the preferred mode for the current study. On the other hand, a fully open (unstructured)

interview protocol brought the risk of collecting data that is too dispersed to properly answer the research question. Furthermore, Bell et al. (2018) state that a semi-structured interview is preferred over an unstructured interview if the researcher has a clear idea of the research question and how the data will be analyzed, which was the case for the current study. Therefore, a semi-structured interview format was found optimal.

The contents of the semi-structured interview guideline were split up in three parts. The SLR aimed to identify which factors may determine the potential demand of vehicle sharing services in area development. Therefore, the first part of the interview would be used to verify, supplement, and nuance these factors through the experiences of the interviewees. Next it would be important to distinguish which factors can be used by UADs, and cooperating parties, to realize the potential for vehicle sharing services by stimulating use. So, the second part of the interview guideline concerned the sphere of influence of the UAD and cooperating parties in facilitating shared vehicles. And finally, it would be important to determine how the UADs should wield the factors, and which methods can be applied to facilitate shared vehicles. Furthermore, to answer SQ3, the final section of the guideline also was used to discuss flexibility in facilitating shared vehicle supply. For each interviewee, the same guideline was employed in order to get comparable findings. A translated (Dutch to English) version of the interview guideline is presented in Appendix 2.2.

2.4.2. Data Analysis

To allow for thorough analysis of the data, all interviews were transcribed. Apart, from this benefit, Bell et al. (2018) state the following advantages of transcribing interviews: (1) "it helps to correct the natural limitations of our memories", (2) "it permits repeated examinations of the interviewees' answers", and (3) "it opens up the data to public scrutiny by other researchers" (p.445). To prevent loss of critical data, making clean verbatim transcriptions was deemed optimal. This style of transcription resembles verbatim (literal) transcription but entails that erroneous speech is left out the document. Furthermore, truncations of single words are corrected to proper spelling. Interviewees' quotes in the empirical findings section are presented in a non-verbatim (interpreted) fashion to increase the legibility and comprehensibility (Kumar, 2019). It should be noted that all interviews were conducted in Dutch, therefore, the quotes in the results section are translated. Anonymized versions of the transcripts are not included in the appendix but can be acquired through the researcher.

As mentioned before, content analysis was used to analyze the interview data, mainly to ensure that the results could be easily compared to the SLR results. However, before the in-depth content analysis, structural coding was employed. This is a so-called first-round coding approach where the data is categorized according to predefined topics (Delve, 2022). According to Saldana (2012), structural coding is especially suitable when specific topics have already been formulated, when semi-structured interview data is analyzed, and when multiple participants are interviewed. For the current study, all conditions applied. The predefined topics that were used for structural coding were adapted from the results of the SLR and the interview guideline. Therefore, as opposed to the SLR, the analysis of the empirical data was done in a more deductive fashion. The following steps, based on Delve (2022), were adopted for structural coding:

1. Select a set of topics that the data should be organized by
2. Read through the interview transcripts and apply the code to relevant sections
3. Analyze within topics by creating sub-codes
4. Utilize more in-depth methods for further analysis

After structural coding, the interview passages were clustered and aggregated, a more thorough description of this clustering is presented in Section 4.2. After clustering and aggregation, design propositions were created according to the CIMO-logic. These propositions are a fundamental element of DSR and prescribe which interventions (I) can be used in a certain context (C) to achieve a desired outcome (O). Furthermore, the mechanisms (M) through which the interventions act are described (Keskin & Romme, 2020). These design propositions represent the bridge between rigorous academic knowledge and relevant practical application. It should be noted that SQ1 was not answered using design propositions since this question does not concern interventions or prescriptive knowledge.

2.5. Stage 4 - Create

Based on the design propositions (CIMOs) and other research outputs, a solution design (or "artifact") was created in the third research stage. To guide this design process, the class of problems, also known as the solution space, was specified in advance. Despite that Simon (1969) discussed the idea behind the class of problems in his *Sciences of the Artificial*, he gives no clear definition of what the term entails. Dresch et al. (2015) later defined the concept as "the organization of a set of problems, either practical or theoretical, that contain useful artifacts for action in organizations" (p.104). The class of problems thus ensures that a solution for a

certain problem does not remain in a vacuum, but can be accessed by other researchers and practitioners who face comparable challenges. Similarly, the current study could draw on existing solutions in related classes of problems to improve its generalizability. Furthermore, design requirements were specified beforehand. Design requirements are those conditions which the final solution design should fulfil to be successful, these requirements should be specific and testable (Keskin, n.d.).

2.6. Stage 5 - Evaluate

In the final stage of the research process, the solution design was evaluated. The main goal of the evaluation stage was to ensure that the solution design is functional, valid and fits in the activities of the client company. For the current study, the Framework for Evaluation in Design Science Research (FEDS) described by Venable et al. (2016) was adopted for evaluation. This framework is designed specifically for evaluation in DSR and consists of four global steps: (1) explicate the goals of evaluation, (2) choose a suitable strategy for evaluation, (3) determine the properties to evaluate, (4) design and execute the individual evaluation episodes (Venable et al. 2016). A more in-depth description of the evaluation process is discussed in Chapter 6.1.

3. Theoretical Analysis

This section describes the second stage of the research assignment, the theoretical analysis. First, the outcomes of theoretical data collection (included studies) and analysis (coding and clustering) are described in further detail. Next, the theoretical data is used to answer SQ1 (*factors determining potential vehicle sharing demand*). These findings are summarized in a hierarchical framework.

3.1. Included Studies

Using the search query described in the SLR-protocol (Appendix 2.1), initially 340 studies were identified (on September 29th, 2022). After applying the first inclusion criteria (published after 2015), 44 studies remained. The majority (280) of the studies were excluded because they were published too long ago, because they were published in irrelevant research fields (e.g. Engineering or Computer Science), or because they were cited less than 5 times. A single exception to the 5-citations criterion was made for the study by Fiorini et al. (2022). This study had not been cited yet but this was because it was still unpublished. After scanning the article and the journal in question it was decided that the article was both very relevant and of sufficient quality. By scanning the titles, abstracts, and figures of the remaining 44 studies, 29 studies were excluded manually, mainly due to their irrelevance to the research question. For example, many studies concerned concepts related to shared mobility and vehicle sharing, such as MaaS and ride-hailing, which were not part of the research scope. Others concerned the adoption of innovative mobility in general, such as electric, autonomous, and even flying cars. A substantiation for each manually excluded study is presented in Appendix 3.2.

Through the use of the snowballing technique, 11 additional studies were identified. To ensure saturation of data, these were mainly studies that had little overlap with the studies identified before, for example because they concerned a different MoT or were conducted in a different regional context. The snowballing process was ended when it was experienced that scanning the newly identified studies did not result in new insights. In the end, a total of 26 studies were reviewed in the SLR, this is in line with Talmar's (2021) recommendations who prescribes to

include around thirty articles for a study of the current scope. An overview of the meta-data of the included articles is presented in Appendix 3.1.

The mean amount of citations from the 26 identified studies was 51,11 with a mean field-weighted citation impact (FWCI) of 5,08 indicating that on average the articles were cited significantly more than expected. The majority (50%) of the studies identified in the SLR used a survey research design with the amounts of respondents varying from 200 to 2841 (1380 responses on average). The other two prevalent research designs were analyses of vehicle sharing rental data and literature reviews (23% and 12% of the articles respectively). The largest part (35%) of the articles concerned shared cars, with some articles drawing comparisons between B2C and P2P carsharing. With regard to the regional context, most studies (58%) were conducted in European cities (e.g., Madrid, Paris, and Milan). However, there were also some studies located around smaller European cities such as Basel, Heinsberg, and Catania. The studies from North-America (23%) were all conducted in large cities (over 500.000 inhabitants). Even though it was stated in the introduction that the current study was mainly focused on the Dutch built environment, the SLR also considered other regional contexts. Firstly because there was a limited amount of existing literature studying vehicle sharing in the Netherlands, which would have resulted in poor reliability. Secondly, the outcomes of the SLR were not directly related to matters which were very country-specific, such as legislation. Finally, the findings of the SLR would be validated in the empirical analysis to ensure the generalizability of the results for the Dutch context.

3.2. Coding and Clustering

To report the findings of the SLR, which answers SQ1 (*potential demand factors vehicle sharing services*), it was deemed necessary to first define what is meant by a "factor". In the current context, a factor was defined as a variable that predicts, determines, or drives the need, demand, or adoption of different MoTs and business models of vehicle sharing services. The ride-sharing and ride-hailing services were excluded from the theoretical results since they have a minimal potential in reducing vehicle ownership and the use of urban space and are thus not as relevant to the domain of urban area development.

As mentioned before, the codes and categories were formulated manually and inductively, and were refined throughout the coding process in an iterative manner. An example of how the low level codes (factors) were formulated is shown in Table 3.1, the full codebook is included in Appendix 3.3.

Table 3.1 – Example overview of codebook for the theoretical analysis

Article	Context	Article Passage	Factor	Interpretation
Aguilera-Garcia et al. (2020)	Free-floating e-moped sharing in Madrid (Spain)	*"feeling concerned about environmental issues when choosing a transport mode significantly increases the probability to be a frequent user of scooter-sharing"*	Environmental concerns	Feeling concerned about the environment increases the likelihood of being a frequent user
		"compared to employees, students significantly present a higher probability of adopting moped scooter-sharing systems."	Employment	Users are more often students than employees
		"individuals from 26 to 35 show a higher probability of being frequent users of these system"	Age	Most frequent users are aged 26 to 35
Becker et al. (2017)	Station-based carsharing in Basel (Switzerland)	*"for station-based car-sharing, it is widely accepted that the most suitable markets are dense urban areas with good public transport"*	Population density / Public transportation	Used most often in dense urban areas / Used most often in areas with good public transport
		"the prototype user is relatively young, affluent and well-educated"	Age / Income / Education	Used often by young people / Used often by affluent people / Used most often by well-educated people
		"members from car-free households are significantly more active carsharers. […] In particular, more than 90% of the members of the station-based carsharing service […] lived in car-free households"	Vehicle ownership	90% of users lives in car free households

After all relevant factors were identified, they were clustered using a hierarchical coding scheme divided into three layers; low-level codes (factors), mid-level codes (categories), and high-level codes (domains). This hierarchical overview, presented in Figure 3.1, was validated using supervisor input. A full overview of the found effects is presented in Appendix 3.4.

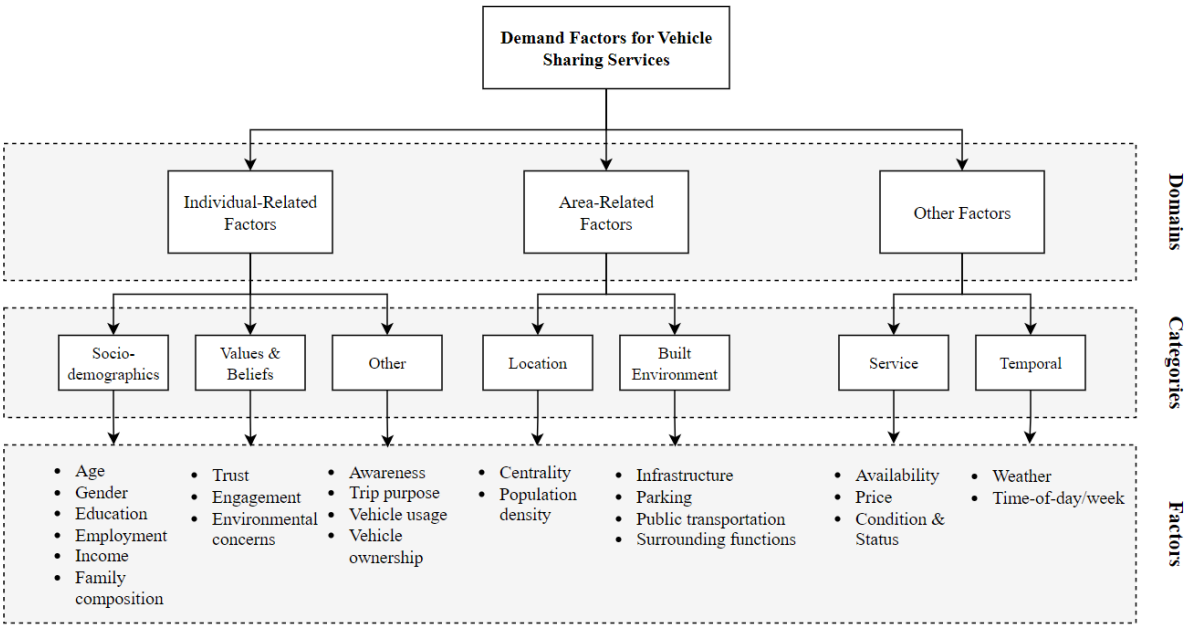

Figure 3.1 – The 24 identified factors that determine the potential demand for vehicle sharing services can be hierarchically divided into three domains, and seven, lower level categories.

3.3. Findings

3.3.1. Individual-Related Factors

Probably the most often reported factor for predicting the adoption of vehicle sharing services concerns the age of (potential) users. For carsharing (CS) services, most users are aged somewhere between 30 and 50 years old (Becker et al. 2017, Liao & Correia, 2020, Munzel et al. 2019, and Schmoller et al. 2015). Nevertheless, some slight differences exist with regard to the type of car and the associated service mode, e.g. free-floating carsharing (FFCS) and station-based carsharing (SBCS). For example, Becker et al. 2017 found that the average age of FFCS users (who have more freedom in where they pick up and leave behind the vehicle) is even lower than that of SBCS users (who need to return the vehicle exactly where they picked it up). Wielinski et al. (2017), in a study on FFCS, found that an age difference also exists between users of electric cars and hybrid cars where the users of electric vehicles (EVs) were on average younger. These findings are in line with Prieto and colleagues' (2017) remarks who state that

"older people are less likely to use CS services, probably because they have been using their own cars for many years and they do not want to change their habits." (p.222).

Users of shared micromobility are generally somewhat younger (mostly between 21 and 45 years old) than CS users (Bielinski & Wazna, 2020). More specifically, shared e-scooters users are the youngest (mostly between 18 and 29), followed by shared e-moped users (mostly between 26 and 35), and finally shared e-bikes (38 on average for frequent users) (Christoforou et al. 2021, Aguilera-Garcia et al. 2020, and Liao & Correia, 2020 respectively). These results could be related to the most prevalent trip purposes for the different MoTs. Bielinski and Wazna (2020) stated that station-based shared bikes are most often used to commute to work and school whereas shared e-scooters were mainly used for touristic and leisure trips. They add that one of the most common reasons for using e-scooters was just because of the pleasure gained from riding them. This hedonic appeal of e-scooters is likely to attract younger users.

Along with age, other socio-demographic factors play an important role in predicting vehicle sharing adoption, among these factors are education, employment, family composition, and income. A high level of education is associated with a high level of vehicle sharing adoption, this finding is consistent across virtually all MoTs and service modes (e.g. Aguilera-Garcia et al. 2020, Becker et al. 2017, Burghard & Dutschke, 2019, and Fiorini et al. 2022). Similar conclusions can be drawn about employment, however, these findings mainly apply to CS (e.g. Burghard & Dutschke, 2019 and Namazu et al. 2018) and shared e-bikes (Liao & Correia, 2020), but less to shared e-mopeds (Aguilera-Garcia et al. 2020). With regard to family composition, most users of vehicle sharing services live in small households. For micromobility (bikes, scooters and mopeds), this finding is probably related to the average lower age of users. However, for CS this is not necessarily the case. For example, Namazu et al. (2018) stated that especially the early adopters of SBCS and FFCS fit the *Dual Income, No Kids* description. For single-person households, the adoption of CS seems to depend on the service mode. Prieto et al. (2017) found that being single decreases the probability of using car club (B2C) shared vehicles and increases the probability of using P2P shared vehicles, this could be related to the lower costs of P2P schemes. Finally, income can also be used to predict the adoption of vehicle sharing. Most studies concur that high income increases the probability of FFCS adoption and middle to high income SBCS adoption (e.g. Ampudia-Renuncio et al. 2020, Becker et al. 2017, and Liao & Correia, 2020), however, Munzel et al. (2019) found mixed results. They state that the average household income for CS adopters is not particularly high. Especially users of P2P

CS services, compared to B2C services, have a lower average income and therefore choose the less-expensive form of CS.

So, socio-demographic characteristics of an individual are important predictors of vehicle sharing adoption, but their personal values and beliefs also play a role. For instance, environmental concerns are for many people an essential driver for adopting shared e-mopeds (Aguilera-Garcia et al. 2020), shared e-scooters (Kopplin et al. 2021), and shared electric cars (Liao & Correia, 2020). For CS in general, the findings are less consistent. For example, Priya Uteng et al. (2019) found that while environmental motives were important for cooperative (B2C) CS adoption, P2P CS adopters were again more motivated by cost-savings. Becker et al. (2017) reported that for neither FFCS nor SBCS, the users are distinguished by environmentally friendly convictions. However, in these studies it was not specified whether the shared cars were electric vehicles (EVs) which could influence the individual's decision. For example, Liao and Correia (2020) did find environmental concerns to be an important predictor for the use of shared EVs. Other individual factors that determine vehicle sharing adoption are awareness and trust. Gross-Fengels and Fromhold-Eisebith (2018) found that a lack of awareness was an important obstacle to the adoption of shared mobility in rural areas. Markvica et al. (2020) drew similar conclusions about e-bike sharing and stated that "among the most important obstacles are the lack of visibility of options" (p.2). The trust of an individual in a service also has a significant influence on adoption. Priya Uteng et al. (2019) found that the absence of trust hindered the adoption of P2P CS services. For B2C schemes, this issue is less present since there is a commercial party that carries the (perceived) risks. Trust and skeptical attitudes also play a part in the low adoption of shared mobility solution in rural areas. According to Gross-Fengels and Fromhold-Eisebith (2018), these issues could be dealt with by offering locally-based services through familiar parties. Finally, and perhaps not surprisingly, vehicle ownership is also a predictor for the use of vehicle sharing services. People who own fewer cars are more likely to adopt vehicle sharing services (e.g. Burghard & Dutschke, 2019, Bielinski & Wazna, 2020, Javaid et al. 2020, and Mehzabin et al. 2021), with the exception of shared e-mopeds (Aguilera-Garcia et al. 2020). It should be noted that especially users of SBCS, as opposed to FFCS, have a lower average car ownership (Ampudia-Renuncio et al. 2020).

3.3.2. Area-Related Factors

Besides factors related to the individual, there are also factors that predict the demand for vehicle sharing services related to the areas in which they are used. These were clustered in two subcategories; (1) location, relating more to where a specific area is located and (2) built

environment, relating more to which physical components are present in a specific area. Two of the most prevalent location-related factors in literature are population density and centrality. Generally, a high population density leads to an increased demand of vehicle sharing services, these findings are unequivocal for micromobility (e.g. Becker et al. 2017, El-Assi et al. 2015, Javaid et al. 2020, Liao & Correia, 2020, and Mehzabin Tuli et al. 2021). For CS, a distinction should be made between SBCS and FFCS where SBCS is more popular in densely populated areas than FFCS (Ampudia-Renuncio et al. 2020 and Becker et al. 2017). Unsurprisingly, similar effects were found for centrality (more central locations lead to higher vehicle sharing adoption), but again, FFCS is an exception. One reason is that the use of FFCS services relies on public parking spaces which are not always readily available in city centers (Ampudia-Renuncio et al. 2020). While a higher availability of parking spaces stimulates the use FFCS, the opposite can be said about the use of SBCS (specifically B2C) (Priya Uteng et al. 2019). A decrease in the available parking space nearby may discourage people to own a vehicle since they would have to spend money and effort to park their car, which is not the case for SBCS for which parking spaces are reserved. Other factors relating to the built-environment are surrounding functions, infrastructure, and public transportation. Mainly areas with mixed or business functions attract vehicle sharing services (Fiorini et al. 2022, Liao & Correia, 2020, Mehzabin Tuli et al. 2021, and Schmoller et al. 2015). Infrastructure was found to be particularly relevant to shared micromobility. For example, the intersection density and the length of bicycle infrastructure influence shared micromobility uptake (El-Assi et al. 2015, Wang et al. 2018, and Torrisi et al. 2021). Additionally, the presence of public transit locations increases the demand of shared micromobility (e.g. Bielinski & Wazna, 2020, El-Assi et al. 2015, and Mehzabin Tuli et al. 2021) while it decreases the demand for FFCS services (Ampudia-Renuncio et al. 2020 and Becker et al. 2017).

3.3.3. Other Factors

Next to individual and area-related factors, temporal and service factors determine the demand for vehicle sharing services. The first temporal factor is the time-of-day at which the services are used, this factor is related to the trip purpose. Shared MoTs that are mainly used for commuting are used most often during commuting hours (Ampudia-Renuncio et al. 2020, Liao & Correia, 2020, and Schmoller et al. 2015) whereas shared e-scooters, which are mainly used for leisure purpose, are used more often during weekends (Mehzabin Tuli et al. 2021). The other temporal factor concerns the weather. Good weather (i.e. high temperature, low precipitation, and few wind gusts) in most cases stimulates shared micromobility use (El-Assi et al. 2015 and

Mehzabin Tuli et al. 2021). However, weather conditions have a limited impact on the use of bikesharing systems by younger millennials (aged 18 to 23) (Wang et al. 2018). Interestingly, weather also influences the use of shared electric cars. More specifically, decreased temperatures lead to a decreased use of shared electric cars (Wielinski et al. 2017 and Liao & Correia, 2020). This effect is caused by the perception that the use of a heater in an electric vehicle will decrease its range (Wielinski et al. 2017).

Finally, service characteristics such as price/costs, availability, and condition/status may influence vehicle sharing uptake. Liyanage et al. (2019) name cost savings as one of the key considerations why people start to make use of CS. Similarly, when car use in general becomes too expensive, because of higher gasoline or parking prices, people may shift to cheaper MoTs such as shared e-scooters or bikes (Mehzabin Tuli et al. 2021 and Torrisi et al. 2021). In addition to competitive pricing, availability and a good condition of shared vehicles increases adoption (El-Assi et al. 2015, Liyanage et al. 2019, Namazu et al. 2018, Torrisi et al. 2021, and Wang et al. 2018).

3.4. Conclusion

Even though (short-term) temporal factors were identified in the SLR, they will be disregarded in the following sections of the study since the main research question focusses on a long-term match between supply and demand. Thus, it can be concluded that three domains of factors determine the long-term demand for vehicle sharing services in the built environment. These are firstly the people that inhabit the environment, secondly the characteristics of the area, and lastly the characteristics of the offered services. Again, a full overview of the found effects organized per factor and MoT is presented in Appendix 3.4.

4. Empirical Analysis

This section describes the third stage of the research assignment, the empirical analysis. First, the outcomes of empirical data collection (interviews) and analysis (coding and clustering) are described in further detail. Next, the empirical findings are used to answer SQ2 (*Which methods can a UAD use to stimulate the use of vehicle sharing services over the use of private cars?*) and SQ3 (*Which methods can a UAD use to facilitate flexibility in the supply of vehicle sharing services?*) using the CIMO-logic. Finally, the overview of factors determining vehicle sharing demand is validated, also based on the empirical findings.

4.1. Interviewed Experts

A total of twelve experts in the field of (shared) mobility in the built environment were interviewed using the semi-structured interview guideline presented in Appendix 2.2. An overview of these interviewees and their experience relevant to the research problem is presented in Table 4.1, as mentioned before, the interview data is anonymized.

Table 4.1 – Overview of interviewees for the empirical analysis.

Interviewee	Organization	Role	Relevant Experience
A	Dutch UAD	Developer	Involved in the development and implementation of SBCS services (9 vehicles) in a housing development project (950 units) in a large Dutch city (±350.000 inhabitants)
B	Dutch SBCS provider	Coach local shared mobility initiatives	Employee of a provider of SBCS services active in housing development projects ranging from approximately 10 to 1000 units.
C	Dutch research institute for infrastructure, public spaces, traffic, and mobility	Project Manager; Parking, Space, and Mobility	Co-author of a research publication on the implementation of the STOMP-principle for sustainable urban area development.
D	Consultancy focused on mobility	Director and consultant on mobility in the built environment	Experience in consulting on innovative mobility in area development and involved in drafting mobility plans for urban development projects.
E	Municipality of a large Dutch city (±230.000 inhabitants)	Policy advisor smart and green mobility	Experience on the governmental perspective of implementing and facilitating smart mobility, shared mobility, and MaaS in the built environment.
F	Dutch vehicle sharing provider	Head of commerce	Head of commerce of a provider of multimodal vehicle sharing services active in housing development projects ranging from approximately 100 to 2000 units.
G	Dutch university of applied sciences	Academic researcher on mobility in the built environment	Published multiple studies on smart mobility in the built environment and is currently part of a research consortium that studies this subject.

Interviewee	Organization	Role	Relevant Experience
H	Dutch UAD	Developer	Involved in the development and implementation of SBCS services (4 cars) in a housing development project (108 units) in a large Dutch city (±550.000 inhabitants).
I	Dutch university of technology	Academic researcher on mobility in the built environment	Co-researcher of a publication on the effect of shared cars on vehicle ownership and published multiple studies on smart and shared mobility in the built environment.
J	Consultancy in urban development, mobility and sustainability	Consultant on mobility in urban environments	Experience in consulting on (smart) mobility in urban areas and involved in drafting mobility plans for urban development projects.
K	Dutch SBCS provider	Founder and director	Director of a provider of SBCS services active in housing development projects ranging from approximately 100 to 1000 units.
L	Dutch UAD	Developer	Involved in the development and implementation of carsharing services (7 cars) in a housing development project (162 units) in a midsized Dutch city (±150.000 inhabitants).

As mentioned in Section 2.4.1, it was aimed to conduct at least two interviews in each category of experts, which was succeeded as can be seen in the table above. Since the three developers that were interviewed were involved in projects with varying sizes and contexts, the data that was gathered in those interviews resulted in relatively diverse insights. Furthermore, the other experts were involved in urban development projects in different capacities, meaning that in total, around fifteen different Dutch development projects in which vehicle sharing services were implemented were discussed.

It should be noted that for a variety of reasons, the scope of the study was narrowed to mainly B2C SBCS services during the empirical analysis. First of all, due to the limited uptake of P2P services, as mentioned in the introduction, they currently have less potential to be an alternative to private cars. Secondly, due to current national and municipal legislation most (kick-style) e-scooters are not yet allowed on Dutch public roads (Stadszaken, 2021). Therefore, there are no providers of shared e-scooter services active in the Netherlands. Shared free-floating cars, bikes, and mopeds on the other hand are already present in the Netherlands. However, as long as those providers have the proper permits, the vehicles can be placed virtually anywhere in public spaces, and since these public spaces are mainly the responsibility of municipalities, commercial UADs have limited influence or control. Finally, even though there are some providers of station-based bikes and mopeds active in the Netherlands, these vehicles are less often an alternative for private cars, and thus have less potential in contributing to the urban densification challenge.

4.2. Coding and Clustering

Before coding and clustering, all interview passages relevant to the sub questions (i.e. containing or indicating insights concerning the research problem) were manually extracted and labeled according to the interviewee (A to L). A passage was deemed relevant if it concerned; the demand factors identified in Section 3.3 (relating to SQ1), adoption barriers for vehicle sharing services or interventions for mitigating those barriers and thus stimulating use (relating to SQ2), or interventions for facilitating flexibility in vehicle sharing supply (relating to SQ3). Besides relevance, the passages were examined for generalizability, for example, one provider of SBCS services indicated that they "have one user who drives 5000 km per month in a shared car, which he does purely because he feels that owning a private car is a thing of the past". Because such a statement seems to point to an exception rather than a rule, it is not taken into account in the data analysis as an absolute truth, nevertheless, it may be used as an example to illustrate a general finding. On the other hand, when the same interviewee stated that they "see that in neighborhoods where there is a lack of parking space, there is a higher demand for shared mobility", it points to the fact that they perceive this to be commonplace behavior, which means that such a passage has better generalizability.

As mentioned before, the interview data was coded in a deductive (top-down) fashion in contrast to the inductive (bottom-up) coding applied in the SLR. So, after the relevant passages had been extracted, they were assigned a code from the existing hierarchical overview of factors (structural coding). This was not just limited to the low-level codes (factors) but also included

the categories and domains, since some passages had no specific relation to the identified factors. Additionally, some passages were labeled "flexibility". This code did not originate from the overview of factors but rather from the interview guideline and was applied to passages relating specifically to SQ3 (flexibility in vehicle sharing supply).

After all passages were assigned a code, it was found that some of the passages relating to SQ2 specifically concerned barriers which people experience for using vehicle sharing services whereas other passages concerned interventions that can be used to overcome those barriers. For example, one interviewee stated that "The security of knowing, *I have it and I can use it*, is something that is inherent to a [private] car. And for a shared car, despite all the promises, there is still skepticism". This clearly describes an adoption barrier, namely the (perceived) reliability of vehicle sharing supply. Another interviewee stated that "not just visibility and accessibility, but the availability is also essential […] so you have to make arrangements with those parties [SBCS providers] to ensure there is always one [shared vehicle] available". So, where this passage *describes* a similar adoption barrier, namely the availability of vehicles and the reliability thereof, it also *prescribes* an intervention for overcoming this barrier, namely guaranteeing supply together with providers. Even though the CIMOs answering SQ2 were related to these adoption barriers, they were identified in a separate clustering scheme since they contained more prescriptive knowledge (as opposed to descriptive). A schematic overview of the data coding and clustering process is shown in Figure 4.1 and an anonymized overview of the coding scheme for the empirical data is presented in Appendix 4.1. It should be noted that the coding scheme contains untranslated passages (Dutch) and that the citations in the current section are translated.

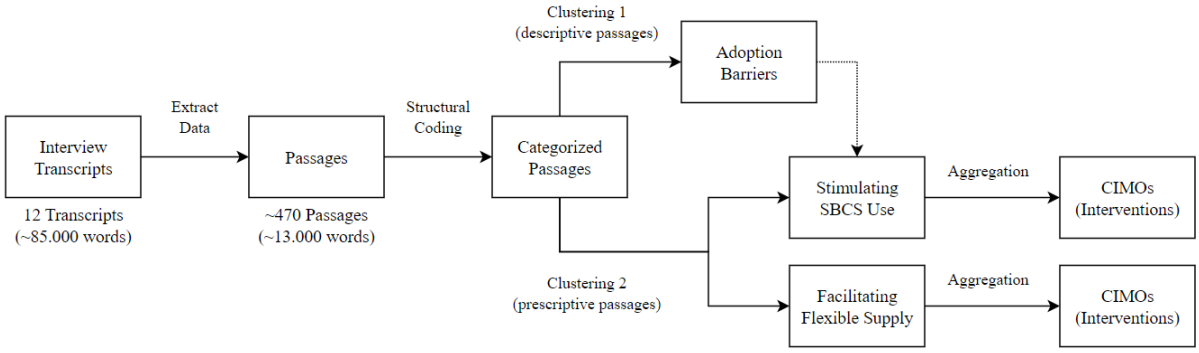

Figure 4.1 – The empirical data was analyzed by extracting the relevant passages, categorizing those passages based on existing codes, clustering the passages, and finally aggregating the passages into specific interventions.

4.3. Findings

4.3.1. Adoption Barriers

Unawareness of SBCS Services

The first barrier that was identified that prevents people from using SBCS services relates to the "awareness" factor discussed in the theoretical analysis, however, interviewees indicated multiple aspects to this barrier. First of all, it was discussed that some people, especially those living in more rural areas, are unaware of the existence of vehicle sharing services in general, which is partly because service providers are not as active in those areas compared to more dense urban areas. Or, as interviewee I indicated; "It is not necessarily that these people [in rural areas] distrust these services, they just don't know, they don't see them". And even when people are aware of the existence of vehicle sharing services, they fail to see their benefits in housing development projects. This was confirmed, among others, by interviewee D, who stated that "it is doubtful whether people realize that by offering shared mobility services, more green or high-quality facilities were implemented in certain areas" and interviewee F; "you have to explain that there is no space for a second car […] that they can see, *I might have to sacrifice the comfort of a second car, but I get a better neighborhood in return*". So, the first barrier to vehicle sharing adoption can be summarized as; people are not enough aware of what SBCS services entail and what the benefits of implementing them in urban development projects are, not just for them personally, but also for society as a whole.

Attractiveness of Private Car

Those people who are aware of vehicle sharing services may encounter a next adoption barrier, namely the attractiveness of the alternative in the form of the private car. Interviewee G summarized this as: "As long as people are able to use private cars relatively easily, they are going to use them". Probably the most important aspect of how easily people can use private cars is to what extent they are able to park them at low efforts and costs. Interviewee E mentioned the availability of parking spots and stated that "if there are enough available parking spots […] why would someone choose the alternative […] there has to be a certain tension if you want people to switch [MoTs]". Interviewee J reinforced this notion by stating that "there is no point in offering vehicle sharing services if there is no regulated parking in an area, there has to be a certain scarcity created by flanking [municipal] policy". And even when there is regulated parking, the price of parking permits might be too low to deter people from owning private cars. The attractiveness of the private car also depends on the available facilities in an area. Or as interviewee J stated "if you have a monofunctional area, which we would never

advocate, then people are automatically going to have longer travel distances", which in turn can result on a higher reliance on private cars for every day trips. Hence the second barrier to SBCS adoption is; the attractiveness of owning and using private cars is too high because they are cheap and easy to park and because the travel distances are too high to rely on other (slower) modes.

(Perceived) Costs of SBCS Services

The third adoption barrier concerns the actual and perceived costs associated with vehicle sharing services. This barrier is important because "people are financially-driven" (interviewee G) and "this does not just apply to shared mobility, but they want value for their money" (Interviewee I). Whether SBCS services are cheaper than using private cars depends largely on how often people make use of the service. Two of the interviewed service providers (Interviewee F and K) indicated that generally, SBCS services can be cheaper than private cars if people only use the vehicles a maximum of around three times a week. The third SBCS provider (Interviewee B) works with a progressive pricing model, i.e. "if you drive more often, you pay less per hour, which means that it is still feasible to use a shared car". Even though these actual costs may be too high for some people, more often the visibility of these costs was mentioned as a barrier by the interviewees. Interviewee L described this as "private car costs [e.g. road taxes, insurance, and parking permits] are hidden in people's monthly overall costs, but all these costs for vehicle sharing services are charged combined directly [after a trip]". Therefore, the third barrier for using SBCS services is defined as: the costs associated with SBCS services, and the fact that they are more direct and visible compared to costs for private cars, discourages people to use those services.

(Perceived) Reliability of SBCS Services

Another concern of potential users of SBCS services that was discussed in multiple interviews was their perception of reliability. Or, as interviewee B stated "one of the most important [concerns] is of course; *is that car going to be available when I need it?*". Different interviewees had different opinions on whether the actual reliability, or the probability that one cannot use a vehicle when one needs it, is high enough. For example, interviewee B, a provider of SBCS services, indicated that "in our experience, people almost never miss a ride, yet they are very scared of it happening". Whereas interviewee C disagreed saying "[users] require reliability, which at the current point in time is insufficiently developed for shared mobility". The perceived reliability was also discussed for different service modes of vehicle sharing services. For instance, one interviewee mentioned that shared vehicles open to everyone, as opposed to

closed community vehicles, “are good on the one hand, but also detract from the concept […] since you cannot be certain that it is there when you need it [due to a larger pool of users]”. So the fourth barrier that people might experience for using SBCS services is formulated as follows: the limited reliability, but more importantly the perceived reliability (i.e. perception that one can use the vehicle when one needs it), compared to private cars discourages people to use SBCS services.

Ease-of-Use of SBCS Services

The fifth and final barrier for using SBCS services that was identified in the empirical data regards their ease-of-use compared to private cars. Interviewee H mentioned the fact that “shared cars have to be booked using an app, you have to take an extra step”. It should be noted that this extra step of using vehicle sharing apps might not be a significant barrier for everyone. Interviewee G stated that “especially older people, who might not even have a smartphone” and “people who are less tech-savvy, or maybe have a lower level of education” may experience this barrier. Another hurdle, which could also be considered technological, arises from the fact that SBCS providers mainly offer EVs. Three interviewees (B, D, and F) indicated that people sometimes find it challenging or even daunting to use the charging cables for EVs. However, ease-of-use does not just concern technology. It is also related to how easily the vehicles can be found. For example, interviewee D stated that “it occurs that shared cars are parked in garages in places which are not simply or quickly found”. Interviewee E added that “if you are going to work with [vehicle sharing] hubs they have to be fine-grained because otherwise they [potential users] are not going to walk [to the vehicle]”. Interviewee F also stated that “people who do not often drive cars genuinely find parking challenging […] if people have to park someone else’s car, in between those [parking garage] columns”. So, the fifth adoption barrier can be summarized as: the ease-of-use of SBCS services, compared to that of private cars, is compromised because of technological barriers (apps and EV-charging) and vehicle placement (far away and difficult to find).

4.3.2. Stimulating Vehicle Sharing Use (SQ2)

Unawareness of SBCS Services

The first method to overcome the unawareness barrier is to attract a target group which is inherently more aware of SBCS services. The theoretical analysis showed that environmental concerns were an important motivation for users of shared mobility services, this effect was confirmed in the empirical analysis. For example, interviewee B (service provider) indicated that, based on survey results among their users, “being more sustainable”, is the second most

important reason for using those services, directly after cost benefits. Interviewee D added that "more and more people, similar to *flight shame*, […] want to show others that they are living more sustainably". But how should these sustainably oriented target groups, which are more inclined to use SBCS services, be attracted to housing projects? According to interviewee F, one way of doing this is by creating a sustainable area identity which is strongly linked to those environmental concerns, which results in that "everybody who lives there fits into a specific value system and they know, I like living here *because* I do not have two cars and I can use my bike for most trips". Interviewee L observed a similar effect and stated that "a project such as [anonymized], where sustainability is strongly represented and where people want to live in an urban environment […] you notice that a certain target groups moves there which embraces shared mobility". However, they also noted that it should be communicated that shared mobility services are an integral part of the living experience in certain areas. Interviewee B agreed by saying "If you elaborate a bit more [than just the reduction in parking places], demonstrate how shared mobility is part of the living concept, that they are integrally connected, then it is much more likely that people will use those services". Hence, the first CIMO is formulated as:

CIMO 1.1: To stimulate the use of SBCS services over the use of private cars (O) in newly developed urban areas (C), clearly communicate that those services are an integral part of a sustainable living experience (I) to attract a target group with environmental concerns which is more aware of and prone to using those services (M).

Another method to mitigate the unawareness barrier is by clearly communicating the benefits of SBCS services compared to private cars. An important motivation of people who have joined SBCS services is to save costs compared to private cars. However, communicating this cost benefit might not always be effective. First of all because whether people save costs depends on what MoT they used before switching to SBCS services and how often they use the services. But secondly since the costs for these services are more direct and therefore often appear to be higher than private car costs. Interviewee F exemplified this by saying that "if you are going to focus [communication] on costs, and that it's cheaper than one's private car, then people are going to make the wrong considerations […] because when you write it down, it's not always going to be cheaper". Another important benefit of using SBCS services that interviewee B identified from survey results is "[gaining] space in the street to improve the quality of the living environment". However, as mentioned before, non-users are often not aware of this particular benefit. Therefore, as interviewee G stated, "it is useful to show what they get in return, which could for example be a more green environment". Interviewee F added to this that

"if you don't communicate it, people will have to move to an area *despite* the lack of parking spaces […], or [if you do] people will move there *because* of the benefits provided by shared services". Hence, the second CIMO is formulated as:

CIMO 1.2: To stimulate the use of SBCS services over the use of private cars (O) in newly developed urban areas (C), clearly communicate that the space saved on parking places by those services are used on high-quality (green) facilities (I) to make the benefits of those services more clearly visible for (future) residents (M).

The third and final way to overcome the unawareness barrier does not necessarily concern the contents of communication, but rather the timing. This is related to the fact that mobility behavior is to a large extent habitual which results in that "as soon as people adopt a certain habit, it is very difficult to alter those habits" (Interviewee F). However, certain so-called *life-events* are usually moments when people rethink and revise those habits. Or, as interviewee J stated, "when something in your life changes, you become more conscious of your behavior […] That is also the case for these [new] areas, where the act of moving house is the most important trigger to realize a behavioral change". Interviewee F illustrated this by saying "if people make the decision [to move] without knowing [about SBCS services], then they will already have a plan. *I'll park my car over there, or in the street*". Therefore, it is not just important to determine how SBCS services will be implemented before finishing a certain area, it is also important to communicate to future residents what they can expect of these services "throughout the entire house buying/rental process" (Interviewee D). Interviewee F demonstrated this with examples: "[1] when they take an option […] you have to be more specific [in communication]: how is the parking situation and what are the alternatives [2] when they buy the house, you have to be very clear about what you are going to offer [e.g. amount of shared cars and costs] [3] when they move in, you have to make people download the [SBCS] app". So, the third CIMO for overcoming the awareness barrier is formulated as:

CIMO 1.3: To stimulate the use of SBCS services over the use of private cars (O) in newly developed urban areas (C), connect the communication relating to those services to contact points in the customer journey (from orientation to moving-in) (I) to create early awareness which allows people to change their habitual mobility behavior before they move house (M).

Attractiveness of Private Car

The second adoption barrier concerned the attractiveness of the private car, which is firstly maintained through cheap and easy parking. In those development projects with centralized

parking facilities (e.g. parking garages), the UAD can often use parking subscriptions to make the private car less attractive. This is because, as interviewee A indicated, "if you are developing in an urban environment, you cannot get parking permits for the public domain because parking has to be solved within the borders of the planning area", which means that people will have to make use of the built parking facilities. However, the way in which the parking spaces in these built parking facilities are offered is crucial for determining SBCS use. For example, interviewee F mentioned that "if people are allocated one or two free parking spots because of commercial considerations […] those people are not going to participate […] but if you sell the parking spots separately, for example the mortgage increases if you want to buy a first or a second spot […] then you are going to make people think, *is there no better way to do this*". Interviewee J went even further by suggesting "in fact you shouldn't sell parking spots at all, you should just rent them […] which also means that you can better employ double use of parking spots [of visitors and residents]". Offering the parking spots through relatively expensive, short-term, subscriptions will more often make people reconsider whether it is the best option for them, since the relative costs of vehicle ownership are increased, with the added benefit that parking spots may free up which can be used to increase the supply of SBCS vehicles. Hence, the following CIMO is formulated:

CIMO 2.1: To stimulate the use of SBCS services over the use of private cars (O) in newly developed urban areas with centralized parking (i.e. parking garages) and regulated parking in surrounding areas (C), offer parking spots through short-term, relatively expensive parking subscriptions instead of selling them along with residences (I) to increase the relative costs of private cars (M).

Another way to decrease the relative attractiveness of the private car is to increase the attractiveness of other MoTs. Because, as interviewee G noted, "the combination of all the alternatives makes that you don't need a [private] car anymore at a certain moment". Interviewee J made a similar observation saying that "they can be seen as communicating vessels, if the quality of S-T-O-M [walking, cycling, PT, and shared mobility] is high, than the quality of P [private cars] can be decreased". One way of increasing the quality of walking and cycling is by shortening the travel distance that people have to cover on a daily basis, which can be done by making the facilities in development projects complementary to surrounding facilities. Interviewee J referred to this as "if most of the daily amenities, such as shops, education, or healthcare, are present in an area, it will be a good indicator for walking and cycling, since most of people's travels are social-recreational". Interviewee G agreed by taking

urban densification projects in older inner cities as an example, where "everything is nearby, all the area-related factors are *sky-high* which means that people rely less on cars". However, having a diverse mix of functionalities nearby is not the only way to stimulate walking and cycling. Interviewee E mentioned the redevelopment of an important arterial road through a city center of a large Dutch city as an example; "in the past it was a three-lane road […] by redesigning it, more green, wider sidewalks, wider cycling paths […] people make a different choice". Besides creating an infrastructure which is more friendly to walking and cycling, facilities such as bicycle parking should also not be forgotten to increase the attractiveness of these modes. For example, interviewee J stated that "if you want to make it [bicycle parking] high-quality, it should be placed at ground level with only one gate between garage and the cycling path". Even though it might seem counterintuitive to stimulate SBCS use by stimulating walking and cycling, these modes are often complementary. Interviewee K illustrated this by saying that if people walk and cycle more often, they will rely less on private cars, potentially causing them to get rid of them entirely. However, there will always be some trips which cannot be done with other modes, which means that these people will use SBCS services for these incidental trips. Concluding, the second CIMO for decreasing the relative attractiveness of private cars is formulated as:

CIMO 2.2: To stimulate the use of SBCS services over the use of private cars (O) in newly developed urban areas (C), stimulate walking and cycling by adding complementary facilities to the development program and by prioritizing walking and cycling infrastructure (including bicycle parking) (I) to decrease the reliance on private cars resulting in people switching to the shared cars when incidentally needed (M).

(Perceived) Costs

As mentioned above, the (perceived) costs are an important barrier for people to use SBCS services. Yet, as interviewee B indicated, cost savings is one of the most important motivations for people who have already started using those services. This illustrates that as soon as people start using the services, they better understand the true costs of SBCS services and what they get in return for those costs. To this end, multiple interviewees proposed that the initial use of SBCS services should be financially stimulated (subsidized). For example, interviewee A stated that "if you offer the initial, or the very incidental, use for free, then you can stimulate people to use it more often". Similarly, interviewee E, responding to the question of what can be done stimulate SBCS use over private car use, answered; "[facilitate] the possibility to try those services, provide credit actually, to let them take the first step". Interviewee L proposed a

similar intervention where “the first year everybody is gifted some credits to make the initial use more attractive”. So, the first CIMO for overcoming the (perceived) costs barrier is formulated as:

CIMO 3.1: To stimulate the use of SBCS services over the use of private cars (O) in newly developed urban areas (C), subsidize the initial use of shared vehicles by temporarily offering reduced subscription or use fees to residents (I) to increase the trialability and thus offer users the opportunity to experience the benefits of the services at minimal costs (M).

Even though facilitating trialability is a good way to overcome the initial (perceived) costs barrier, structurally lowering the costs of SBCS services is also useful, since, as mentioned before, people are inherently financially-driven. In some previous Dutch development projects, the UAD was expected to make “a financial contribution, which is based on the commitment [predefined duration and amount of vehicles] expected of the provider for offering shared mobility, regardless of the use of those vehicles” (Interviewee F). This financial contribution is employed to lower the use fees and is often needed because, according to interviewee J, on average an SBCS provider just about earns enough to be profitable. However, indefinitely offering reduced use fees is no guarantee for uptake when the alternative (i.e. private car) is still attractive. Interviewee F named examples of this where “they were practically burning the UADs money, because nobody was making use of the services”. An alternative approach is to structurally lower use fees by making all residents of a development project, regardless of whether they use the services, contribute financially to the SBCS provider. According to interviewee D, “creating a model where everybody contributes, which could be as little as 10 euros per month, creates a substantial cashflow to offer shared mobility”. A similar strategy was employed by interviewee B (SBCS provider) in a small-scale housing project (10 units). In this project, each household was asked to pay a fixed monthly rate (similar to service costs of an apartment) which was used to lower the use costs. According to interviewee B, this was one of the main reasons that the uptake of the services was abnormally high in this project resulting in two shared cars for ten households. The added benefit of this is that people who pay the monthly contribution but do not use the services may reconsider, since you create a feeling of “*if I pay for something, I might as well use it*” (Interviewee D). Furthermore, it could be argued that even the people who pay the monthly contribution but do not use the services are better off, since through implementing SBCS services, less parking, and thus more valuable functionalities could be realized, which can be enjoyed by everyone and not just the users of

SBCS services (Interviewee B). Summarizing, the second CIMO for overcoming the (perceived) cost barrier is formulated as follows:

CIMO 3.2: To stimulate the use of SBCS services over the use of private cars (O), in newly developed urban areas (C), employ a pricing model with a mandatory contribution for all residents (I), to (1) generate a cash flow which structurally lowers the use-fees and thus (perceived) costs and (2) to make more people realize that they might as well use a service for which they are paying (M).

(Perceived) Reliability

The fourth barrier that might withhold people from using SBCS services is their perception of reliability, or the notion that a vehicle will be (un)available when they need it. This perception is largely based on the (perceived) amount of available shared vehicles and the (perceived) size of the user pool for those vehicles. The size of the user pool, in turn, is based on who has access to the shared vehicles. According to interviewee E, giving access to both (future) residents and residents of surrounding areas will "make it more attractive for providers, because there will be a larger pool users [and corresponding income], but also for the neighborhood, which may kickstart the transition", yet there are no direct benefits for residents of the development projects. On the contrary, having open access vehicles will detract from the perceived reliability since the users are not sure if they can trust on the fact that a vehicle will be available when needed due to the larger user pool (Interviewee F). And, as interviewee E noted "if you *miss a ride* just once, it will take some time before you take another shot". Besides limiting the user pool, another way to increase reliability is by placing more vehicles, however, this will also increase the costs for the provider, since the vehicles are less often used and thus less money is earned through use fees. Nevertheless, especially directly after finishing a development project, it is sometimes better to temporarily place an extra vehicle to rule out the probability of a missed ride and to create trust in the service among users (interviewee K). Interviewee L implemented a similar intervention in a development project, where, despite the fact that not all houses were finished yet, 3 shared vehicles were placed knowing that it would probably be too much in the long run. Concluding, the following CIMO is proposed:

CIMO 4.1: To stimulate the use of SBCS services (O) in newly developed urban areas (C), especially in the beginning offer a slight excess of shared vehicles to closed user groups (communities) (I), to reduce the risk of a missed ride and to increase the user's trust in the service reliability (M).

Ease-of-Use

The first way to improve the ease-of-use of SBCS vehicles compared to private cars is to place them nearby, because, as interviewee B indicated, "people are not willing to walk 300 or 400 meters before they reach a car". Interviewee E affirmed this by stating that "a provider wants to be close to the homes, they have to be near their users who have to take their groceries home, then they can return it instantly". The relative proximity of the vehicles is particularly salient in development projects with built parking garages, since otherwise people can just park their cars on their own property (e.g. private garage or driveway) or in the street in front of their house, which will nearly always be closer than a shared car. An example of realizing relative proximity was described by interviewee H (developer); "the shared cars are also close to the entrance and exit [of the parking garage] so close-by and easy to use". Another developer (interviewee A) realized relative proximity by placing the shared vehicles in the public space at ground level, and the private cars in an underground parking garage. Even though this is a good solution, it might not always be possible because of a lack of space or restrictive legislation. So, the first CIMO for increasing the relative ease-of-use of SBCS services is formulated as follows:

CIMO 5.1: To stimulate the use of SBCS services over the use of private cars (O) in newly developed urban areas with centralized parking (i.e. parking garages) (C), ensure that the walking distance to the shared vehicles is shorter than the walking distance to the private cars (e.g. by placing the shared vehicles at the ground level and near an entrance/exit of the garage) (I) to increase the relative ease-of-use (M).

The second method to enhance the ease-of-use of SBCS services, which is partly related to vehicle placement, is to make the vehicles more visible to the potential users. Again, a good way to make the vehicles more visible is by giving them a prominent spot in a built parking garage. Or, as interviewee F (SBCS provider) indicated; "we like it if the [vehicle sharing] hub is placed in the best space of the parking garage, that everybody sees them every day […] next to the elevator, in the spot with the best lighting". Interviewee E had a similar view saying that "it has to be accessible and visible, is should just be a logical spot". Besides vehicle placement, clear signing can be used to increase visibility. For example, interviewee L (developer) described that in their project "signs will be hung from the ceiling indicating; *reserved for the vehicle sharing provider,* there will be signing on the wall, and the parking spots themselves will be painted in a different color". Finally, visibility may not just stimulate SBCS uptake through increased ease-of-use, it may also create awareness for those people passing the

vehicles who were not yet familiar with the services. Hence, the second CIMO for increasing ease-of-use is stated as follows:

CIMO 5.2: To stimulate the use of SBCS services over the use of private cars (O) in newly developed urban areas with centralized parking (i.e. parking garages) (C), ensure that the shared vehicles are visible (e.g. by placing them at ground level and by creating clear signing) (I) to increase both the ease-of-use and awareness (M).

Finally, ease-of-use can be stimulated by assisting people who may find it difficult to use SBCS services. As mentioned before, especially apps and EV-charging might be obstacles for some people to use SBCS services. Interviewee J pointed to the importance of making mobility inclusive, for example for "digital illiterates, because we always simply assume that everybody can use a smartphone". Interviewee B added that "somebody might find it challenging to download the app, especially older people sometimes find this daunting". Or, as interviewee G stated; "also people […] who have a lower level of education. That group is probably quite small but it certainly has an effect". Multiple interviewees indicated that contact points should be appointed who can be called upon to assist people who face such challenges. For instance, interviewee B (SBCS provider) indicated that they try to recruit voluntary ambassadors in the user groups, "then we can just tell those people [who need assistance], if you find it intimidating to use an electric vehicle, we can make an appointment that somebody comes along to show you how it works". It should be noted that such an arrangement relies on the presence of social cohesion in the user group. Interviewee J proposed a similar intervention but instead suggested a so-called *mobility director*, "which could be a party such as [SBCS provider] but you could also appoint someone on behalf of the building […] a sort of janitor for that specific area who also organizes the shared mobility". Such an arrangement could more easily work without social cohesion but would result in extra costs. So, the final CIMO is formulated as:

CIMO 5.3: To stimulate the use of SBCS services (O) in newly developed urban areas (C), appoint an easy to reach (if possible voluntary) contact point for users (I) to ensure that those people in need (e.g. older people or digital illiterates) are assisted with the enabling technologies of those services (e.g. apps or EV-charging) (M).

A full overview of the adoption barriers and interventions for overcoming those barriers is shown in Figure 4.2.

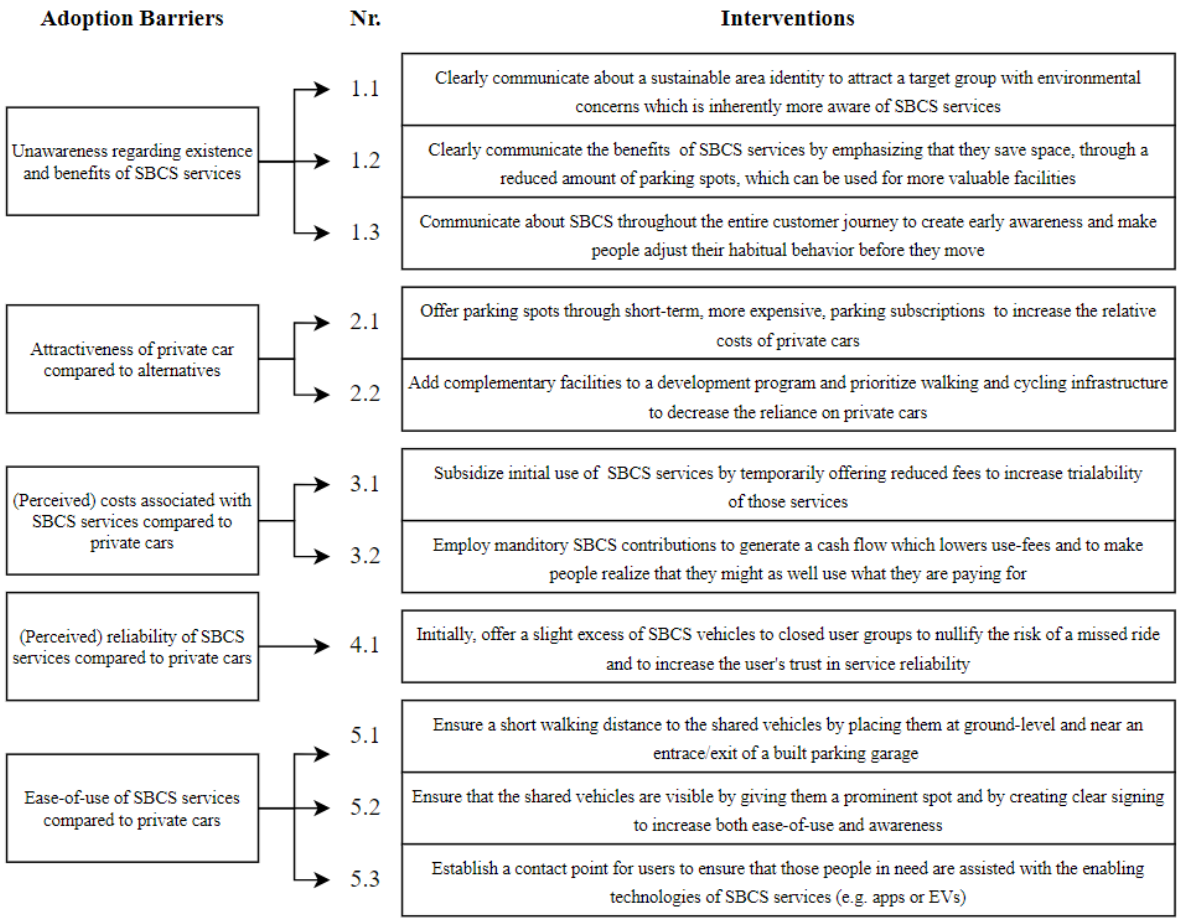

Figure 4.2 – Five adoption barriers for using SBCS services were identified together with eleven interventions to overcome those barriers.

4.3.3. Facilitating Flexibility (SQ3)

Space Reservation

As mentioned in the introduction, it is in everybody's interest to accurately match the supply of shared vehicles to the demand, to optimize the profit margins and the use of space. However, in many development projects, the demand will begin low and grow over time, for example because a project might be finished in multiple stages, resulting in a growing number of residents (and potential users). Therefore, as interviewee E indicated, "if a UAD intends to place ten shared cars in a project, they shouldn't all be available from day one, that is unreasonable". When an SBCS provider does want to add an extra vehicle due to growing demand, it is important that there is space available. However, as interviewee F (provider) pointed out, "there are also many projects where we really want to scale-up, yet we can't, because all the parking places are sold". According to interviewee A, this would mean that "someone has to sell his place to the SBCS provider, which also means that the provider has to pay more", further

narrowing the already slim profit margins of SBCS providers. Therefore, it is important to estimate and reserve the required amount of space for shared vehicles in advance.

But how much is enough space, how many shared vehicles are approximately needed for a certain project size? In some discussed development projects, shared cars were implemented to reduce the amount of required parking spaces to be able to comply to municipal parking norms. For example, interviewee L (developer) indicated that "initially, we could only comply to the parking norms by placing 18 shared cars [for 162 households], so that was quite excessive". Interviewee I (academic researcher) confirmed that "the question is always […] how many parking places can I omit and how many shared cars should I place in return […] but we [research team] were not able to solve this question because it is a very difficult calculation to perform". This is also one of the reasons that in the end, interviewee L chose a different approach for determining the amount of shared vehicles in their project: "not reasoning from an amount of parking spaces but from an amount of users, so how big should a user group be to place one shared car […] Based on the current market we saw that it should be one shared car for approximately 25 households, that is more or less rational". Interviewee H took a similar approach for determining the amount of shared vehicles and stated that "we did it together with the [SBCS] provider […] where we said; we have 108 houses, assuming a relatively high occupation rate, how many shared cars would we need? That resulted in a total of four vehicles". Even though these two ratios (around 1/25) are very similar, it should be noted that they are both high since the conditions for SBCS services in those areas were favorable. For example, both areas were clearly marketed towards a sustainably oriented target group and had a relatively high parking pressure in surrounding areas. Therefore this ratio does not necessarily apply to all development projects, as interviewee F (provider) clearly stated; "everybody is looking for a holy grail, a parking norm for shared cars so to speak, but it doesn't exist […] It all has to do with these conditions; who are the users, are there shops around the corner, is there PT nearby […]". For instance, in a development project in the outskirts of a large Dutch city, only eight shared cars were placed for 1600 households (1/200). This was not just because this location had relatively low centrality, but also since there was an abundance of unregulated street parking places available. Interviewee F gave another example of a development project, again around 1600 households in the outskirts of a different large city, where seven shared cars were implemented. In this case, the facilities in the surrounding area of the development project were limited, thus increasing the travel distances and reliance on private cars. Interviewee A (developer) applied a ratio of around 100 households per shared car (nine shared cars for 950

households). This project, in a large Dutch city, was located quite centrally and close to PT, but again, there was still unregulated parking in the surrounding areas.

Finally, interviewee B discussed some projects with extremely high or extremely low ratios. For example, in a neighborhood of ten houses they placed two cars. This was because they were contacted by the households themselves to place the vehicles, indicating that those households were already unusually inclined to using SBCS services. Contrastingly, in an existing neighborhood of around 1000 houses they also placed two cars. This was not just because people had no trigger to change their habitual behavior (i.e. the act of moving to a new house), but also because there was "virtually no parking pressure and no financial stimulus". Furthermore, both of these projects were located in relatively rural areas. It can thus be concluded that, in general, the ratio of shared cars per household in urban development projects can be estimated between approximately 1/25 and 1/200, depending on the conditions determining potential SBCS demand. Hence the following CIMO for facilitating flexible supply is proposed:

CIMO 6.1: To be able to effectively adjust SBCS supply to the quantitative demand (i.e. amount of vehicles) (O) in newly developed urban areas (C), estimate and reserve an amount of space for shared vehicles based on the amount of shared vehicles per household (around 1/25 for very high SBCS potential to 1/200 for very low SBCS potential) (I) to prevent parking spots being unavailable when additional supply is needed (M).

Adding and Removing Vehicles

Besides just reserving the needed pace, it is important to adjust the supply of shared vehicles when needed. And even though it is not the UAD's task to add or remove these vehicles, they do have the responsibility to facilitate (shared) mobility for the residents. As mentioned above, one of the main causes for a changing demand through time is the fact that many development projects are finished in stages. Interviewee A (developer) indicated about their project; "the first 100 houses [of a total of 950] have been finished so the first shared car has been placed […] roughly speaking, an additional shared car will be placed for each 100 newly finished houses". However, they also indicated that "if you finish larger houses or houses with an included parking spot, than the amount of shared cars can grow a little slower", since the people moving into those houses will be less inclined to use SBCS services.

Contrastingly, all three SBCS providers stated that they monitor the use of shared vehicles to determine whether they should add or remove vehicles, instead of using a predetermined ratio.

Interviewee B, for example, said that they "constantly monitor the use of our shared vehicles. And we adjust the supply if necessary". Similarly, interviewee F stated that for them "a good indicator [for adding vehicles] is what we call a missed ride; you wanted to leave, you checked the app, and you couldn't because all the vehicles were in use". However, completely excluding the probability of a missed ride by adding vehicles is not viable, because, as interviewee E illustrated; "if there are 10 shared cars there is always going to be one available, but for the commercial party (SBCS provider) it is not feasible to have multiple cars standing still". Interviewee F (provider) confirmed this by saying: "[a missed ride] is a very important gauge, if that happens to often we have to scale-up. The condition, however, is that it is commercially justifiable […] I am not going to place an extra car for an incidental demand-peak, because everyone wanted to go to the Home Depot during the easter weekend for example".

This trade-off between missed rides and profitability can in some cases result in a tension between the SBCS provider and a UAD, since a provider might be inclined to wait with adding a vehicle to guarantee profitability, whereas a UAD might want an extra vehicle placed to comply to municipal norms. Interviewee L (developer) gave the following example: "that is what we discussed over the last couple of months; when is [SBCS provider] going to place an extra vehicle? The discussion went well for quite a while. We had a good verbal agreement up until the point that we had to write it down in a contract, that is when [SBCS provider] got a bit anxious". Interviewee D endorsed this by stating: "with regard to flexibility in supply, it is important to formally arrange this with contracts". Finally, interviewee L added that it is important to communicate these arrangements with a municipality because "we complied to the parking norms with seven [shared cars], but we're not placing seven directly". Concluding, the second CIMO for facilitating flexible supply is formulated as.

CIMO 6.2: To be able to effectively adjust SBCS supply to the quantitative demand (i.e. amount of vehicles) (O) in newly developed urban areas (C), formally determine (i.e. in contracts) the moment when an SBCS provider should add or remove vehicles, based on an acceptable percentage of missed rides and under the condition of commercial profitability (I) to prevent ambiguity between the SBCS provider, the UAD, and the municipality.

Types of Vehicles

Not only the quantitative demand (i.e. amount of shared vehicles) can vary though time, but also the qualitative demand (i.e. types of shared vehicles). This could be caused by the fact that people with different needs move to an area, e.g.: "I am certainly willing to use shared mobility but I am not going to sit in one of those tiny cars, that has to do with my age. But somebody

else might want the cheapest option" (interviewee J). Or, the needs of individuals may change over time, e.g.: "young people without children are more inclined to use a shared car […] but we also know that the first thing one does when they have kids is to buy a car" (interviewee I). A solution for this was proposed by interviewee C, who stated; "just ensure that two large family cars, with plenty of spaces, are added to the fleet. The shared mobility offering should grow together with the life phase of the users", and to effectively realize this, the use of the different types of vehicles should be monitored. Interviewee L (developer) employed a similar method: "if they [SBCS provider] place a small and larger car, and they see that the small car is being used all the time and the large one isn't, then they will place two small ones. They are going to adjust the fleet to the needs [of the users]".

However, just monitoring the use of the shared vehicles may not be enough to get accurate insights into the qualitative needs. Because, as interviewee J suggested, "then you don't really know what the latent demand is". For example, there might be multiple small-scale entrepreneurs in an area who could benefit from a shared electric van, yet if the SBCS provider does not place such a vehicle initially, they will not find out that there is a demand. To this end, interviewee J proposed that "the service provider should have periodical contact moments with the residents, for example thrice a year through surveys or resident gatherings, to discuss the shared mobility offer" and "if they [users] don't all want [Toyota] Aygo's anymore, but rather Tesla Model 3's, then it is your responsibility to find this out and to facilitate it". So, the following CIMO is formulated:

CIMO 6.3: To be able to effectively adjust the SBCS supply to the qualitative demand (i.e. types of vehicles) (O) in newly developed urban areas (C), periodically gather feedback from users (e.g. through surveys) to determine what mix of vehicles is best for them at that point in time (I), since just an analysis of use data cannot map the latent demand (M).

Adaptive Programming

Even though UADs are currently mainly focused on cars when it comes to shared mobility services, this could change in the long-term. Interviewee J illustrated this by saying; "at the moment we are all talking about shared cars, but who knows, in a couple of years it may be micro vehicles, because then you could fit two into a single parking spot". Interviewee D gave a similar example stating that "for now, we can assume that they are going to be shared cars. But through the years, the focus could slowly but surely shift more to shared bicycles, cargo bikes, and other modes of transport". Such a shift would require that the "design and layout of buildings should be able to easily move along with this development, which is called adaptive

programming" (Interviewee C). Interviewee G agreed with this view by stating that "it could be interesting to integrate the parking garage into the area in such a way that you can introduce flexibility". The specific methods for adaptive programming suggested by interviewees ranged from relatively rigorous to fairly small-scale. For example, interviewee J (consultant) mentioned that they "always advise to design parking garages with floor heights of 2,70 meter instead of just 2,20. Then you can always turn them into houses so to speak". Whereas interviewee D gave a less drastic example: "in most parking garages, the fast and slow mobility [i.e. cars and bicycles] are separated. But if you want to substitute two shared cars for four cargo bikes for instance, it has to be possible from a spatial point of view". To this end, interviewee J also advised: "maybe we should not be talking about an amount of parking spaces but about an amount of square meters in the best possible location in the garage" and "the column structure in a garage should not be designed that it only allows the parking of cars". Hence, the final CIMO for facilitating flexible supply is:

CIMO 6.4: To be able to effectively adjust the vehicle sharing supply to the demand (O) in newly developed urban areas with centralized parking (i.e. parking garages) (C) design the parking garage in such a way that its functionality can be more easily adjusted to different (shared) modes of transport (I) to prevent a garage from becoming obsolete or unfit for its purpose (M).

A full overview of the interventions answering SQ3 are shown in Figure 4.3.

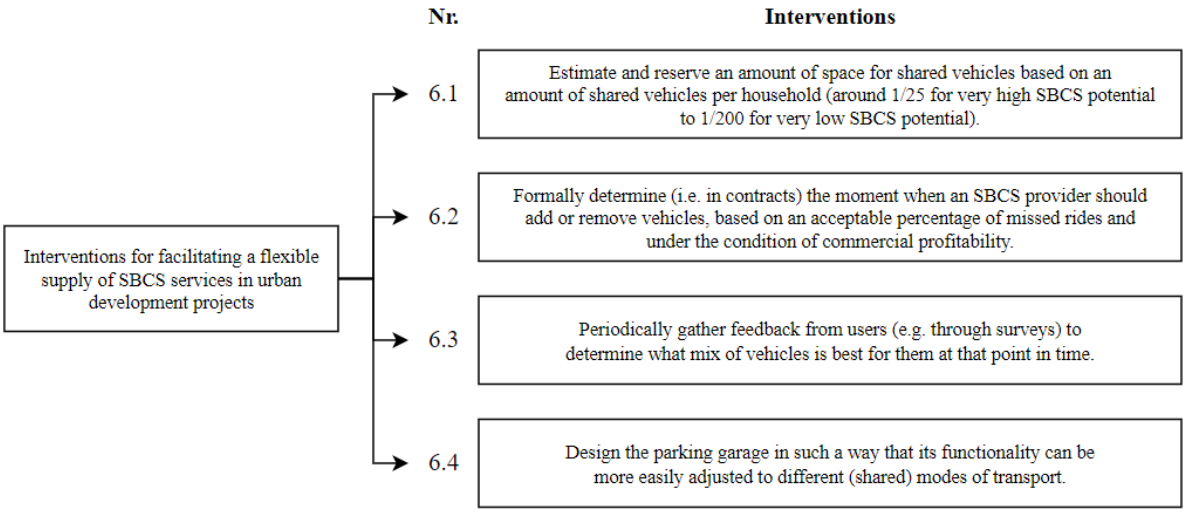

Figure 4.3 – Four interventions were identified which can aid in facilitating flexibility in supply of SBCS services.

4.3.4. Validation of Demand Factors

In general, most insights from the interviews were consistent with the findings in literature. For example, as shown in Appendix 3.4, the SLR indicated that the use of SBCS services is stimulated by poor or difficult parking. Interviewee A, among others, confirmed this finding by stating that "it [SBCS use] is often driven by the impossibility of owning a private car", referring to poor parking facilities. Similarly, the interviewees agreed that living in centrally located areas (i.e. closer to city centers) with a high population density will generally stimulate use. Interviewee I illustrated this by saying; "a large portion of the people moving to a centrally located, high density area, will realize that they have to make compromises [with regard to owning cars]".

Besides the area-related factors, there were also some individual-related factors validated by the interviewees. The SLR results showed that users of carsharing services generally live in small households, often without children. Several interviewees affirmed this notion. For instance, interviewee I mentioned that "young people without kids are more inclined to use a shared car […] but we also see, as soon as young people have kids, the first thing they do is to buy car" or interviewee B; "and then there are those who are going to start a family, they also drop out [of carsharing services]". There was also one point where the interviewees did not seem to agree completely with literature. Where the literature indicated that the users of carsharing services are mostly aged between 30 and 50 years old, the empirical data yielded slightly different findings for SBCS services. For example, interviewee B (SBCS provider) indicated that they "often see that young people join our services, who just got their driver's license [18], up until around 30-32". Similarly, interviewee A and G both mentioned that currently, most users are young adults. Interviewee D stated that "for carsharing services the age group is slightly different [compared to micromobility], you also see some older people [18-35] using the services". One reason why older people do not use carsharing services, according to interviewees H and I is the status value connected to a private car. Or, as interviewee I indicated, "for a certain generation, a car is more than just a mode of transport, it is a symbol status and freedom, not just a way to go from A to B". So, it can be concluded that, at least for the current context (SBCS services in the Netherlands), the users are generally aged somewhere between 18 and 35 years old.

5. Solution Design

This section discusses the formulation of the solution design (or "artifact"), which is the application of the knowledge from the theoretical and empirical analysis, in order to make the jump from scientific rigor to practical relevance. Before presenting the solution, the class of problems is specified to guide the design process, in accordance with DSR-theory. Next, requirements are formulated to which the solution should comply to be successful. Finally, the solution design itself is presented.

5.1. Class of Problems

The research problem formulated in the introduction can be summarized as: UADs lack structured knowledge with regard to the implementation and facilitation of vehicle sharing (in particular SBCS) services in urban development projects. Even though the overview of factors presented in Section 3.3, and the CIMOs formulated in Section 4.3, contain such knowledge, it is still fairly unstructured. Therefore, the knowledge should be organized in a way that it is directly applicable in the activities of a UAD. These urban development projects, and the corresponding activities, most often follow a series of high-level sequential stages, ranging roughly from envisioning a certain urban concept (for a certain area) to finishing and allocating houses and other buildings. So, to integrate the knowledge on facilitation of SBCS services in these projects, it should be organized in a procedural manner. Hence, the class of problems for the current solution design can be summarized as the mapping of an implementation process.

5.2. Design Requirements

To further guide the solution design, requirements were formulated. These requirements combined represent the desired situation and they offer criteria on which the solution design should be evaluated (Keskin, n.d.). According to van Aken et al. (2007), it is useful to structure requirements in three categories, namely: (1) *functional requirements*; performance demands which form the core design specification, (2) *user requirements*; demands from the viewpoint of the user, and (3) *boundary conditions*; which have to be met unconditionally. The

requirements for each category were created and validated using company supervisor (i.e. the intended user) input. The requirement specification is displayed in Table 5.1.

Table 5.1 – Requirement specification for the solution design

Type	Nr.	Description
Functional	1.1	The solution design should help UADs in general, and BPD specifically, to successfully implement SBCS services in urban development projects.
	1.2	The solution design should help UADs in general, and BPD specifically, to facilitate flexibility in the supply of SBCS services.
	1.3	The solution design should align with the activities and procedures of Dutch UADs in general, and BPD specifically.
	1.4	The solution design should display existing interrelations between different interventions.
	1.5	The solution design should be easily extendable with additional interventions.
User	2.1	The solution design should be comprehensible by employees of UADs in general, and BPD specifically.
	2.2	The solution design should be communicable to other stakeholders in the development process (e.g. SBCS providers and municipalities).
	2.3	The solution design should be displayed in a single overview.
Boundaries	3.1	The solution design should be applicable to all urban development projects in the Netherlands.
	3.2	The solution design should be in line with the activities of providers of SBCS services.
	3.3	The solution design should not contain confidential information.
	3.4	The solution design should be translatable to both Dutch and English.

5.3. Final Design

Since the solution design should be mapped as an implementation process, and since it should be specifically applicable to BPD's activities, the company's archetypical area development process is used as a starting point. This process (see Figure 5.1) globally describes which activities a UAD should undertake in which stage of area development. Besides the relevance to the client company, the development process is logical enough to also be useful to other practitioners. It should be noted that physical activities such as real-estate construction are not part of the activities of a traditional UAD. Nonetheless, some of these activities are displayed at the bottom of the figure to give a more clear overview of the development process.

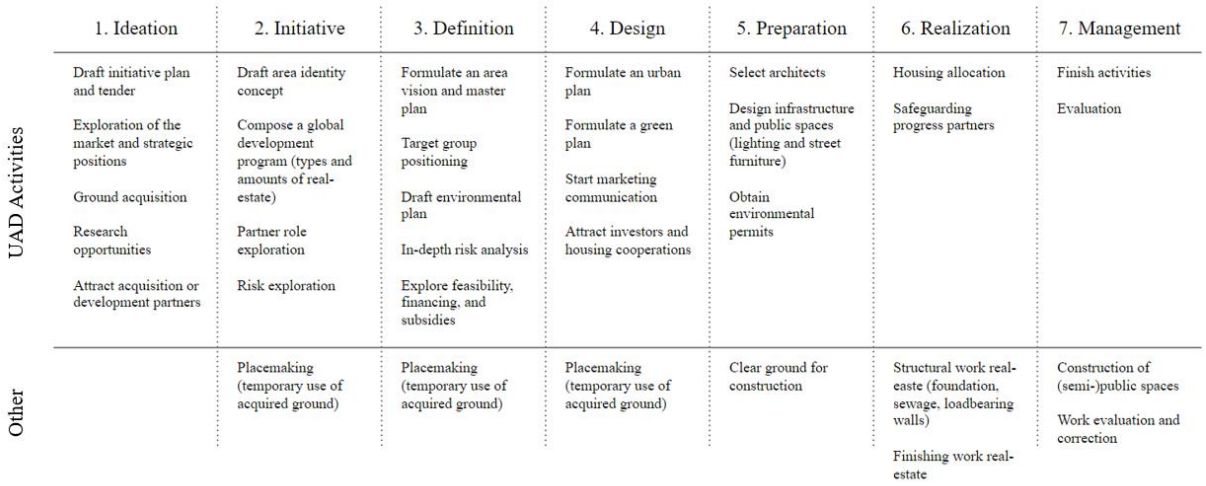

Figure 5.1 – The archetypical development process used by BPD consists of seven stages ranging from ideation to management.

Next, based on the activities in the stages from the archetypical development process, all CIMOs described in Section 4.3 are integrated in the process, and labeled according to the stage (e.g., the first intervention in the first stage is labeled "A1"). Furthermore, where needed, the interrelations and sequentiality between the interventions are depicted using arrows. An overview of the solution design is shown in Figure 5.2, an elaboration for the interventions is provided in the following sections.

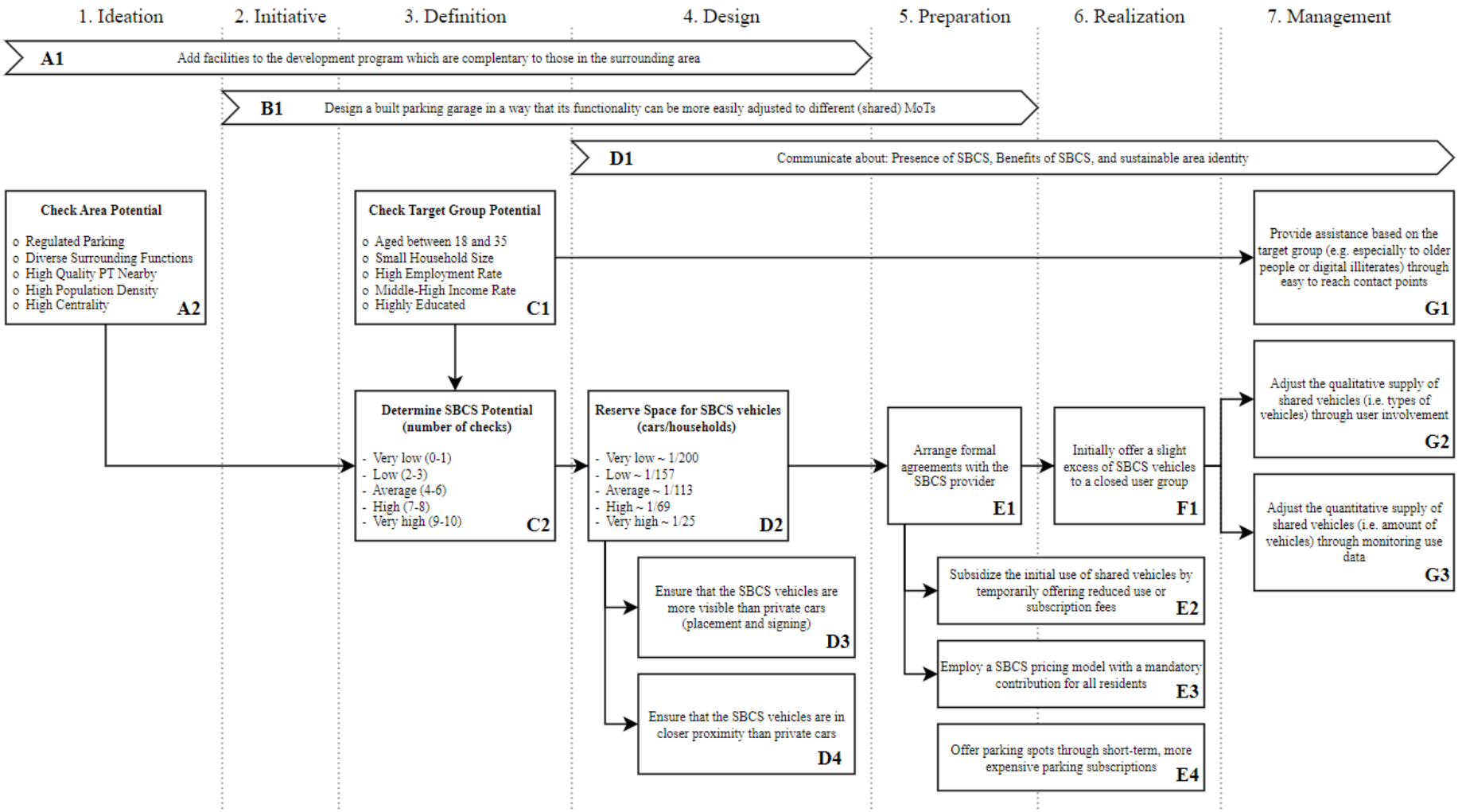

Figure 5.2 – The solution design incorporates the interventions (including interdependency and sequentiality) from the empirical analysis in the seven-stage archetypical development process used by BPD.

As can be seen in Figure 5.2, some CIMOs should be taken into account during a longer period of time, instead of during individual stages. For example, CIMO 2.2 [box A1] ("add complementary facilities to the development program to stimulate walking and cycling"), should already be taken into account in the ideation (1st) stage, since it should be part of the initiative plan. However, the exact types of facilities may only be definitively determined in the design (4th) stage, when the final urban plan is set. Similarly, CIMO 6.4 [B1] ("design a parking garage so that is functionality can be adjusted to different MoTs"), can be taken into account from the initiative (2nd) stage, because at this point in time, the global development plan is determined, so it is also roughly known if and where a parking garage will be built. But some of the more specific details that determine the adaptability of the design, such as the allocation of parking places, may be determined later on, around the preparation (5th) stage. Finally, CIMO 1.3 [D1] stipulated that the communication with regard to SBCS services (CIMO 1.1 and 1.2) should be connected to the customer journey. Figure 5.1 shows that the socio-demographic target groups are determined in the definition (3rd) stage. Hence, the communication with regard to SBCS services should be started in the following stage, together with the general start marketing communication, and should be continued all the way to the 7th stage (management). Communication in the management stage might for example be keeping residents up to date on when vehicles are added or replaced, or how residents can get assistance with using SBCS services.

A second important feature of the solution design is that some interventions have interdependence. For example, the amount of space that should be reserved for SBCS services (CIMO 6.1 [D2]) depends on the potential in that specific area. Which, in turn, depends on factors such as those identified in the theoretical analysis (Figure 3.1). Since each urban development project starts with a location, the area-related factors are more or less set from the ideation (1st) stage. At this point in time, it is already known how centrally located the area is, what the population density in the surrounding area is, how the parking is arranged in the surrounding area, which facilities are nearby, and if there is high-quality PT nearby. Even though *infrastructure* was also identified as an area-related factor, it had no specific relation with SBCS services according to the literature (see Appendix 3.4). The individual-related factors, on the other hand, are set later on in the development process. As Figure 5.1 shows, the socio-demographic target group is determined in the definition (3rd) stage, based on the types of real-estate being built. However, these types of houses do not necessarily attract a target group with specific values and beliefs or other individual-related factors, this can be done using

communication for example (CIMO 1.1 [D1]). Even though gender did have a significant effect on potential carsharing demand according to the SLR, it is not feasible to build real-estate specifically for one gender, and therefore it is not used to determine the potential. Finally, the service factors are not take into account for determining the potential since they can be controlled by the SBCS provider and the UAD to stimulate use. For example, the "availability" factor is used in CIMO 4.1 and the "price" factor in CIMOs 3.1 and 3.2.

Once the potential for SBCS services is determined using the area and individual-related "success-factors", space should be reserved based on the expected amount of shared cars per household (about 1/25 for very high potential and 1/200 for very low potential), in accordance with CIMO 6.1 [D2]. This should be done in the design (4th) stage, since it is here that the urban plan is made specific. Furthermore, the location where this space is reserved is important to guarantee ease-of-use, through short walking distances to the vehicles and high visibility (CIMOs 5.1 [D3] and 5.2 [D4]). However, the SBCS vehicles themselves should only be placed once the first houses are finished, in the realization (6th) stage. At this point in time, CIMO 4.1 [F1] ("initially offer a slight excess SBCS vehicles to closed user groups to guarantee reliability") should also be carried out. In the management (7th) stage, the quantitative supply should be adjusted based on missed rides and profitability (by monitoring use data) whereas the qualitative supply should be adjusted through user involvement (CIMO 6.2 [G2] and 6.3 [G3]). Additionally, assistance should be provided to those users in need, according to CIMO 5.3 [G1]. Younger, more highly educated target groups might need less intensive assistance, just through a digital contact point for instance, whereas older target groups might require more intensive assistance, in the form of a physical contact point. This assistance should be available from day one of moving in, and should remain in place so that people who move in later can also make use of it (both the realization and management stage).

Lastly, CIMOs 2.1 [E2] ("offer parking spots through short-term, relatively expensive, subscriptions"), 3.1 [E3] ("subsidize initial use by temporarily offering reduced SBCS fees"), and 3.2 [E4] ("employ a pricing model with mandatory contributions") do not have specific interdependencies. However, it is important to start planning these interventions in the preparation (5th) stage. This is mainly because the outcomes of these interventions, such as costs for parking and SBCS subscriptions can be important to communicate early to potential residents. Because, as mentioned before, a person has to be aware of the alternatives of private cars before they decide to move house, in order to change their habitual behavior. Nevertheless, the actual implementation of the interventions cannot be done until the realization (6th) stage.

6. Solution Evaluation

In this section, the solution design is evaluated according to the Framework for Evaluation in Design Science Research (FEDS). First, the four steps of the FEDS are discussed in more detail, these are determining (1) the goals of evaluation, (2) the strategy of evaluation, (3) the properties to evaluate, and finally (4) the design of the evaluation protocol. Subsequently, the outcomes of the evaluation sessions are discussed.

6.1. Evaluation Process

6.1.1. Goals of Evaluation

According to Venable et al. (2016), evaluation in DSR may have four goals; rigor, uncertainty and risk reduction, ethics, and efficiency. Of these four, *uncertainty and risk reduction*, and *ethics* are especially salient evaluation goals for artifacts with many uncertainties or safety criticalities, which was not necessarily the case for the current solution design. The *rigor* evaluation goal, on the other hand, is described as "establishing that it is the artifact instantiation that causes an observed outcome and only the artifact, not some confounding independent variable or circumstance (efficacy) [or] establishing that the artifact instantiation works in a real situation (effectiveness)" (p.82). Finally, the purpose of *efficient* evaluation is to balance the three aforementioned evaluation goals with the available resources, most notably time and money. So, the goal of the evaluation episode was a combination between *rigor* and *efficiency*, because it was important to demonstrate whether the solution design works, yet there were limited resources and a limited time frame to conduct the evaluation, due to the nature of the study.

6.1.2. Strategy for Evaluation

Based on the goals of evaluation, in this case rigor and efficiency, the strategy for evaluation was selected, which implied a choice on three dimensions, namely the motivation, moment, and method of evaluation. An overview of the choices which can be made in these dimensions are shown in Figure 6.1.

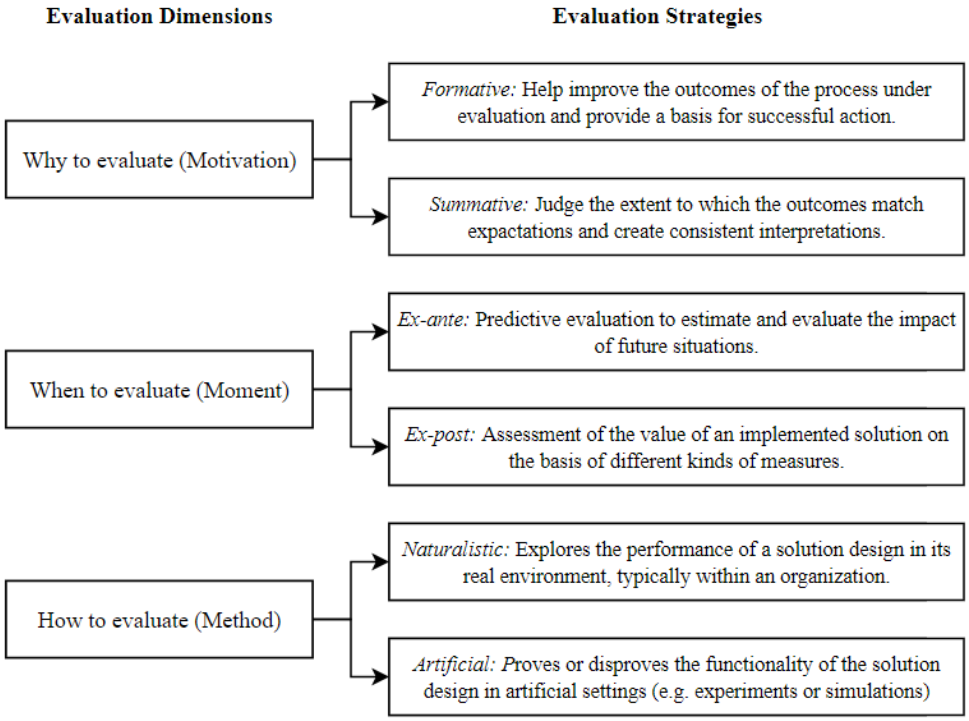

Figure 6.1 – The evaluation strategy implies a choice on three dimensions; motivation, moment, and method of evaluation (Venable et al. 2016).

Due to the nature of urban development projects (which are generally realized over about five to fifteen years), and the limited time frame of the current study (of about half a year), some evaluation strategies were inherently unsuitable to evaluate the solution design. For instance, evaluating the solution design in a naturalistic setting would have meant that a full development project would have to be completed to test the entire solution design, since the interventions are spread out over all development stages (ideation to management). Because of similar reasons, it was not feasible to evaluate ex-post (afterwards), since this means that the solution design would have to be implemented before it could be evaluated. Hence, evaluation for the current solution design in the current context and time frame was limited to ex-ante (beforehand) and artificial, which coincidentally enabled the *efficiency* goal formulated above. As mentioned above, one of the main purposes of rigorous evaluation is to establish if a solution design would work, i.e., whether it is effective or not. To this end, a formative evaluation strategy was most suited, since it is able to provide a basis for the successful implementation of the solution design, as opposed to a summative evaluation which is more useful for creating consistent interpretations among users of the solution design (Venable et al. 2016).

6.1.3. Properties to Evaluate

The final step before designing the initial evaluation episode was to determine which properties of the solution design to evaluate. According to Mathiassen et al. (2000), examples of such properties include; usability, flexibility, comprehensibility, and reliability. It can be seen that these properties overlap to a large extent with the design requirements presented in Table 5.1. Furthermore, as stated in Section 5, the solution was considered successful if it met the requirements. However, it was not desirable or realistic to translate each design requirement into a property to evaluate, because some could simply be passed or failed (such as requirement 3.3; *the design should not contain confidential information*). So, the properties to evaluate were derived from those design requirements that can be scored in a quantitative manner. An overview of these properties, and the requirements from which they originate is shown in Table 6.1.

Table 6.1 – Properties to evaluate based on design requirements

Requirement	Evaluation Property	Description
1.1/1.2	Usefulness	The solution design helps with successfully implementing/facilitating SBCS services in urban development projects.
1.3	Alignment UAD	The solution design aligns with the activities and procedures of UADs/BPD.
1.5	Extendibility	The solution design is easily extendable with additional interventions.
2.1	Comprehensibility	The solution design is comprehensible.
2.2	Communicability	The solution design can be easily communicated to other stakeholders.
3.1	Applicability	The solution design is applicable to all (BPD's) urban development projects.
3.2	Alignment provider	The solution design aligns with the activities of SBCS providers.

6.1.4. Design of Evaluation Protocol

According to Venable et al. (2016), popular methods for artificial ex-ante evaluation include experiments, simulations, criteria-based analysis, and theoretical arguments. For the current evaluation protocol, it was important that the properties listed in Table 6.1 were scored similarly

to a criteria-based analysis, to see if the solution design met requirements. However, just letting end-users (i.e. employees of BPD) score the individual properties after scanning the solution design would have been a poor representation of reality, since the scores would be relatively unmotivated resulting in bias. To this end, the solution design was evaluated using the real-world context of development projects of BPD, similar to a simulation. By organizing group discussions with employees, on how the individual interventions of the solution design could theoretically be implemented in the existing project context (ex-ante), the end-users could get a better idea of the solution design. Besides, actual interventions in development projects will in many cases be determined in project team discussions, which meant that the evaluation was a better representation of reality. To further increase the reliability of the evaluation, the discussion groups were composed of different types of employees, similar to real-life multifunctional project teams (within BPD). For example, a developer might have a better idea what the effects of the interventions will be on the built environment, whereas a process controller knows more about the contractual arrangements and agreements between different stakeholders (e.g. UADs and SBCS providers) in the development process. The group discussions were roughly structured as follows:

1. Briefly present the solution design and the origin of the interventions.
2. Briefly present the context of the development project under discussion.
3. Discuss the interventions in the solution design chronologically. Possible points of attention are what the potential (side) effects of or barriers to implementing the interventions are.

To ensure that the employees' comments were not lost in discussion, they were encouraged to take notes on physical prints of the solution design. After the discussion session, the employees were asked to individually rate the properties on a Likert-scale ranging from "strongly disagree" (1) to "strongly agree" (5). The advantages of using such a scale are that they are easy to understand, the results are easily quantifiable, and can be easily combined in a total score (LaMarca, 2011). The employees were also asked to write additional notes to ensure that properties not captured by the requirement specification could be evaluated. A full overview of the translated (Dutch-English) evaluation protocol is presented in Appendix 6.1.

6.2. Evaluation Outcomes

The solution design was evaluated in two separate discussion groups of four employees. Table 6.2 displays shows the average ratings for the evaluation properties for the evaluation rounds.

Table 6.2 – Average scores for evaluation properties for the two discussion session

Property to evaluate	Average Session 1	Average Session 2	Total
Usefulness	4	3,75	Agree (3,875)
Alignment UAD	4	3,75	Agree (3,875)
Extendibility	4	4,25	Agree (4,125)
Comprehensibility	4,25	3,25	Agree (3,75)
Communicability	3,5	3,25	Neutral (3,375)
Applicability	4,2	3,5	Agree (3,875)
Alignment provider	3,25	3,5	Neutral (3,375)

The following important points of attention were addressed in the two evaluation sessions:

1. **Interpretation of the solution design**: It is not instantly clear how the solution design should be interpreted. For instance, it was indicated that the arrow between box C1 in the definition (3rd) stage and box G1 in the management (7th) seems to imply that all the intermediate stages should be skipped, similar to a flowchart with conditional operators. In reality, the arrow only indicates the interrelation between the two interventions. Therefore, the solution design should more clearly depict how it should be used.
2. **Rigidity of potential factors:** In boxes A2 and C1, the area and individual-related potential for SBCS services are determined respectively. However, as was pointed out in the discussion sessions, these factors are not always set in stone. Firstly, especially UADs that develop large-scale urban development projects, can influence the area-related factors to some extent through political lobbying. An example was given where a UAD can initiate the moving of a bus stop so it is in closer proximity to a development project. Secondly, due to the long-term nature of urban development projects, both the area and individual-related factors may change during the course of a development project. For instance, a UAD might position an area to another target group if market research shows such a need. Or, a municipality may decide to regulate parking in an area based on wishes of residents in surrounding areas.
3. **Feasibility of conducting every intervention:** Another point of attention concerned the providers of SBCS services. It was mentioned that even though these parties have very similar modes of operation, some slight differences might exist in their service

offering. This could result in some providers not being able to help execute all interventions. For example, box G2 prescribes to adjust the qualitative supply (types of vehicles) based on user feedback. However, if a certain provider has just one type of vehicle in their fleet, this would not be directly possible. Similarly, some providers may only employ a standard pricing scheme, meaning that box E1 (subsidize trialability through reduced use fees) or box E2 (use a pricing scheme with a mandatory contribution) cannot be followed. Therefore, it was suggested that the service offerings of the available providers need to be screened before a provider is selected.

4. **Stakeholder involvement:** Comments were made regarding which stakeholders should be involved for which interventions. For example, box D1 concerns the communication about SBCS services to future residents. However, it is also important to communicate to municipalities about how these services will be implemented to convince them that the complete mobility plan (i.e. the way in which the UAD fulfills/facilitates the mobility needs of residents) will be adequate, in order to gain the required building permits. Furthermore, as can be seen in Table 6.2, the Alignment provider property was scored relatively low. This was mainly because most of the employees partaking in the evaluation sessions were not aware of what the activities of SBCS providers precisely entail, therefore answering "Neutral" (3).
5. **Interrelations with other MoTs:** It was indicated that it could be useful to show how the interventions in the solution design compare to interventions for facilitating other MoTs, because they are highly interrelated. For example, if the SBCS potential for a certain development project is high, more space should be reserved for those vehicles. This could also mean that less space needs to be reserved for private car parking, which is not clarified in the solution design. However, since these interventions for other MoTs are neither documented by the client company nor part of the research scope, they deserve additional attention before they can be integrated.
6. **Communicability to external stakeholders:** Even though it was not the primary goal of the solution design, communicability was found to be limited (see Table 6.2). Mostly because the substantiations behind the interventions are not present in the overview, regardless of the actual quality of the substantiations. This can result in an external stakeholder (e.g. municipality or SBCS provider) questioning the validity of the solution. Two suggestions were made for improving communicability. Firstly, the solution design can be made so that the adoption barriers and mechanisms behind the interventions can be quickly accessed, while keeping the complete overview concise.

Secondly, examples of successful implementation of the interventions in previous projects can be added to the solution design, this would increase the perception of practical validity.

6.3. Conclusion

Even though the solution design did not score insufficiently on any of the evaluation criteria, it can be concluded that several improvements can be made to the solution design. Some of those can be directly integrated, others will be integrated in an adapted version that can be used in client company's activities and communication, and still others require further research before they can be integrated. For example, the communicability requirement is not directly important for the academic validity of the solution design, whereas the comprehensibility is relevant to researchers and practitioners outside the client company. Hence, the former is not treated further in this study and the latter is integrated in an updated solution design. A full overview of the feedback from the evaluation sessions, and how this feedback is processed is shown in Appendix 6.2. The updated solution design is presented in Appendix 6.3.

7. Discussion

In this closing section, the study is concluded by first recapulating the most important findings which answered the research question. Next, both theoretical and practical implications are discussed that show what the study contributes to the existing knowledge in the research domain. Finally, limitations of the study and recommendations for future research are presented.

7.1. Conclusion

The central research question that was posed in the current study was:

How can a UAD facilitate an effective long-term match between supply and demand of B2C vehicle sharing services in to be developed urban areas in the Netherlands?

The scope of the study was narrowed further to SBCS services in the empirical analysis since they align better with the activities of UADs than FFCS services and they have greater potential to reduce private car reliance than shared micromobility. The research question was answered by first taking a look at what factors determine the potential vehicle sharing demand (SQ1), to estimate how much space should be made available for these services. It was found that mainly individual-related characteristics of future residents (e.g., age, household size, and education) and area-related factors of the to be developed area (e.g., centrality, parking regulation, and proximity of PT) determine the potential long-term demand for vehicle sharing services. Service factors, such as price and availability, are also important, but these can be more easily controlled by the UAD and SBCS service providers, and can thus be employed to stimulate use.

That is why next, interventions for stimulating SBCS use were identified (SQ2), because even when the vehicle sharing potential for a certain development project is high, it is no guarantee that the services will actually be used. This also means that the reliance on private cars is not necessarily decreased. The discrepancy between potential demand and use of SBCS services was found to be caused by five adoption barriers that potential users might experience, namely: (1) people are not enough aware of what SBCS services entail and what their benefits are, (2) private cars are too attractive due to cheap and easy parking and long travel distances, (3) SBCS

costs, and also the fact that they are more direct and visible than private car costs, discourage use, (4) the perceived reliability of SBCS services (i.e., “will the vehicle be available when I need it”) is limited, and (5) the ease-of-use of SBCS vehicles compared to private cars is limited due to technological barriers (e.g., apps and EV-charging) and vehicle placement.

To overcome the adoption barriers, a total of eleven interventions, along with their mechanisms, were identified according to the CIMO-logic. For example, to mitigate the awareness obstacle, the UAD should clearly communicate the sustainable identity of a development project to attract a target group with environmental concerns which is inherently more aware of SBCS services. Additionally, the UAD should communicate the benefits of SBCS services (e.g. less space is used on parking which can be utilized for high quality facilities). Besides communication content, timing was also found to be relevant. More specifically, the communication to future residents with regard to SBCS services should be coupled to the customer journey to create early awareness, this ensures that the residents can make an informed decision to change their habitual mobility behavior before they move house.

Lastly, since it is not expected that the demand for SBCS services will remain stable through time, interventions for facilitating a flexible supply of SBCS services were identified. An example of such an intervention is that a UAD should formally determine (in contracts) when an SBCS provider should add or remove vehicles (quantitative supply), based on an acceptable percentage of missed rides and under the condition of commercial profitability. The qualitative supply (types of vehicles), on the other hand, should be adjusted based on periodically gathered user feedback, since analyzing the use data cannot accurately map the latent demand.

7.2. Theoretical Implications

The current study contributes to existing literature on vehicle sharing services in several ways. Firstly, most studies in this research domain, such as those identified in the SLR, have just focused on the required conditions for successfully implementing vehicle sharing services from the perspective of service providers. Contrastingly, this study shows that UADs, cooperating with SBCS providers and municipalities, can and should take a more active role in facilitating the space-efficient alternative to private passenger cars, if they want these services to be used and hence contribute to the densification challenge. Even though the research by CROW (2021) already presented some policy guidelines for facilitating and stimulating the use of vehicle sharing services, the current study presents more specific, lower-level interventions which can be directly implemented in urban development projects. Furthermore, these interventions are

not just focused on stimulation through the design of the built environment, but also take into account financial and psychological barriers that people may experience.

Another theoretical implication resulted from the validation of the demand factors by the interviewed experts. Where the SLR indicated that carsharing users are generally between 30 and 50 years old, the expert interviews showed that, at least for SBCS services in Dutch urban areas, users are generally younger. This is not just because these younger people often care less about the status value of a private car, but also because they generally have fewer kids which means they need less flexibility in their mobility. Other demand factors identified in the SLR, such as parking, centrality, and environmental concerns, were confirmed to be valid for the current context by the experts.

7.3. Practical Implications

Besides the theoretical implications, there are some important practical implications. Probably the most notable one is that, if UADs truly want SBCS services to be an alternative to private cars in urban areas, they have to be taken into account from the very first stage of the development process, instead of as an afterthought when selling the houses. Not just to ensure that the shared vehicles are prioritized over private cars in the design of the built environment, but also to create early awareness among future residents. However, the solution design also clarifies early-on in the development process in which conditions SBCS services will probably not thrive, due to the lack of the right target group or impeding area-related factors. This can prevent UADs from placing an excess of shared vehicles which would result in wasted space and resources.

Successfully facilitating vehicle sharing services is not the only benefit of the solution design for UADs. It also allows them to be more prepared in conversations and negotiations with SBCS providers, and can help them convince municipalities of their mobility plans relying less on external mobility consultants. This can help the UADs with gaining the required building permits at reduced costs.

7.4. Limitations

Like any other, the current study was subject to limitations. However, generalizability limitations caused by the research scope (i.e. B2C SBCS services in Dutch urban areas) will not be further discussed. One of the first actual limitations concerns SQ2, which regarded interventions to stimulate the use of SBCS services over the use of private cars. This question was answered in two parts; identifying adoption barriers and subsequently prescribing

interventions to overcome them. To answer this question, qualitative expert interviews were deemed optimal because limited knowledge was available on best practices. However, such interviews do not directly capture the experiences of (potential) users and are not as suitable to precisely quantify the effects of the adoption barriers. For example, the adoption barriers could not be rated in terms of importance or frequency of occurrence. Quantitative user surveys, on the other hand, would be able to make such distinctions.

Another limitation stems from the method of evaluation of the solution which, due to the long-term nature of development projects and the short-term nature of the study, was relatively artificial. Even though most of the individual interventions extracted from the interview data had been applied in some capacity in existing development projects, none of these projects had taken such an exhaustive approach for facilitating vehicle sharing services as the solution design does. So, despite the fact that the individual mechanisms and effects of the interventions were clearly described, the combined effect has not been extensively studied. This would not have been a problem if the solution design had been evaluated in a naturalistic and ex-post manner, in which potential (side) effects can be more easily observed. However, in a simulation (artificial and ex-ante), it is difficult to expose such intricate interrelationships.

Lastly, it should be noted that the study was commissioned by one of the larger UADs active in the Netherlands. Furthermore, during the expert interviews, mostly relatively large-scale urban development projects (generally more than 100 houses) were discussed. Therefore, it could be argued that the results have limited generalizability for smaller urban development projects. For example, the solution design prescribes to reserve space for one SBCS vehicle for twenty-five households in areas with very high potential. However, this does not necessarily mean that it is not viable to place an SBCS vehicle in such an area if only twenty houses will be realized. Despite this limitation, it should be noted that implementing SBCS services will have the largest net effect (most space saved) in larger urban development projects.

7.5. Recommendations for future research

The first recommendation for future research concerns a limitation described above, namely that the adoption barriers were identified in experts interviews as opposed to through (potential) user surveys. It is recommended that the adoption barriers are specified, verified, and rated using such surveys. This could not only increase the validity of the solution design, by coupling the adoption barriers to more general well-known adoption barriers (resulting in a more sound theoretical basis). It could also tell a UAD on which interventions they should focus their

attention first. For example, if the unawareness barrier is much more salient for most people than the ease-of-use barrier, it would be wise to invest more effort on communication than assisting people with the use of SBCS services.

Two other recommendations for further research stem from the evaluation of the solution design. First of all, because the data for the empirical analysis was gathered using qualitative expert interviews, it was not possible to exactly quantify some of the potential checks in the solution design. For instance, it was not defined when surrounding functions can be considered *diverse* or when public transport can be considered *high quality* or *nearby*. Therefore, it is recommended to more accurately specify these potential factors for the specific context of SBCS services in Dutch urban areas. Additionally, it was noted that it could be useful to also include interventions needed to facilitate or implement other MoTs in the solution design, since the MoTs are interrelated. However, these interventions were not part of the scope of the current research. So, it is recommended to study what would be needed to fulfill all mobility needs of future residents, possibly using a systems perspective to get a better understanding of the intricate links between different MoTs.

Finally, even though the interventions prescribed for stimulating SBCS use are effective for that specific purpose, the current research did not study potential side effects of the interventions in detail. Therefore, especially some of the more drastic interventions should be studied further. For example, while CIMOs 2.1 (“offer parking spots through short-term, relatively expensive subscriptions”) and 3.2 (“employ mandatory SBCS contributions”) will stimulate use of SBCS services of people who decided to move to an area, it may prevent some people from moving to an area in the first place, due to a higher perceived monthly cost-of-living. So, it is recommended that the effect of the interventions on the overall attractiveness of an urban area is studied further.

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Appendix 2.1 – SLR Protocol

Keywords and Search Query

The question that is treated in the systematic literature review (SLR) is the first sub question (SQ1) of the study. This question is based on an exploratory review of the literature and is stated as follows: *Which factors determine the potential demand for vehicle sharing services in to be developed areas?* To formulate a search query, first the keywords of the research question are identified, these are; "factor", "demand", "shared", "mobility", and "solution". Based on the exploratory review of the literature and a thesaurus (Dictionary.com, 2022), synonyms and related terms for the keywords are identified. These are presented in Table A2.1.

Table A2.1 – Keywords and their synonyms and related terms for the SLR

Keyword	**Synonyms**
Factors	Determinants, Predictors
Demand	Need, Adoption, Diffusion
Shared	Pooled
Mobility	Transport, Vehicle, Car, Bicycle, Micromobility, Scooter, Moped
Solutions	Services

As stated in the introduction, ride-sourcing forms of shared mobility will not be part of the current research. Therefore, the related term "pooled" is excluded from the search query. Furthermore, to prevent gathering irrelevant literature, the underlying business models of ride-sourcing (e.g., ridesharing and ridehailing) are also excluded in the query. A prior version of the query also included terms such as "transport", "vehicle", "car", "bicycle", and "micromobilitty". However, because too many irrelevant studies were returned, the updated search query only includes "mobility". The following query will be used for the SLR:

(demand OR need* OR adopt* OR diffusion) AND share* AND mobility AND (solution* OR service*) AND (factor* OR determinant* OR predict*) AND NOT ("ridesourcing" OR "ride-sourcing" OR "ridesharing" OR "ridehailing" OR autonomous)*

An overview of the functions of the operators in the search query are presented in Table A2.2.

Table A2.2 – Operators for search queries (specific to the Scopus database)

Operator	Function
AND	Must contain both terms before and after operator (limits search)
OR	Must contain either of the terms before and after operators (narrows search)
AND NOT	Excludes results with term after the operator
*	Used after the stem of a word to include all variations (e.g. plural or adjective)
"…"	Exact term in between brackets must (not) appear in result (phrase search)

The query is limited to searching in article titles, abstracts, and keywords in the Scopus database. The main reasons for using the Scopus database are:

- **Wide coverage:** Includes articles (abstracts and citation statistics) for both Elsevier and non-Elsevier content. Furthermore, not just peer-reviewed articles, but also conference papers, book chapters, and gray literature are included.
- **Multidisciplinarity:** Includes articles in a broad range of research fields.
- **Accessibility:** Scopus can be readily accessed through an Eindhoven University of Technology account.

Inclusion and Exclusion Criteria

After articles have been identified using the search query mentioned above, the articles need to be filtered using inclusion/exclusion criteria. These criteria, including their substantiation, are listed below:

- **Date range:** Only articles published after 2015 will be included in the SLR. In the bibliometric analysis by Shams Esfandabadi et al. (2022) it was found that literature on carsharing only started to take shape after 2015-2016. Therefore, it is expected that literature before this time either looks at the concept differently or presents outdated views.
- **Subject area:** Only articles published in the subject areas social sciences, environmental sciences, business/management/accounting, and decision sciences will be included in the SLR. Although articles in other subject areas may discuss shared mobility, they are probably not relevant to this specific research question

- **Number of citations:** Only articles which are cited 5 or more times will be included in the SLR. It is expected that articles that are cited less are not rigorous enough. However, exceptions may be made if the articles are published very recently.
- **Language:** Only articles published in English or Dutch will be included in the SLR. Other languages are not known by the researcher and can thus not be easily analyzed.
- **Field-Weighted Citation Impact (FWCI):** The FWCI is an indicator in the Scopus database which shows how well cited an article is when compared to similar articles (Elsevier, 2022). An FWCI greater than 1 is cited more than expected. Therefore, only articles with an FWCI of 1 or greater will be included in the current SLR.
- **Geographical context:** Only articles/studies that were conducted in countries with a Human Development Index (HDI) over 0.800 will be included in the SLR. The HDI is "a summary measure of average achievement in key dimensions of human development…" (United Nations, 2022). An HDI over 0.799 is labeled as "very high" and applies to most western countries. This criteria is applied since it is expected that countries with lower HDIs will be very different in terms of supply and demand of shared mobility than the Netherlands.
- **Manual Exclusion:** Finally, since some irrelevant articles may still be included after the first six criteria, some articles will be manually excluded. By globally reading the article (title, abstract, results, and figures) it will be determined whether it is relevant to the research question.

Data Extraction

After all relevant studies are identified based on the keyword search and the inclusion criteria, meta-data of the articles are documented in a data extraction form. These meta-data include the authors, year of publication, title, digital object identifier (DOI), amount of citations, FWCI, study purpose, methodology, and most important results. An overview of the outcomes of the data extraction is shown in Figures A2.1 and A2.2.

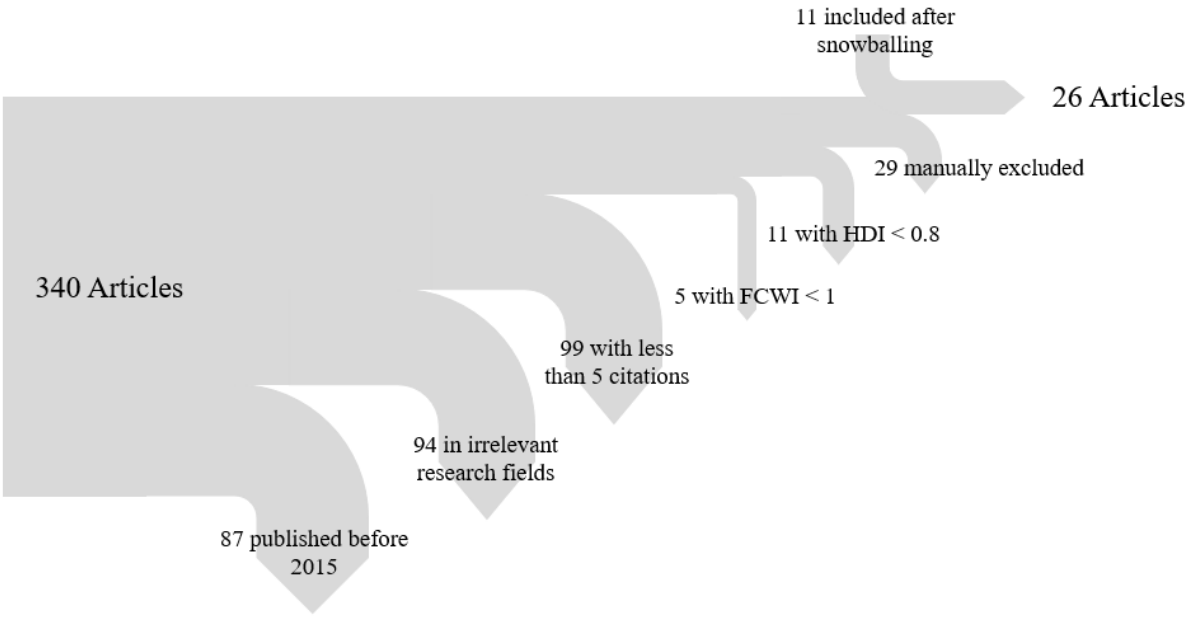

Figure A2.1 – Exclusion process of the Systematic Literature Review

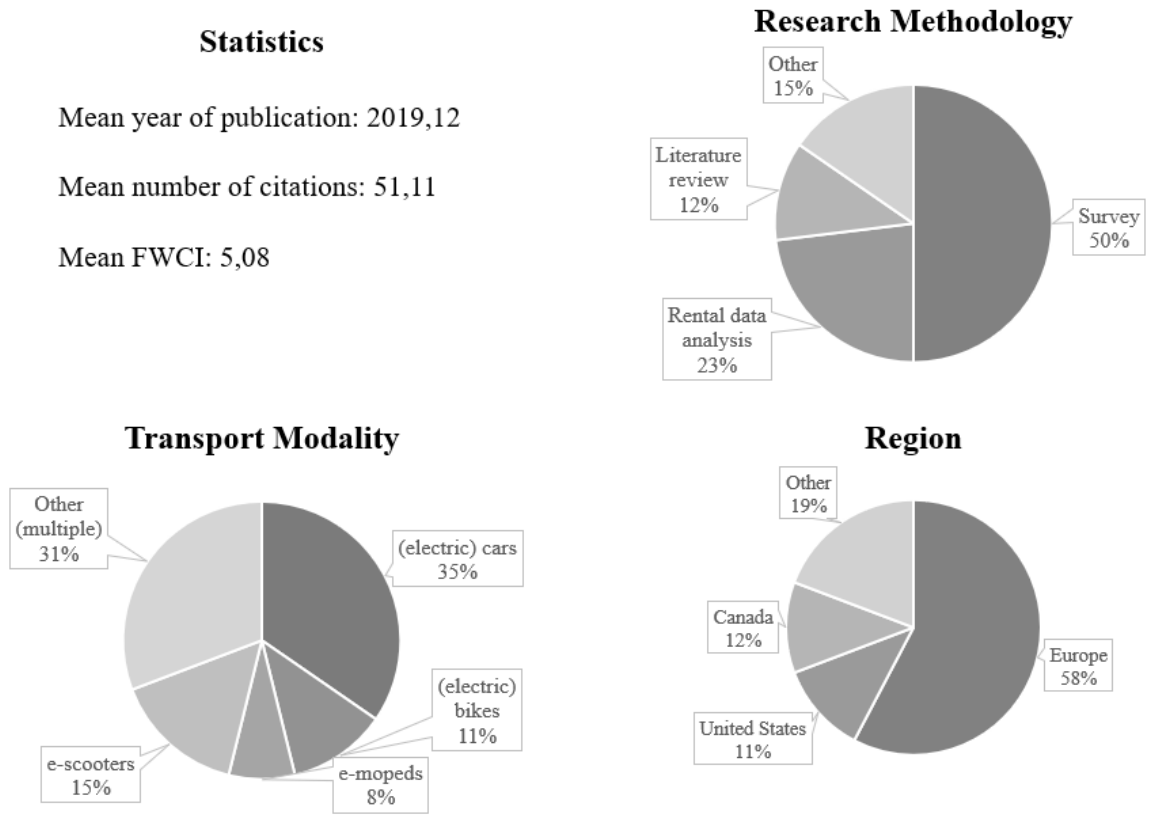

Figure A2.2 – Descriptive statistics of the included articles of the Systematic Literature Review

Appendix 2.2 – Interview Guideline

Introduction

- Request permission to record (audio of) the interview.
- Inform the interviewee about the interview consent form
- Goal of the research assignment: How can an urban area developer (UAD) effectively facilitate a long-term match between supply and demand of shared mobility solutions in newly developed areas?
- Goal of the interview: Threefold
    - Discuss factors identified from literature that determine the potential demand for shared mobility solutions.
    - Discuss which factors (categories) are "under control of" or can be influenced by UADs and cooperating stakeholders.
    - Discuss how the factors should be influenced (methods) by UADs and cooperating stakeholders to realize the potential for shared mobility.
- Maximum duration of the interview: 90 minutes

Part 1 – Demand factors shared mobility

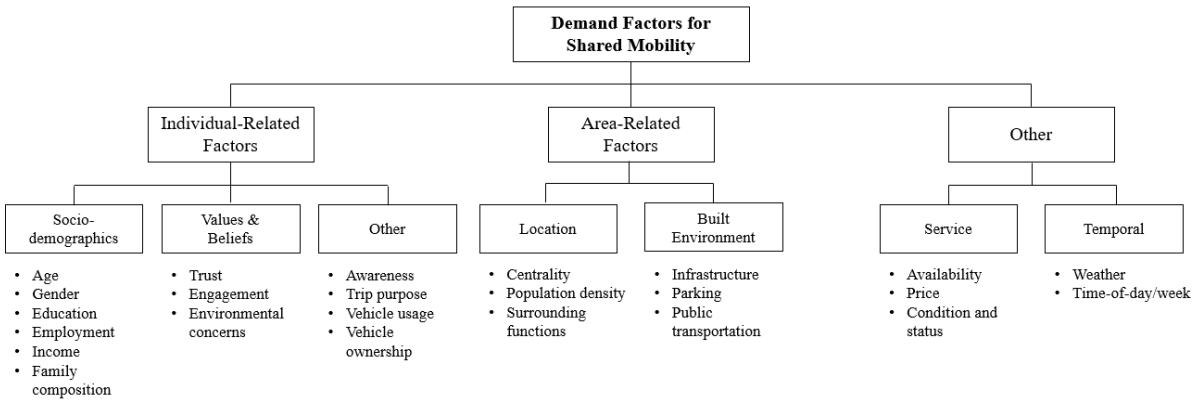

Figure A2.3 – Overview of demand factors for vehicle sharing services.

- Discuss the interviewee's experiences related to the factors above.
- Are the (sub)categories complete and accurate?
- Which factors are the most important?

Part 2 – Factors within control/under influence of UADs

- Which factors can be directly influenced by UADs?
- Which factors can be influenced by UADs through cooperating parties?
- Which factors cannot be influenced in area development?

Part 3 – Available methods

- How should the UADs wield these factors to realize the potential for shared mobility?
- How should the UADs wield these factors to realize the STOMP-principle?
- How should the UADs facilitate scalability in shared mobility supply?

Wrap-up

- Additional remarks interviewee.
- Discuss other potential interviewees.

Appendix 3.1 – Included Articles SLR

Nr.*	Author(s)	Year	Title	DOI	Citations	FCWI
1	Aguilera-Garcia, A., Gomez, J., Sobrino, N.	2020	Exploring the adoption of moped scooter-sharing systems in Spanish urban areas	10.1016/j.cities.2019.102424	56	10,28
2	Ampudia-Renuncio, M., Guirao, B., Molina-Sanchez, R., Braganca, L.	2020	Electric free-floating carsharing for sustainable cities: Characterization of frequent trip profiles using acquired rental data	10.3390/su12031248	10	1,18
3	Becker, H., Ciari, F., Axhausen, K.W.	2017	Comparing car-sharing schemes in Switzerland: User groups and usage patterns	10.1016/j.tra.2017.01.004	172	8,94
4	Bielinski, T., Wazna, A.	2020	Electric scooter sharing and bike sharing user behaviour and characteristics	10.3390/su12229640	50	5,45
5	Burghard, U., Dutschke, E.	2019	Who wants shared mobility? Lessons from early adopters and mainstream drivers on electric carsharing in Germany	10.1016/j.trd.2018.11.011	54	4,11
6	Christoforou, Z., Gioldasis, C., de Bortoli, A., Seidowsky, R.	2021	Who is using e-scooters and how? Evidence from Paris	10.1016/j.trd.2021.102708	31	6,59

Nr.*	Author(s)	Year	Title	DOI	Citations	FCWI
7	El-Assi, W., Salah Mahmoud, M., Nurul Habib, K.	2017	Effects of built environment and weather on bike sharing demand: a station level analysis of commercial bike sharing in Toronto	10.1007/s11116-015-9669-z	260	15,76
8	Fiorini, S., Ciavotta, M., Joglekar, S., Scepanovic, S., Quercia, D.	2022	On the adoption of e-moped sharing systems	10.1140/epjds/s13688-022-00358-2	0	0
9	Gross-Fengels, S., Fromhold-Eisebith, M.	2018	Adapting transport related innovations to rural needs: Smart Mobility and the example of the Heinsberg region, Germany	10.1016/bs.atpp.2018.09.007	5	1,46
10	Javaid, A., Creutzig, F., Bamberg, S.	2020	Determinants of low-carbon transport mode adoption: systematic review of reviews	10.1088/1748-9326/aba032	23	0,99
11	Kopplin, C.S., Brand, B.M., Reichenberger, Y.	2021	Consumer acceptance of shared e-scooters for urban and short-distance mobility	10.1016/j.trd.2020.102680	25	5,18
12	Liao, F., Correia, G.	2022	Electric carsharing and micromobility: A literature review on their usage pattern, demand, and potential impacts	10.1080/15568318.2020.1861394	13	7,76
13	Liyanage, S., Dia, H., Abduljabar, R., Bagloee, S.A.	2019	Flexible mobility on-demand: An environmental scan	10.3390/su11051262	34	1,49

Nr.*	Author(s)	Year	Title	DOI	Citations	FCWI
14	Markvica, K., Millonig, A., Haufe, N., Leodolter, M.	2020	Promoting active mobility behavior by addressing information target groups: The case of Austria	10.1016/j.jtrangeo.2020.102664	15	1,76
15	Mehzabin Tuli, F., Mitra, S., Crews, M.B.	2021	Factors influencing the usage of shared E-scooters in Chicago	10.1016/j.tra.2021.10.008	5	1,24
16	Mounce, R., Beecroft, M., Nelson, J.D.	2020	On the role of frameworks and smart mobility in addressing the rural mobility problem	10.1016/j.retrec.2020.100956	9	1,41
17	Munzel, K., Piscicelli, L., Boon, W., Frenken, K.	2019	Different business models – different users? Uncovering the motives and characteristics of business-to-consumer and peer-to-peer carsharing adopters in The Netherlands	10.1016/j.trd.2019.07.001	38	2,87
18	Namazu, M., MacKenzie, D., Zerriffi, H., Dowlatabadi, H.	2018	Is carsharing for everyone? Understanding the diffusion of carsharing services	10.1016/j.tranpol.2017.12.012	42	3,16
19	Narayan, J., Cats, O., Van Oort, N., Hoogendoor, S.	2017	Performance assessment of fixed and flexible public transport in a multi agent simulation framework	10.1016/j.trpro.2017.12.029	8	1,44
20	Prieto, M., Baltas, G., Stan, V.	2017	Car sharing adoption intention in urban areas: What are the key sociodemographic drivers?	10.1016/j.tra.2017.05.012	128	6,41

Nr.*	Author(s)	Year	Title	DOI	Citations	FCWI
21	Priya Uteng, T., Julsrud, T.E., George, C.	2019	The role of life events and context in type of car share uptake: Comparing users of peer-to-peer and cooperative programs in Oslo, Norway	10.1016/j.trd.2019.01.009	26	1,97
22	Schmoller, S., Weikl, S., Muller, J., Bogenberger, K.	2015	Empirical analysis of free-floating carsharing usage: The munich and berlin case	10.1016/j.trc.2015.03.008	134	4,29
23	Spurlock, C.A., Sears, J., Wong-Parodi, G., Walker, V., Jin, L., Taylor, M., Duvall, A., Gopal, A., Todd, A.	2019	Describing the users: Understanding adoption of and interest in shared, electrified, and automated transportation in the San Francisco Bay Area	10.1016/j.trd.2019.01.014	59	4,67
24	Torrisi, V., Ignaccolo, M., Inturri, G., Tesoriere, G., Campisi, T.	2021	Exploring the factors affecting bike-sharing demand: Evidence from student perceptions, usage patterns and adoption barriers	10.1016/j.trpro.2021.01.068	18	26,25
25	Wang, K., Akar, G., Chen, Y.J.	2018	Bike sharing differences among Millennials, Gen Xers, and Baby Boomers: Lessons learnt from New York City's bike share	10.1016/j.tra.2018.06.001	86	5,7
26	Wielinski, G., Trepanier, M., Morency, C.	2017	Electric and hybrid car use in a free-floating carsharing system	10.1080/15568318.2016.1220653	28	1,83

*These numbers are also used to identify the articles in Appendix 3.4

Appendix 3.2 – Manually Excluded Articles SLR

Author(s)	Year	Title	DOI	Reason for manual exclusion
Ahmed, S.S., Fountas, G., Eker, U., Still, S.E., Anastasopoulos, P.C.	2021	An exploratory empirical analysis of willingness to hire and pay for flying taxis and shared flying car services	10.1016/j.jairtraman.2020.101963	This study discusses to hire/pay for flying taxis/cars and is not relevant for the current context.
Alisoltani, N., Leclercq, L., Zargayouna, M.	2021	Can dynamic ride-sharing reduce traffic congestion?	10.1016/j.trb.2021.01.004	This study does not discuss demand or adoption factors but only operational challenges.
Aman, J.J.C., Smith-Colin, J., Zhang, W.	2021	Listen to E-scooter riders: Mining rider satisfaction factors from app store reviews	10.1016/j.trd.2021.102856	This study concerns user satisfaction and not adoption.
Bilali, A., Dandl, F., Fastenrath, U., Bogenberger, K.	2019	Impact of service quality factors on ride sharing in urban areas	10.1109/MTITS.2019.8883364	This study concerns ride-sharing which is not part of the research scope.
Campisi, T., Ignaccolo, M., Tesoriere, G., Inturri, G., Torrisi, V.	2020	The Evaluation of Car-Sharing to Raise Acceptance of Electric Vehicles: Evidences from an Italian Survey among University Students	10.4271/2020-24-0021	This study is on the acceptance of electric vehicles in general and not shared mobility.

Author(s)	Year	Title	DOI	Reason for manual exclusion
Cao, Z., Zhang, X., Chua, K., Yu, H., Zhao, J.	2021	E-scooter sharing to serve short-distance transit trips: A Singapore case	10.1016/j.tra.2021.03.004	This study does not concern adoption.
Cicchino, J.B., Kulie, P.E., McCarthy, M.L.	2021	Injuries related to electric scooter and bicycle use in a Washington, DC, emergency department	10.1080/15389588.2021.1913280	This study discusses injuries related to electric scooter and bicycle usage which is not part of the research scope.
Di Donato, M., Lomas., P.L., Carpintero, O.	2015	Metabolism and environmental impacts of household consumption: A review on the assessment, methodology, and drivers	10.1111/jiec.12356	This study does not concern shared mobility.
Fluri, C., Ruch, C., Zilly, J., Hakenberg, J., Frazzoli, E.	2019	Learning to Operate a Fleet of Cars	10.1109/ITSC.2019.8917533	This study concerns operational challenges.
Gamelli, D., Peled, I., Rodrigues, F., Pacino, D., Kurtaran, H.A., Pereira, F.C.	2020	Estimating latent demand of shared mobility through censored Gaussian Processes	10.1016/j.trc.2020.102775	This study concerns methodology for predicting demand rather than demand factors.
Horl. S., Ruch, C., Becker, F., Frazzoli, E., Axhausen, K.W.	2019	Fleet operational policies for automated mobility: A simulation assessment for Zurich	10.1016/j.trc.2019.02.020	This study discusses supply and demand at the short term (rebalancing).
Ivanova, D., Vita, G., Wood, R., Lausselet, C., Dumitru, A., Krause, K., Macsinga, I., Hertwich, E.G.	2018	Carbon mitigation in domains of high consumer lock-in	10.1016/j.gloenvcha.2018.06.006	This study does not concern shared mobility but only briefly discusses car ownership.

Author(s)	Year	Title	DOI	Reason for manual exclusion
Jain, S., Ronald, N., Thompson, R., Winter, S.	2017	Predicting susceptibility to use demand responsive transport using demographic and trip characteristics of the population	10.1016/j.tbs.2016.06.001	This study concerns methodology for predicting demand rather than demand factors.
Jenn, A., Labertaux, K., Clewlow, R.	2018	New mobility service users' perceptions on electric vehicle adoption	10.1080/15568318.2017.1402973	This study discusses the potential demand for (purchasing) electric vehicles and not sharing them.
Jokinen, J.P., Sihvola, T., Mladenovic, M.N.	2019	Policy lessons from the flexible transport service pilot Kutsuplus in the Helsinki Capital Region	10.1016/j.tranpol.2017.12.004	This study only discusses policy lessons for flexible micro transport services (FMTS) and not demand/adoption factors.
Kang, S., Mondal, A., Bhat., A.C., Bhat, C.R.	2021	Pooled versus private ride-hailing: A joint revealed and stated preference analysis recognizing psycho-social factors	10.1016/j.trc.2020.102906	This study concerns ride-hailing which is not part of the research scope.
Karlsson, I.C.M., Mukhtar-Landgren, D., Smith, G., Koglin, T., Kronsell, A., Lund, E., Sarasini, S., Sochor, J.	2020	Development and implementation of Mobility-as-a-Service – A qualitative study of barriers and enabling factors	10.1016/j.tra.2019.09.028	This articles discusses mainly MaaS and not shared mobility.
Ketabi, R., Al Qathrady, M., Alipour, B., Helmy, A.	2019	Vehicular traffic density forecasting through the eyes of traffic cameras; a spatio-temporal machine learning study	10.1145/3345838.3356002	This study concerns vehicular traffic density forecasting.
Konig, A., Grippenkoven, J.	2020	Modelling travelers' appraisal of ridepooling service characteristics with a discrete choice experiment	10.1186/s12544-019-0391-3	This study concerns ride-pooling which is not part of the research scope.

Author(s)	Year	Title	DOI	Reason for manual exclusion
Laurischkat, K., Jandt, D.	2018	Techno-economic analysis of sustainable mobility and energy solutions consisting of electric vehicles, photovoltaic systems and battery storages	10.1016/j.jclepro.2017.11.201	This study presents a system dynamics view of sustainable mobility (including electric vehicles) and energy solutions.
Lazonick, W.	2017	The New Normal is "Maximizing Shareholder Value": Predatory Value Extraction, Slowing Productivity, and the Vanishing American Middle Class	10.1080/08911916.2017.1407736	This study does not concern the research subject in the slightest.
Meurs, H., Sharmeen, F., Marchau, V., van der Heijden, R.	2020	Organizing integrated services in mobility-as-a-service systems: Principles of alliance formation applied to a MaaS-pilot in the Netherlands	10.1016/j.tra.2019.09.036	This study discusses the forming of alliances for MaaS.
Mohamed, M., Ferguson, M., Kanaroglou, P.	2018	What hinders adoption of the electric bus in Canadian transit? Perspectives of transit providers	10.1016/j.trd.2017.09.019	This study concerns adoption from the perspective of mobility suppliers, not users.
Santucci, M., Pieve, M., Pierini, M.	2016	Electric L-category Vehicles for Smart Urban Mobility	10.1016/j.trpro.2016.05.433	This study does not concern shared mobility.
Schluter, J., Weyer, J.	2019	Car sharing as a means to raise acceptance of electric vehicles: An empirical study on regime change in automobility	10.1016/j.trf.2018.09.005	This study concerns the adoption of EVs and not necessarily the adoption of shared EVs.

Author(s)	Year	Title	DOI	Reason for manual exclusion
Schonwetter, D.J., Hamilton, J., Sawatzky, J.A.V.	2015	Exploring Professional Development Needs of Educators in the Health Sciences Professions	10.1002/j.0022-0337.2015.79.2.tb05865.x	This study does not concern the research subject in the slightest.
Shaheen, S., Cohen, A.	2019	Mobility on demand (MOD) and mobility as a service (MaaS): Early understanding of shared mobility impacts and public transit partnerships	10.1016/B978-0-12-815018-4.00003-6	This study mainly discusses MaaS and not shared mobility.
Snellen, D., De Hollander, G.	2017	ICT'S change transport and mobility: Mind the policy gap!	10.1016/j.trpro.2017.07.003	This study does not discuss demand or adoption factors but an ICT perspective of new mobility modes.
Yang, L.	2018	Modeling the mobility choices of older people in a transit-oriented city: Policy insights	10.1016/j.habitatint.2018.05.007	This study does not concern shared mobility.

Appendix 3.3 – Codebook Theoretical Analysis

Article	Context	Quotes	Low-level code (description)	Interpretation 1
Aguilera-Garcia et al. (2020)	Free-floating e-moped sharing systems in Madrid (Spain)	*"individuals from 26 to 35 show a higher probability of being frequent users of these system"*	**Age**	Most frequent users are aged 26 to 35
		"...are used more frequently by those people living in the city centre..."	**Centrality**	Most frequent users live in the city center
		"... since most occasional and habitual users of scooter-sharing are males"	**Gender**	Most frequent users are male
		" Likewise, those people that declared to have car, moped or motorcycle, and those individuals having ever used carsharing systems, show a higher probability of being scooter-sharing users."	**Vehicle ownership / Vehicle usage**	Owners of cars, mopeds or motorcycles are more likely to be users
		"...the adoption of scootersharing is strongly influenced by socioeconomic and trip-related attributes."	**Trip purpose**	-
		"...compared to employees, students significantly present a higher probability of adopting moped scooter-sharing systems."	**Employment status**	Users are more often students than employees

Article	Context	Quotes	Low-level code (description)	Interpretation 1
		"Additionally, the education level also influences scooter-sharing adoption, since having or coursing a university grade increases the likelihood of being a frequent user of scootersharing by 400%, compared to having non-university education."	**Education**	Having or coursing a univeristy grade increaes the likelihood of being a frequent user
		"... income level does not seem to influence on the occasional usage of moped scooter-sharing systems. However, a higher level of income significantly reduces the likelihood of being a frequent user of this mobility alternative."	**Income**	High income reduces the likelihood of being a frequent user
		"sharing a house with flatmates/friends also increases the adoption of using moped scooter-sharing, which again would be strongly related to younger ages"	**Family composition**	Sharing a house with flatmates or friends increases the adoption
		"those individuals never using private car or private moto are significantly more likely to have ever used scootersharing, compared to those respondents rarely choosing these mobility alternatives"	**Vehicle usage**	Non-users of private cars and motors are more likely to adopt
		"feeling concerned about environmental issues when choosing a transport mode significantly increases the probability to be a frequent user of scooter-sharing"	**Environmental concerns**	Feeling concerned about the environment increases the likelihood of being a frequent user
		"those individuals frequently using scooter-sharing for commuting (p-value = 0.012) and going to the city center (p-value = 0.059 ≈ 0.05) are more likely to become frequent users of this mobility option"	**Trip purpose**	Users who commute or go to the city center are more likely to be come a frequent user
Ampudia-Renuncio et al. (2020)	Free-floating carsharing systems in Madrid (Spain)	*"a daily usage pattern with a smaller morning peak and a larger afternoon peak, with some exceptions such as New York and Madrid … Madrid differed from other cities by showing an additional peak around lunchtime"*	**Time-of-day/week**	Used mainly during a morning and an afternoon peak
		"… FFCS were mainly used for shorter trips with a median rental time of 27 min and actual driving time of around 15 min …"	**Trip purpose**	Used mainly for shorter trips (15 minutes driving time)

Article	Context	Quotes	Low-level code (description)	Interpretation 1
		" three rental peaks on weekdays. The first peak started at 7 am ... The second one began around 1 pm and it distinguished Madrid from other cities without this peak at lunchtime ... When people return home or go to spare time activities (from 6 pm), the third peak occurred."	**Time-of-day/week / Trip-purpose**	-
		"... the districts with the lowest volume of trips were those located on the outskirts ..."	**Centrality**	Not often used at the outskirts of the city
		"some neighborhoods of the central district were among the last positions due to the difficulties for parking in this area before the implementation of Madrid Central and to the high supply of other transportation modes"	**Centrality / Parking**	Not often used in districts with difficult parking
		"... the trend would lean towards "intra-neighborhood" trips."	**Trip purpose**	Often used for intra-neigborhood trips
		"peculiarities that make them generate and attract a larger number of trips are be detailed below: ... low population desnity ..."	**Population density**	Often used in neighborhoods with a low population density
		"peculiarities that make them generate and attract a larger number of trips are be detailed below: ...lot of space available for FFCS parking ..."	**Parking**	Often used in neighborhoods with lots of parking space available
		"peculiarities that make them generate and attract a larger number of trips are be detailed below: ... high average income ..."	**Income**	Often used in neighborhoods with an high average income
		"peculiarities that make them generate and attract a larger number of trips are be detailed below: ... large supply of parking areas, either next to the buildings, or on public roads"	**Parking**	Often used in neighborhoods with on-street parking space

Article	Context	Quotes	Low-level code (description)	Interpretation 1
		"peculiarities that make them generate and attract a larger number of trips are be detailed below: … there is a lack of public transportation supply that connects it with other points of attraction in the city"	**Public transportation**	Often used in neighborhoods with poor PT connection
		"peculiarities that make them generate and attract a larger number of trips are be detailed below: … one of the main business hubs is found in the eastern part ..."	**Surrounding functions**	Often used in main business hubs
		"peculiarities that make them generate and attract a larger number of trips are be detailed below: … It is precisely in the on-street parking space of this area where more FFCS cars are parked ..."	**Parking**	-
		"we clearly see how the main points generating and attracting FFCS trips corresponded to predominantly residential neighborhoods with low population density and high income, that a priori would not constitute the traditional nodes of generation of public transport trips"	**Centrality / Population density / Income / Public Transportation**	-
Becker et al. (2017)	Free-floating carsharing system in Basel (Switzerland)	*"free-floating car-sharing attracts mostly young customers living in small households"*	**Age / Family composition**	Attracts mostly young customers
		"free-floating car-sharing would also be used for commuting and that trips with free-floating car-sharing generally would turn out to be shorter than trips made with stationbased car-sharing"	**Trip purpose**	Used mainly for commuting and shorter trips compared to SBCS
		"... men are substantially overrepresented among car-sharing members, compared to their share of 55% in the control group of drivers license holders. Yet, the difference is only significant for free-floating members ... but not for station-based members ..."	**Gender**	Used significantly more by men than women
		"… the average age of free-floating car-sharing members was found to be even lower than that of the station-based carsharing service. In fact, half of the free-floating car-sharing scheme members were less than 36 years old) ..."	**Age**	Lower avergage age compared to SBCS, half were less than 36 years old

Article	Context	Quotes	Low-level code (description)	Interpretation 1
		"Regarding household size and income, free-floating car-sharing members' average was slightly above the control group and members of the station-based car-sharing slightly below."	**Family composition / Income**	Household size slightly above average
		"In particular, more than 90% of the members of the station-based car-sharing service and 73% of the free-floating members lived in car-free households."	**Vehicle ownership**	73% of users lives in car free households
		"the free-floating car-sharing service was employed for multiple purposes. In particular, there was also substantial usage for commuting and airport transfers"	**Trip purpose**	Used mainly for commuting and airport transfers
		"... free-floating car-sharing thrives among young men with higher incomes, whose home location is not optimally served by public transportation ..."	**Age / Income / Surrounding function / Public transport**	Used mainly by those whose home location is not served optimally by PT
		"... This research also revealed that neither of the two car-sharing groups is distinguished by particularly environmentally friendly convictions."	**Environmental concerns**	Users are not motivated by environmental convictions
		"... for station-based car-sharing, it is widely accepted that the most suitable markets are dense urban areas with good public transport ..."	**Population density / Public transport**	Used most often in dense urban areas
	Station-based carsharing system in Basel (Switzerland)	*"... the prototype user is relatively young, affluent and well-educated ..."*	**Age / Income / Education**	Used most often by young people
		"Self-employed workers and students were significantly over-represented among station-based car-sharing members. Only 3% of the car-sharing members were retirees."	**Employment Status**	Used often by self-employed workers and students

Article	Context	Quotes	Low-level code (description)	Interpretation 1
		"most of the trips undertaken with a station-based car-sharing vehicle were shopping or leisure trips, or trips where the customer had large items to carry"	**Trip purpose**	Used most often for shopping, leisure, or heavy hauling trips
		"... both schemes disproportionately attract transit-oriented university graduates living in car-free households ..."	**Employment status / Education / Vehicle ownership**	
		"... members from car-free households are significantly more active car-sharers. […] In particular, more than 90% of the members of the station-based car-sharing service […] lived in car-free households"	**Vehicle ownership**	90% of users lives in car free households
Bielinski & Wazna (2020)	Shared micromobility in general	*"Managed and supported by government, station-based public bicycles are mainly used to commute to work or school, while newer and private e-scooter sharing services are more often used for touristic and recreational trips."*	**Trip purpose**	Used mainly to commute to work or school (SBBS)
		"One study conducted in Groningen (the Netherlands) showed that e-bikes were most often used in work-related single-destination journeys"	**Trip purpose**	Used for work-related single-destination journeys
		"Most of them indicate that the users are generally well-educated, younger adults between 21–45 years old, with middle and upper income, and no children, living in urban build environments with limited access to private cars"	**Education / Age / Income / Family composition / Centrality / Vehicle ownership**	Users have limited access to private cars
	Free-floating e-scooter sharing system in Gdansk (Poland)	*"the difference in age is bigger in the case of scooter sharing users, who are on average 3 years younger than (e-bike) use"*	**Age**	Users are on average 3 years younger than bike sharers
		"We did not find a significant difference in the income of e-bike or electric scooter sharing users."	**Income**	

Article	Context	Quotes	Low-level code (description)	Interpretation 1
	Free-floating e-bike sharing system in Gdansk (Poland)	*" The most common reason to use shared e-scooter (appointed by 51.8% of users) was just to have fun riding it. This was placed as the eighth reason for the use of e-bikes … that e-bikes were used to commute"*	**Trip purpose**	Used mainly to have fun riding it (scootersharing)
		"The share of students was significantly lower in case of e-bike users—18.5%."	**Employment status**	Not used often by students
		" E-bikes were used as a first-last mile mean of transportation by 71.7% of their users, while only 30.4% of e-scooter users rode them to get to (or from) public transportation stops"	**Trip purpose**	Used as first or lastmile transportation
Burghard & Dutschke (2019)	Carsharing (Germany)	*"Concerning carsharing, those not interested are significantly older than all other carsharing groups and own more cars than users and aspiring users."*	**Age / Vehicle ownership**	Non-users are significantly older
		"Sharing users live in significantly more central locations than the two reference groups. However, this result is related to the structure of the projects through which the sharing users use EVs, as these are usually located in cities, especially in central urban locations"	**Centrality**	Users live in significantly more central locations
		"… the prevalence of cars among sharing users is significantly lower than in the comparison groups."	**Vehicle ownership**	-
		"In summary, it can be seen that e-carsharing is particularly attractive for younger people who live as couples and do not own cars ... or are starting a family and use carsharing as a supplement to their own cars .... The sharing of pedelecs in this sample is particularly attractive for older people, some of whom live in families and are rather monomodal in everyday life. "	**Family composition / Age / Vehicle ownership**	Used mainly by people who live as couples or are starting a family

Article	Context	Quotes	Low-level code (description)	Interpretation 1
		"In terms of socio-demographics the surveyed sharing users are a rather homogeneous group: Young, employed, highly-educated men in small households."	**Age / Employment status / Education / Family composition / Gender**	Used mainly by employed people
		"Users of electric bike sharing systems, on the other hand, are older and are more likely to have a car in the household"	**Age / Vehicle ownership**	-
Christoforou et al. (2021)	Free-floating e-scooter sharing system in Paris (France)	*"According to our sample, e-scooter users rarely own their proper microvehicle, are mostly men aged 18 to 29, and have a high educational level."*	**Vehicle ownership / Age / Education / Gender**	Used mainly by people who do not own their own microvehicle
		"Electric scooters seem mainly used for leisure purposes ..."	**Trip purpose**	Used mainly for leisure purposes
El-Assi et al. (2015)	Station-based bike sharing system in Toronto (Canada)	*"... as station status (operational efficiency, docks availability) and weather conditions improve from one day to another, an increase in station use is likely to result for both trip attraction and generation purposes and vice versa."*	**Weather / Condition and Status / Availability**	Use is positively related to operational efficiency
		"Trip activities were higher in zones that had university campuses as well as transit stations, which indicated that the system users may be using bicycles to both access and egress transit stations."	**Surrounding functions / Public transport**	Used more often in zones with university campusses
		"... stations with a higher number of docks were more likely to generate or attract more trips."	**Availability**	Use is positively related to docks availability
		"Population and employment density were positively correlated with both trip attraction and trip generation. Nonetheless, the estimates for population density are more substantial for trip generation while the estimates for employment density are larger for	**Population density / Trip purpose**	Used more often in zones with a high population density

Article	Context	Quotes	Low-level code (description)	Interpretation 1
		trip attraction. This may indicate that the bike share service is being used for commuter purposes."		
		"The results also display a positive correlation between bike share activity and temperature increase. Specifically, bike share ridership seems to be at its highest whenever the perceived temperature is between 20 to 30 degrees Celsius."	**Weather**	Used most often at temperatures between 20 and 30 degrees celcius
		"The zonal population density was significant and positively correlated with both trip attraction and generation"	**Population density**	-
		"... the increase in the number of intersections between the bike path and major roads has a negative effect on the number of trips to/from each origin-destination pair"	**Infrastructure**	The number of intersections is negatively related to use
		"... the increase of bicycle infrastructure length compared to the total bicycle path significantly encourages more bicycle trips. "	**Infrastructure**	The length of bicycle infrastructure is positively related to use
		"Daily bike share trip activity was also positively correlated again with zones that have transit stations ..."	**Public transportation / Surrounding functions**	Used more often nearby transit stations
Fiorini et al. (2022)	E-moped sharing system in Milan (Italy)	*"... the use of mopeds is also negatively influenced by the walkability: pedestrian areas have a reduction in the distance traveled. Therefore, these are areas where the environment is suitable for walking and does not encourage the use of e-mopeds."*	**Surrounding functions / Infrastructure**	Not often used where the environment is suitable for walking
		"... that moving away from the center leads to an increase in daily scooter use." "... the use of shared e-mopeds (average daily flow) and the distance travelled (travel radius) is directly proportional to the distance from the city centre."	**Centrality**	Use is directly proportional to the distance from the city center

Article	Context	Quotes	Low-level code (description)	Interpretation 1
		"... an increase in the education index leads to an increase in scooter use."	**Education**	The education index is positively related to use
		"... seems to suggest that the diversification of the POIs and the organization of the roads play a central role in explaining mobility patterns."	**Surrounding functions / Infrastructure**	Diversification of POIs is positively related use
Gross-Fengels & Fromhold-Eisebith (2018)	Smart (including shared) mobility in Heinsberg (rural Germany)	*"Again we must point out that the dominance of private cars in rural mobility represents one of the most crucial hindering factors for implementing mobility innovations in the countryside"*	**Vehicle ownership**	Dominance of private cars hinders adoption of shared mobility in rural areas
		"Communication and marketing campaigns are decisive means not only to inform potential consumers about new products or services, but also to enhance their acceptance"	**Awareness**	Communication and marketing can enhance acceptance of shared cars in rural areas
		"... the personal issues of customer comfort, skeptical attitudes and traditions of usage are important actor-based factors that impede the rural adoption of mobility innovations."	**Trust**	Customer comfort and skeptical attitudes impede use of shared cars in rural areas
		"Locally based services that are offered by well-known actors or institutions will not only meet the need for the passengers' security but can also better promote the users' identification with this innovation."	**Trust**	Locally based services can increase identification and adoption in rural areas
		"They (testing opportunities and pilot projects) may accelerate the adoption process, too, as the visibility and observability of novel mobility initiatives further influence the innovation decision of users"	**Awareness**	Increased visibility and observability may positively influence the uptake in rural areas
Javaid et al. (2020)	Shared mobility in general	*"Shared mobility services are typically more successful in densely populated urban areas where there is a critical mass of users, competing directly with public transit."*	**Population density**	Typically more successful in densly populated areas

Article	Context	Quotes	Low-level code (description)	Interpretation 1
		"The rate of vehicle ownership among members of urban car-sharing programmes tends to be lower (between 10% and 30% decrease by some estimates)."	**Vehicle ownership**	Lower rate of vehicle ownership among carsharers
Kopplin et al. (2021)	E-scooter sharing systems (Germany)	*"... performance expectancy was found to be the strongest predictor for intention to use, followed by environmental concerns."*	**Environmental concerns**	Environmental concerns are a strong predictor for intention to use
		"... for non-owners, environmental concerns have a positive influence on intention to use, this effect was absent for owners."	**Environmental concerns**	-
		"... participants stated that e-scooters have a strong appeal of entertainment and that this appeal is an important motivation to undertake an e-scooter trip"	**Trip purpose**	A strong appeal of entertainment is an important motivation to use
Liao & Correia (2020)	Electric car sharing	*"30-40"*	**Age**	Users are mostly aged between 30 and 40
		"60-70% with a university degree"	**Education**	60-70% of users has a university degree
		"The preference for using an EV is lower if the user is male, the trip distance is longer and the weather is cold."	**Gender / Trip purpose / Weather**	Users are less often males
		"The user profile for shared e-mobility services share some common traits in terms of socio-demographic characteristics: most users are predominantly male, middle-aged (typically between 25 and 45), with a higher education degree and above-average income."	**Gender / Age / Education / Income**	-

Article	Context	Quotes	Low-level code (description)	Interpretation 1
		"High level of employment"	**Employment status**	Users have a high level of employment
		"Environmentally friendly and open- minded toward shared mobility concepts"	**Environmental concerns**	Users are environmentally friendly and open-minded towards shared mobility concepts
		"... previous travel behavior before the system became available, they usually have limited access to a car ..."	**Vehicle ownership**	Users usually have limited access to a car
		"The most commonly investigated attributes include price level, availability of a shared car, access distance, shared car type, etc. These attributes largely determine the quality of the entire service and have a great influence on consumers' willingness to use the service."	**Price / Availability**	The price level influences the willingness to use the service
		"... all indicators of connectivity including transit proximity, public transport service level, and bike infrastructure are all found to have a significantly positive impact on the demand for electric carsharing and e-bike sharing"	**Public transporation / Infrastructure**	Transit proximity positively relates to use
		"... residential and office areas increase electric carsharing demand, as well as places with mixed land use purpose."	**Surrounding functions**	Residential, office, and mixed use areas positively increase demand
		"Population size [has a significant positive effect] (Population in each zone)"	**Population density**	Population size positively effects demand
		"Entropy of [mixed] land use ... percentage of residential land ... shopping POI ... Educational POI [campus]"	**Surrounding functions**	-

Article	Context	Quotes	Low-level code (description)	Interpretation 1
	E-bike sharing	*"Average age: 37.5 for frequent users, 34.8 for occasional users. Over 50% between 27–40"*	**Age**	Average age of frequent users is 37.5
		"Share of university degree: 60-78%"	**Education**	60-78% of users have a university degree
		"Middle and upper"	**Income**	Users mainly have middle and upper incomes
		"High level of employment"	**Employment status**	Users mainly have a high level of employment
		"Similar to bike sharing, a large percentage of shared e-bike trips correspond to commuting."	**Trip purpose**	Used most often for commuting
		"... shows that the hours of peak usage of e-bike roughly match the commuting peak hours, which makes sense since e-bikes are often used for commuting."	**Time-of-day/week**	Used most often during commuting peak hours
		"... most types of POIs have a positive impact on electric carsharing and ebike sharing demand, while some recreational POI such as sports facilities and cinemas do not have a significant impact on e-bike sharing, probably because the e-bike is more suitable for transporting single individuals while people usually visit these places in groups."	**Surrounding functions**	Most types of POIs have a positive impact on demand

Article	Context	Quotes	Low-level code (description)	Interpretation 1
		"... females being found to have a higher intention of using e-bike sharing compared to males (Kaplan et al., 2018) which contradicts the typical early adopter profile of new mobility modes."	**Gender**	Females have a higher intention of using
		"Public transport service level high"	**Public transportation**	Used most often in areas with high PT service level
		"Length of bicycle infrastructure"	**Infrastructure**	Length of bicycle infrastructure is positively related to use
		"Number of workplaces per zone … number of bars and restaurants … recreational center"	**Surrounding functions**	Number of workplaces, bars/restaurants, and recreational centers is positively related to use
	E-cargo bike sharing	*"Another example is that electric cargo bikes are used for significantly longer trips when compared to normal cargo bikes."*	**Trip purpose**	-
	E-scooter sharing	*"... more often used for social, shopping and recreational trips, although the percentage of people who say they use e-scooter for work and transit are around the same compared to those who use it for social and recreational purposes."*	**Trip purpose**	Used more often for social, shopping, or recreational trips
Liyanage et al. (2019)	Flexible on-demand shared mobility	*"Surveys have also shown key considerations why people are encouraged to use car sharing ... these reasons included cost savings …"*	**Price**	Users are encouraged by cost savings
		"... possibility to choose the desired car from a number of available options, convenient booking and payment arrangements, and the good condition of the car."	**Availability / Condition and status**	Possibility to choose from a number of available options positively influences use

Article	Context	Quotes	Low-level code (description)	Interpretation 1
		"... reducing emissions foot-print, and users believing that they are making a difference by sharing."	**Environmental concerns**	Reducing emissions foot-print is an important reason to use
Markvica et al. (2020)	E-bike sharing	*"Among the most important obstacles are the lack of visibility of options (e.g. e-bike sharing ...."*	**Awareness**	Lack of visibility of options hinders adoption
		"The 'Spontaneous – On the Go' and 'Highly Informed Sustainability' clusters use different transport options and have a positive attitude towards all transport modes and sharing concepts."	**Awareness**	Highly informed people are more likely to use
Mehzabin Tuli et al. (2021)	E-scooter sharing in Chicago (United States)	*"... the study finds that areas with high employment rates and bicycle infrastructure are associated with higher e-scooter usage."*	**Employment status / Infrastructure**	Areas with high employment rates are positively related to use
		"... show that proximity to the city center, better transit accessibility, and complex land uses are positively related to e-scooter usage."	**Centrality / Public transportation / Surrounding functions**	Proximity to the center is positively related to use
		"... the study observes the streets having bike lane facilities attract more e-scooter trips."	**Infrastructure**	Areas with good bicycle infrastructure are positively related to use
		"The study shows that the percentage of commercial land use, public and semi-public land use, intersection density, average elevation, walk score, park score, and job proximity index positively impact the density of e-scooter trips."	**Surrounding functions / Infrastructure**	Complex land use is positively related to use
		"While higher average temperature produces more e-scooter trips, precipitation (rain) and wind gust are negatively associated with e-scooter usage."	**Weather**	Higher temperatures and less precipitation and wind gusts are positively associated with use

Article	Context	Quotes	Low-level code (description)	Interpretation 1
		"... leading to higher e-scooter demand during weekends as more people go out for non-work purposes during weekends."	**Time-of-day/week / Trip-purpose**	Used more often during weekends
		"The main reason behind this finding may be that people prefer to avoid car trips when gasoline prices are higher, and these trips shift to more e-scooter trips as higher gasoline taxes (prices) are related to greater use of "green" transportation modes. "	**Price**	Used when gasoline prices are higher
		"A neighborhood with medium- and higher-income households produce more e-scooter trips than that of a lower-income neighborhood."	**Income**	Used in neighborhoods with medium- and higher-income
		"As expected, neighborhoods with a higher number of carless households produce more e-scooter trips."	**Vehicle ownership**	Used in neighborhoods with more carless households
		"The population density variable reaffirms the findings of the previous studies ... by showing a positive relationship with e-scooter usage."	**Population density**	Population density is positively related to use
		"The land use mix variable appears to be an important determinant of e-scooter demand with a statistically significant positive sign."	**Surrounding functions**	-
		"... indicating that a neighborhood with more network density in terms of facility miles of multimodal links per square mile is associated with more e-scooter usage."	**Public transportation**	Good transit accessibility is positively related to use
		"The parking feature variable is significant and positive in both origin and destination models ... indicate that a one-dollar increase in per hour parking price is associated with around a 10 % increase in escooter demand."	**Price**	Used when parking prices are higher

Article	Context	Quotes	Low-level code (description)	Interpretation 1
		"The positive coefficient for the number of parks and open spaces in a census tract is consistent with prior expectations and in line with previous studies."	**Surrounding functions**	Used more often in areas with parks and open spaces
Mounce et al. (2020)	Shared mobility in rural Europe	*"Key success factors in the shared mobility solutions identified… strong community engagement."*	**Engagement**	Used more often when there is strong community engagement
Munzel et al. (2019)	Carsharing (P2P and B2C) in the Netherlands	*"The level of education of carsharing users is much higher than the Dutch average with 63% of carsharing users having at least a bachelor's degree, whereas the household income is not particularly high with the mode at an income category of 38,800€–51,300€."*	**Education / Income**	Used more often by people with a high level of education
		"... carsharing users often live in densely populated areas. Indeed, many users in our sample live in the four largest cities of the Netherlands. "	**Population density**	Used more often by people living in densly populated areas
		"More than half of the carsharing users live in car-free households and two-thirds have a public transport subscription; amounts that are significantly higher than those of the non-adopters."	**Vehicle ownership / Public transportation**	Used more often by people from car-free households
		"Also, strong attitudes towards the environment can be observed in carsharing users: 18% of carsharing users have voted for a green party in the last general election against 4% of the total Dutch population."	**Environmental concerns**	Used more often by people with strong attitudes towards the environment
		"Only 9% of respondents mentioned [environmental concerns] as the most important reason to adopt carsharing, while 40% stated that the most important reason to carshare is the cost savings and 11% stated the convenience of not owning a car."	**Environmental concerns / Price / Vehicle ownership**	Used to save costs
		"Respondents that provide their own car to others through a P2P carsharing platform are more often male (60%) and have a mean age of 45. The level of education is again high compared to the national average, with two-thirds of adopters having at least a bachelor's degree."	**Gender / Age / Education**	-

Article	Context	Quotes	Low-level code (description)	Interpretation 1
		"The income of car providers is slightly higher compared to non-adopters as well as carsharing users, and the mode lies in the 51,300–65,000€ annual household income category"	**Income**	-
		" Compared to non-adopters as well as carsharing users, a large number of P2P providers live with children in the household"	**Family composition**	-
		"The variables that significantly influence the likelihood for a person to be an adopter are partly in line with Rogers' (2003) early adopter description, as well as with findings from previous studies."	**Engagement / Awareness**	Users often match the classical early adopter description
		" On the other side, a lower income influences people to be interested in adopting carsharing. Carsharing can thus act like a car access option for these cost-sensitive households that are not able to afford car ownership."	**Income**	Lower incomes influences people to be interested
		" A higher level of educational attainment and income make users choose the more expensive but also more convenient form of B2C carsharing, while cost-sensitive users choose the less expensive P2P carsharing form. "	**Education / Income / Price**	High income users choose B2C
		"... P2P carsharing may be used primarily for special purposes or in special situations, whereas B2C users make it part of their normal routine. "	**Trip purpose**	Used mainly for daily routine (B2C)
		"For the more specific circumstances in which users use P2P carsharing, like for example a weekend trip or moving, it could additionally be the case that private lending of cars between friends, family and neighbors takes place without a P2P organization acting as matchmaker."	**Trip purpose**	-
		"The differences in adopter characteristics thus seem limited, whereas the usage patterns differ substantially between B2C and P2P carsharing. "	**Trip purpose**	-

Article	Context	Quotes	Low-level code (description)	Interpretation 1
		"Users that have no private car in their household but are more public transport-oriented choose for B2C carsharing, which they also use more frequently than users only using P2P carsharing."	**Vehicle ownership / Public transportation**	Used more often by people without cars (B2C)
Namazu et al. (2018)	Carsharing (one-way and two-way) in metropolitan Vancouver (Canada), Early adopters	*"living in buildings with on-site two-way CS vehicles positively correlated with two-way CS service membership"*	**Availability**	On-site vehicles stimulate use
		"living within Car2go home area positively correlated with one-way CS service membership"	**Availability**	Nearby vehicles stimulate use
		"having better access to multiple two-way CS vehicles positively correlated with the membership of one-way CS"	**Availability**	Better access to vehicles stimulates use
		"have more family members who are employed"	**Employment status**	Having more employed family members stimulates use
		"own fewer cars – even fewer for two-way CS users"	**Vehicle ownership**	Users generally own fewer cars
		"one-way users were … less likely to have childeren … less likely to have older family members … more likely to have resided in current units for a longer period of time"	**Family composition**	Users are less likely to have children
		"Also, CS [carsharing] membership status is less affected by … availability of facilities near home … subjective quality evaluation of public transit acces"	**Surrounding functions / Public transportation**	-

Article	Context	Quotes	Low-level code (description)	Interpretation 1
		"The distinctive characteristics of Early Adopters of one-way CS match with the definition with DINK (Dual Income, No Kids) households. The one-way CS adopters also tended to own fewer cars."	**Family composition / Vehicle ownership**	Users match the Dual Income, No Kids (DINK) description
		"… two-way CS adopters are more likely to live in buildings with on-site CS, have more family members working outside home, live in more expensive housings, and own fewer or no cars … This group had the lowest car ownership rate – 38% of households did not own a car."	**Availability / Employment status / Vehicle ownership**	-
		"Overall, the Early Adopter groups, in particular, one-way CS users, were more likely to be at an early stage of forming an independent household"	**Family composition**	Users were more likely to be at an early stage of forming an independent household
		"The top three amenities/improvements leading to further CS recruitments are the same for all three groups [of potential adopters]: … availability of CS near home … lowering membership fees … lowering usage fees"	**Availability / Price**	Availability of vehicle near home may stimulate use
Narayan et al. (2017)	Flexible public transport	*"... showed a steady decline of mode share for flexible PT with increasing cost."*	**Price**	Declining adoption for increasing costs
		"… at higher relative cost ratios, the flexible PT that operate without sharing becomes less attractive than the one with sharing. "	**Price**	-
Prieto et al. (2017)	Car clubs and P2P carsharing in metropolitan areas (London, Madrid, Paris, Tokyo)	*"CS adoption intention is negatively correlated with being the main driver of the household, suggesting that main drivers have greater need for uninterrupted access to their own private car."*	**Vehicle usage**	Adoption intention is negatively related with being the main driver of the household
		"Gender is also positively related with CS adoption intention. More specifically, men are more likely to use the service than women. This could be attributed to men having fewer safety concerns."	**Gender**	Users are more likely to be men

Article	Context	Quotes	Low-level code (description)	Interpretation 1
		"Older people are less likely to use CS services, probably because they have been using their own cars for many years and they do not want to change their habits. "	**Age**	Users are less likely to be older
		"Respondents living in city centers, people with graduate degrees … are more likely to affect choice of CS services positively. "	**Centrality / Education**	Users are more likely to liver in city centers
		"Having a relatively recent car is positively related to CS as new car owners might wish to keep their vehicles safe and mileages low."	**Vehicle-ownerswhip**	Users own relatively recent cars
		"the results suggest that people living in city centers, male, and with a graduate level of education are more likely to choose a CC [car club] option. "	**Centrality / Education / Gender**	-
		"… full-time employment also raise probability of CC selection, as such drivers are likely to travel more and need to rent out cars more often."	**Employment status**	Full time employment raises probability of B2C adoption
		"The results also reveal that older people and single respondents are less likely to use CC. Being the main driver is also negatively related to CC choice."	**Age / Family composition / Vehicle usage**	Single people are less likely to use B2C
		"The results show that living in the city center, being male, and being single increase the probability of using P2P option."	**Centrality / Family composition/ Gender**	Being single increases the probability of using P2P
		"… older people are less likely to choose P2P."	**Age**	-

Article	Context	Quotes	Low-level code (description)	Interpretation 1
Priya Uteng et al. (2019)	Station-based cooperative and P2P carsharing in Oslo (Norway)	*"While the hierarchy of trip purposes was same for the groups – weekend trips, heavy shopping, and leisure trips – the share of the respondents is significantly different for these two user groups"*	**Trip purpose**	-
		" It seems that the stress related to parking might also be an important factor pushing people to carsharing … One can hypothesize that parking difficulty discourages car use, and with reserved spaces, car sharing eliminates this difficulty and encourages further use of car sharing."	**Parking**	Parking difficulty of private cars encourages use
		"Respondents emphasized the need to cut out the phase of picking and delivering cars at dedicated areas, and rather have dedicated parking spots available in close vicinity."	**Parking**	Ease of parking of shared cars encourages use
		"The success of electric cars in Norway is also, to a great extent, based on a generous set of incentives and subsidies."	**Price**	-
		" Interviews conducted with households with young children further confirmed that the biggest barrier that these families face in using car sharing in the setting up and dismantling of child seats."	**Condition and status**	Setting up and dismanting child seats may discourage use
		"It seems that one of the reasons why P2P hasn't taken off in Oslo is simply because members exhibit a low level of trust in general."	**Trust**	Low-level of trust hinders uptake (P2P)
		" The data highlights that uptake or membership remains gendered as male users/members dominate both schemes, but significant differences related to age exist as well – P2P has a larger share of younger drivers."	**Gender / Age**	Users are most often male
		"... the first factor (Children in the household) significantly influenced use of traditional cooperative car sharing, the second (Relocation) had, in contrast, influenced uptake of P2P."	**Family composition**	Having children positively relates to use (B2C)

Article	Context	Quotes	Low-level code (description)	Interpretation 1
		"The P2P users were significantly more motivated by cost saving while the Coop users had stronger practical, social and environmental motives."	**Price / Environmental concerns**	Users are motivated by cost savings (P2P)
		"Interestingly, former car ownership as well, as present ownership, were influential for the P2P users. In contrast, the Coop users were, to a much larger extent, previous non-owners, and relied solely on shared cars. "	**Vehicle ownership**	Users are (former) car owners (P2P)
		"... highlighting that poor parking facilities significantly influenced members of the Coop scheme but not the P2P users."	**Parking**	Poor parking facilitaties positively influece use (B2C)
Schmoller et al. (2015)	Free-floating carsharing system in Munich and Berlin (Germany)	*"... from Monday to Thursday, the booking numbers increase slightly but stay on a comparable level ... In contrast, the number of bookings is considerably higher on Fridays ... and especially on Saturdays when nearly 17% of all bookings take place. On Sundays, the number of bookings declines and is on one level with Monday to Thursday."*	**Time-of-day/week**	Used most often on fridays and saturdays
		"... free-floating carsharing is used more often at weekends ... but station-based carsharing has a considerably higher booking frequency on Fridays ..."	**Time-of-day/week**	Used more often during weekends (FF)
		"Both carsharing curves for workdays show one peak between 8 a.m. and 10 a.m. and a second, even higher peak between 5 p.m. and 8 p.m. Both of these peaks occur later than the ones of workday trips with private cars."	**Time-of-day/week**	Use peaks occur slightly after commuting peaks for private cars
		"... at weekends, there is no such distinct peak in carsharing usage. The majority of weekend trips start later when compared to workdays and are spread out over the whole day, with only one slight peak between 7 p.m. and 8 p.m."	**Time-of-day/week**	No use peaks occur during weekends

Article	Context	Quotes	Low-level code (description)	Interpretation 1
		"Examining the literature about station-based carsharing shows that the most frequent trip purposes are shopping, covering approximately 30% of all trips, social-recreational activities and personal business, with approximately 20% of all trips each … show some characteristics indicating that the main trip purposes of free-floating carsharing could be similar."	**Trip purpose**	Most frequent trip puurposes are shopping and social-recreational activities
		"… show both a high population density and a high density of shopping possibilities, so this explains why cars are needed in these areas in all the observed time period."	**Population density / Surrounding functions**	Used in areas with a high population density
		"mostly residential areas where the highest share of trips is assumed to start in the morning"	**Trip purpose / Surrounding functions**	Used mainly in residential areas
		"… show a high density of shopping possibilities and many working places paired with a rather low population density; this explains why vehicles are hardly needed in the morning, but very often in the evening."	**Surrounding functions / Population density**	-
		"This table indicates an influence of weather changes on booking frequencies. The quotient between bookings in the evening and bookings in the afternoon is about 6% higher than the average when it starts to rain in the evening."	**Weather**	Used more often when raining
		"In Munich, the highest (positive) correlation is given in the percentage of persons between 30 and 39 years of age whereas in Berlin this applies for persons between 40 and 49 years of age. "	**Age**	Used mainly by people between 30 and 49 years old
		"… it appears that users of free-floating carsharing mostly are young people who live in small households (in the presented case especially single households as two-person households have a negative effect)."	**Age / Family composition**	Used mainly by people living in small households

Article	Context	Quotes	Low-level code (description)	Interpretation 1
		"... the number of companies per km2 (containing huge employers as well as shopping facilities or bars, restaurants, etc.) has a positive – in Munich even the highest – impact."	**Surrounding functions**	The office density is positively related to use
		"... how high rents are also has a positive influence: in areas with higher rents, the number of bookings is also higher. "	**Income**	Rents are positively related to the amount of bookings
		"... shown that most Hot Spots coincide with residential areas or areas where many companies are located."	**Surrounding functions**	Used mainly in residential and office areas
Spurlock et al. (2019)	Carsharing systems in San Francisco (United States)	*"... relative youth is associated with somewhat less interest in car-sharing; those born in the 1970s and 1980s are 11–12 percentage points less likely to be interested in adopting car-sharing relative to those born in the 1960s."*	**Age**	-
		"Individuals who value minimizing environmental impact are slightly more likely to have already adopted ride-hailing services ... and similarly more likely to be interested in adopting car-sharing services."	**Environmental concerns**	Minimizing environmental impact is an important motivation for adoption
Torrisi et al. (2021)	Bikesharing system at a Sicilian (Italy) university campus	*"... there is a lack of reserved infrastructures (i.e. cycle paths) and dedicated services (i.e. racks and bike parking) and there are high levels of congestion that lead to the overcoming of road capacity and to significant interference with vehicular traffic. These aspects certainly represent a deterrent to the use of the bike"*	**Infrastructure / Parking**	Lack of bicycle infrastructure hinders use
		"... almost in equal terms, there were the factors 'I do not have a car', 'it allows me to save money' and 'Availability of bike sharing system and bike rental'."	**Vehicle ownership / Price / Availability**	Used by people who do not have cars

Article	Context	Quotes	Low-level code (description)	Interpretation 1
		"The most [hindering] critical factor that emerged was the lack of infrastructure and safe cycle routes, as often the connections with the bike are too long, and not having dedicated itineraries, one is not encouraged to use this means of transport."	**Infrastructure**	-
Wang et al. (2018)	Station-based bikesharing system in New York (United States)	*" All age cohorts, except for younger Millennials, generate more bike sharing trips during the rush hours … One explanation could be that younger Millennials are still not employed and their bike share trip purposes may not be the same as other age cohorts."*	**Time-of-day/week**	Used most often during rush hours
		"All age cohorts make more bike sharing trips when the weather is sunny rather than cloudy, except for younger Millennials."	**Weather**	Used most often when the weather is sunny
		"Increasing temperature is positively associated with bike share trip production in most situations, except for younger Millennials."	**Weather**	Used most often when temperatures are high
		"Especially, younger Millennials' bike sharing ridership is less likely to be influenced by weather conditions as compared to older and mid Millennials."	**Age / Weather**	-
		"Off-road bike route length, bike route length and the number of bicycle racks are positively associated with bike share trip productions across all cohorts. These facilities are important indicators of bicycle friendliness."	**Infrastructure**	Length of bicycle infrastructure is positively related to use
		"With respect to the station attributes, the more bike docks, the more bike share ridership for all cohorts. As expected, system operators should anticipate more use at stations with more docks."	**Availability**	Amount of bicycle docks is positively related to use
		"… younger people are less likely to be influenced by the spatial allocation of bike share stations. One possible interpretation is that the younger generation's bike sharing behavior is more attitudedriven than purpose-driven. "	**Trip purpose**	-

Article	Context	Quotes	Low-level code (description)	Interpretation 1
		"Intersection density is positively related to younger Millennials' bike share trip production. However, this factor is not statistically significant for other cohorts."	**Infrastructure**	Intersection density is positively related to use for younger millenials
		"Second, as compared to traditional bicycling trips, bike share trips are more likely to be commuting trips ..."	**Trip purpose**	Used more often for commuting trips
		"Population density is positively associated with younger Millennials', mid Millennials' and Baby Boomers' bike sharing use in our analysis. "	**Population density / Age**	Population density is positively related to use
		"... food services density is positively associated with trip productions for all age cohort … We further find that bike share stations with higher food services density generate more trips on weekdays as compared to weekends."	**Surrounding functions / Time-of-day/week**	Food service density is positively related to use
		"Proximity to the nearest university campus is positively associated with older Millennials', Gen Xers' and Baby Boomers' bike sharing trip production. This may be because university employees generate more bike sharing trips than others."	**Surrounding functions**	Proximity to campusses is positively related to use
		"On weekdays, increasing park area is positively associated with bike share ridership of younger Millennials and Baby Boomers, but negatively associated with mid and older Millennials. Parks could be potential destinations for leisure trips, but could also be physical barriers to bicycle commutes."	**Surrounding functions / Time-of-day/week / Trip purpose / Age**	-
		"The area of recreation space is positively associated with bike share for younger Millennials, mid Millennials, and Baby Boomers. However, this factor does not have significant influence on bike share ridership for older Millennials and Gen Xers. "	**Surrounding functions / Age**	Recreation space area is positively related to use
		"... adding bike sharing stations around bus stops increases bike share usage during rush hours."	**Public transportation / Time-of-day/week**	Used more often around bus stops during rush hours

Article	Context	Quotes	Low-level code (description)	Interpretation 1
		"Increasing the number of subway entrances is positively associated with bike share ridership of younger Millennials and Baby Boomers."	**Public transportation**	-
Wielinski et al. (2017)	Free-floating electric carsharing system in Montreal (Canada)	*"A clear preference for HVs is observed for longer distances. There is not really a clear explanation of this distance threshold: however, it represents approximately 2 to 3 times the size of the service area, this may be a kind of "psychological" barrier for EV users."*	**Trip purpose**	Used more often for short distances (EV)
		"... desired travel distance, affects negatively the odds to borrow an electric car [compared to a hybrid vehicle]. For every desired travel kilometre, the odds to borrow an electric vehicle decrease."	**Trip purpose**	-
		"Users older than 65 years old have a higher probability to rent a HV [compared to an EV]"	**Age**	Used more often by young people (EV)
		".. All three, travelled distance, male users, and cold temperatures reduce the odds of borrowing an EV, while a higher energy level increase the attractiveness of an electric car. "	**Trip purpose / Gender / Weather / Condition and status**	Used more often by females (EV)

Appendix 3.4 – Theoretical Results Table

Factor	A. Carsharing	B. Bikesharing	C. E-Mopedsharing	D. E-Scootersharing
1. Age	• Users are mostly between about 30 and 50 years old.[12, 22] • Especially EVs and FF are used more often by younger people. [3, 26]	• Users are mostly between about 30 and 40 years old. [12]	• Users are mostly between about 25 and 35 years old. [1]	• Users are mostly between about 20 and 30 years old. [4,6]
2. Gender	• Users are most often male. However, this is not necessarily the case for EVs. [3,5,12,20,21,26]	• Females show a higher intention of using. [12]	• Used most frequently by males. [1]	• Used most frequently by males. [6]
3. Family Composition	• Users generally live in small households (often without children). [3,5,18,22] • Single people are more likely to use P2P than B2C. [20]		• A large part of users shares a flat with housemates. [1]	
4. Education	• Users are highly educated (more likely to have a university degree). [3,5,12,17,20] • Between 60% and 70% of EV users has a university degree. [12]	• Between 60% and 78% of users has a university degree. [12]	• University students and graduates are more likely to be users. [1,8]	• Users are highly educated. [6]

Factor	A. Carsharing	B. Bikesharing	C. E-Mopedsharing	D. E-Scootersharing
5. Employment	• Used most often by employed people. [5,12,18] • Especially the probability of adopting B2C is increased by full-time employment. [20]	• Free-floating bikes are not often used by students. [4]	• Users are more often students than employed people. [1]	• Used more often in areas with high employment rates. [15]
6. Income	• SB are used mostly by people with middle and upper income and FF by people with high incomes.[3] • High income users are more likely to choose B2C than P2P. [17]	• Users mostly have middle- and upper incomes. [12]	• Having a high income reduces the likelihood of being a frequent user. [1]	• Used more often in areas with middle- and upper incomes. [15]
7. Environmental concerns	• Especially users of EVs and B2C are motivated by environmental convictions. [12, 13,17,21,23]		• Frequent users are often concerned about the environment. [1]	• Environmental concerns are a strong predictor for intention to use. [11]
8. Awareness	• Especially in rural areas, a lack of awareness hinders adoption. [9]	• Highly informed people are more likely to use. [14] • A lack of visibility of options hinders adoption. [14]		
9. Trust	• Especially in rural areas and for P2P, a lack of trust hinders adoption. [9]			
10. Engagement	• Strong community engagement can stimulate adoption. [16]			

Factor	A. Carsharing	B. Bikesharing	C. E-Mopedsharing	D. E-Scootersharing
11. Vehicle Ownership	• Generally users own fewer cars than non-users. [5,10,12,17,18] • Car-ownership is lower for SB users than for FF users. [2] • Generally, P2P users are former car owners whereas B2C users are not. [21]	• Users often do not have cars or have limited access to cars. [4,24]	• Owners of cars, mopeds, or motorcycles are more likely to be users. [1]	• Generally, users do not own their own microvehicle. [6] • Used more often in neighborhoods with low car-ownership. [15]
12. Trip Purpose	• Especially FF and EVs are used for short, often intra-neighborhood trips. [2,3,12] • FF is more often used for commuting. [3] • Compared to P2P, B2C is more often used for daily routines instead of special purposes/situations. [17]	• Used most often for commuting trips. [5,7,12,25] • Used often as a first/last mile solution. [5]	• Users who commute or go to the city center are more likely to become frequent users. [1]	• Used mainly for leisure purpose (social, shopping, or recreational trips). [6,12] • Often used because it is fun and has a strong appeal of entertainment. [4,11]
13. Vehicle Usage	• People who are the main driver of the household are less likely to adopt. [20]		• People who do not use private cars or motors are more likely to adopt. [1]	
14. Centrality	• Users live in significantly more central locations. [5,20] • FF, compared to SB is more often used in less central areas. [2]	• Users mostly live in highly urbanized built environments. [5]	• Most frequent users live in the city. [1]	• Use is positively related to the proximity to the city center. [15]

Factor	A. Carsharing	B. Bikesharing	C. E-Mopedsharing	D. E-Scootersharing
15. Population Density	• Used most often in areas with high population densities. [3,10,12,17,22] • Compared to EV and SB, FF is more often used in less dense areas. [2]	• Used most often in areas with high population densities. [7,25]		• Used most often in areas with high population densities. [15]
16. Surrounding Functions	• Used in areas with mixed purposes (residential, office, and shopping). [12,22]	• Used often nearby university campuses. [7,25] • Used often in areas with high food service density (e.g. bars and restaurants). [12, 25]	• Used often in areas with diverse points of interest. [8]	• Used often in areas with mixed purposes. [15] • Used often in areas with parks and open spaces. [15]
17. Infrastructure		• The length of bicycle infrastructure in an area is positively related to use. [7,12,24,25] • A large amount of intersections is only an obstacle for using for older people. [7,25]	• Not often used in areas with an infrastructure suitable for walking. [8]	• More often used in areas with good bicycle infrastructure. [15]
18. Public Transportation	• Especially FF is most often used in neighborhoods with poor PT connections. [2,3] • Often used by people with PT subscriptions. [17]	• Especially SB is most often used in areas with good public transport connections. [7,12,25]		• Good transit accessibility is positively related to use. [15]
19. Parking	• Especially FF is often used in neighborhoods with lots of (on-street) parking available. [2] • Poor or difficult parking facilities stimulate SB use. [21]	• Lack of bike parking hinders use. [24]		

Factor	A. Carsharing	B. Bikesharing	C. E-Mopedsharing	D. E-Scootersharing
20. Availability	• Better access and close-by vehicles stimulate use. [12,18] • Possibility to choose from a number of options stimulates use. [13]	• The number of available docks for SB bikesharing stimulates use. [7,24,25]		
21. Price	• The price levels (membership and usage fees) influence the willingness to use. [12, 18,19] • Especially users of P2P are motivated by cost savings. [17,21]	• Users are motivated by cost savings. [24]		• More often used when gasoline and parking prices are higher. [15]
22. Condition and Status	• A good condition of the car positively influences use. [13] • Higher energy levels stimulate use for EVs. [26]	• Use is positively related to operational efficiency (SB) [7]		
23. Time-of-day/week	• Most often used on Fridays. [22] • Most often used during morning and afternoon peaks on weekdays. However, these peaks are slightly after the general commuting peak. [2,22] • No use peaks during weekends. [22]	• Used most often during commuting and rush hours. [12, 25]		• Used more often during weekends. [15]
24. Weather	• EVs in particular are used less often in colder temperatures. [12, 26]	• Especially SB is most often used at temperatures between 20 and 30 degrees Celsius when the weather is sunny. [7,25]		• Higher temperatures and less precipitation and wind gusts are positively associated with use. [15]

Factor	A. Carsharing	B. Bikesharing	C. E-Mopedsharing	D. E-Scootersharing
		• Weather conditions have a limited impact on use for younger millennials (aged 18 to 23).[25]		

Appendix 4.1 - Codebook Empirical Analysis (Anonymized Overview)

Table A4.1 – Passages Extracted from Interviews

Interview	Transcript passage (Untranslated)	Assigned Code	Cluster
A	[SBCS in public domain] zorgt er dus ook voor en dat heb ik ook wel met die deelmobiliteitsaanbieder besproken, dat dus ook mensen uit de omgeving daar gebruik van kunnen maken.	Availability	Access
B	En wat ons, zeg maar onderscheidt, is dat wij deelmobiliteit aanbieden vanuit, zeg maar besloten groepen.	Availability	Access
D	Terwijl je bij een station-based, een wat meer gesloten systeem, bijvoorbeeld ook andere mogelijkheden hebt, als het reserveren van voertuigen	Availability	Access
E	Dan [access for locals and plan area] wordt het én aantrekkelijker voor de marktpartijen, want er zijn gewoon meer gebruikers die van die deelauto's of deelvoertuigen gebruik maken, én voor de buurt, ja dan help je die transitie misschien ook een beetje op gang.	Availability	Access
E	Maar is dat dan zichtbaar voor die bewoners, dus in principe Amber […] binnen 3 uur staat daar een deelauto […] Maar heb jij dan het gevoel dat het betrouwbaar is?	Availability	Access
F	het [Greenwheels] is voor iedereen […] dat is fijn en het is ook wel weer een afbreuk, want hoe zeker ben je dan, hoe netjes gaan we met de spullen om, kan ik mijn, kan ik er op vertrouwen dat hij er echt is als ik hem nodig heb.	Availability	Access
F	Wij geloven heel erg dat alleen hier [station-based/community-based] je de eigen auto overbodig kan maken	Service	Access
F	als er 1, 2 of 3 Greenwheels in een hele woonwijk staan, achteraf toegevoegd, dit is even waarom ik het uitleg, dat betekent niet dat er meteen 11 mensen, in de data zie je dat wel, dat 11 mensen de volgende dag zeggen, dan doe ik mijn auto weg	Service	Access
L	En er is ook een Greenwheels hier [...] En mensen met een [anonymized] app […] die kunnen ook met hun app in een Greenwheelsauto, dus dat versterkt elkaar dan ook weer.	Service	Access
C	Laten we alsjeblieft, ook qua ontwerp en inrichting, dat die mee kunnen bewegen met die ontwikkeling. Adaptief programmeren heet zo iets.	Flexibility	Adaptive program

Interview	Transcript passage (Untranslated)	Assigned Code	Cluster
D	En dat je dus de inrichting van die parkeergarage of mobiliteitshub zo maakt dat het dan ook veilig is om die parkeergarage of hub in te gaan met je fiets of bakfiets, terwijl er misschien ooit vroeger twee auto's stonden.	Flexibility	Adaptive program
D	Dus dat je hem misschien zo positioneert dat het dichterbij de fietsenstalling of bij de langzaam verkeersroutes ook is. Zodat die adaptiviteit of flexibiliteit mogelijk is.	Flexibility	Adaptive program
D	want vaak is in het ontwerp van garages bijvoorbeeld dat ofwel het langzaam verkeer en snel verkeer, dat dat gescheiden moet zijn. Nou als die regel er is en je wilt later dan bijvoorbeeld 2 deelauto's omzetten in 4 deelbakfietsen, of misschien wel meer, ja dan moet dat ruimtelijk ook inpasbaar zijn.	Flexibility	Adaptive program
D	Maar dat je misschien een soort buffer inbouwt standaard, dus dat je uitgaat van meer autogebruik, nu nog, en dat dat langzamerhand gedurende de jaren misschien meer ook gaat naar deelfiets, deelbakfiets, en andere modaliteitsgebruik.	Flexibility	Adaptive program
D	als er teveel auto's staan, maar bijvoorbeeld wel een grotere behoefte is aan bakfietsen, dat je dan, dat de aanbieder dan doorrekent oke, een auto kost per maand €450, een bakfiets kost per maand €80, nou dan kan ik zoveel bakfietsen inzetten voor hetzelfde bedrag als die auto kostte	Flexibility	Adaptive program
G	Wat interessant kan zijn is of je dus private voorzieningen die worden gerealiseerd [...] parkeergelegenheid, of je die ook op zo een manier kunt integreren in het concep [...] zodat je daar flexibiliteit kunt krijgen om eventueel als die uptake dus groter wordt [...] dat je daar wel ook een gedeelde faciliteit van kan maken in plaats van alleen privaat.	Flexibility	Adaptive program
J	dus je moet flexibiliteit in je plan inbouwen, net zoals je misschien wel, ik begreep nu ook dat er een daktuin op de parkeerbak komt, op de parkeergarage, ja dan kan je dus niet meer optoppen.	Flexibility	Adaptive program
J	bij de harde *assets* moet je ook flexibiliteit introduceren dus dat je kan schalen maar dat wil je eigenlijk ook in je gebruik en in je exploitatie	Flexibility	Adaptive program
J	je kolommenstructuur moet niet zo zijn dat je er niks anders mee kan dan parkeren.	Flexibility	Adaptive program
J	Dan moet je eigenlijk ook in je fysieke omgeving wat ruimte hebben gecreëerd, dus vandaar dat wij ook altijd zeggen van ja, ontwerp nou een parkeerbak niet op 2,20 meter maar op 2,70, dan kun je er altijd nog een woning van maken bij wijze van spreken.	Flexibility	Adaptive program
J	Maak dat je kan optoppen, kan je ook afschalen. Vandaar dat wij altijd voorstander zijn van centrale parkeervoorzieningen en niet dat ieder blok zijn eigen parkeerbak heeft.	Flexibility	Adaptive program

Interview	Transcript passage (Untranslated)	Assigned Code	Cluster
J	niet meer hebben over aantallen parkeerplaatsen maar over een aantal vierkante meters die de beste locatie in de garage hebben, die je kan inrichten [...] want nu denken we dat het deelauto's zijn maar wie weet denken we over een paar jaar dat het allemaal [...] van die kleine autootjes want dan passen er twee op een parkeerplaats	Flexibility	Adaptive program
J	Vandaar dat wij altijd voorstander zijn van centrale parkeervoorzieningen en niet dat ieder blok zijn eigen parkeerbak heeft.	Parking	Adaptive program
A	Dus de eerste 100 woningen zijn nu opgeleverd, en nu dus ook de eerste deelauto, die staat daar ook. En dus die deelauto's groeien mee in principe met het aantal [woningen].	Flexibility	Add/remove
A	Dus als je heel veel grotere woningen hebt met een eigen parkeerplaats dan hoef je dat misschien iets minder hard te laten groeien. Maar we hebben dat inderdaad een beetje gedaan zoals jij zegt, van joh, ongeveer elke 100 woningen dan doen we er eentje bij.	Flexibility	Add/remove
B	Dus ik denk zelf dat die, nou ja, dat er ongeveer bij 80 tot 100 gebruikers een knip zou moeten komen. Dus als je over die 100 heen gaat dan kan je er beter twee groepen van 50 van maken, dan krijg je een soort celdelingsprincipe.	Flexibility	Add/remove
B	Maar stel nou dat er uit die wijk geen 30 mensen meedoen maar 200 mensen meedoen, ja dan wordt die wijk als het ware in 3 of 4 clusters verdeeld.	Flexibility	Add/remove
Etc.	Etc.	Etc.	Etc.

Table A4.2 – Adoption Barriers for SBCS Services (SQ2)

Barrier	Interview	Passage	Assigned Code
Unawareness	D	Of dan deelmobiliteit daar aan heeft bij gedragen, ik twijfel of dat bij gebruikers of bewoners van zo een ontwikkeling, of die daar [more space for facilities through shared mobility] besef bij hebben.	Awareness
	E	één van de aandachtspunten ook uit de enquête. Dat de gemeente wel meer mag, nou ja, erover mag communiceren	Awareness
	E	het echt zo duidelijk en ook zichtbaar te maken, dan beginnen er wat kwartjes te vallen. Maar als je zegt, ja er niet veel parkeerruimte, dan denken ze ja, maar ik kan mijn auto wel houden.	Awareness
	F	dat ze kunnen zien van, ik lever misschien in op het gemak en het comfort van een tweede auto, maar ik krijg er wat voor terug in de vorm van die wijk. Het wordt mij uitgelegd en ik snap dat het niet allebei kan	Awareness
	F	Dan zien mensen pas concreet wat het oplevert, dat als je een reductie op de parkeernorm effectueert, dat daar dus groen voor terug komt.	Awareness
	F	Die kosten [for a private car] zijn niet zichtbaar maar het is een, ja het is een hele moeilijke.	Awareness
	G	En het is ook handig om te laten zien dan wat je daarvoor terugkrijgt. Dat kan bijvoorbeeld zijn een groenere omgeving	Awareness
	H	mensen die geen deelauto's gebruiken of het niet kennen zullen niet heel snel een deelauto gaan gebruiken, in het kader onbekend maakt onbemind.	Awareness
	I	kijk altijd belangrijk is dat, het begint natuurlijk met, dat je bekend geraakt. Dat mensen weten, wat is het. En ik denk dat daar nog best wel wat te winnen is.	Awareness
	I	Dus het is niet zo dat men [in rural areas] wantrouwend is, maar men weet het gewoon niet, men ziet het gewoon niet.	Awareness
Attractiveness of Private Car	A	dan zal dat [regulated parking] denk ik een grote invloed hebben op ook het gebruik van deelmobiliteit. Omdat als je dat niet hebt, dan is er, ja dan kunnen mensen natuurlijk alsnog gewoon hun eigen auto nemen.	Parking
	A	[…] als je dan hier geen betaald parkeren of parkeren voor vergunningshouders invoert, ja hoeveel kans van slagen heeft het [SBCS] dan. Want dan gaan mensen gewoon hun auto in die wijk ernaast zetten. Dus dat probeer ik nu wel bij de gemeente ook om hen te zeggen	Parking
	A	Maar dat het [vehicle sharing use] meer wordt gedreven ook vanuit de onmogelijkheid om een eigen auto te hebben […] dan ik zit ik dus eerder te denken aan een soort van, de overheidsregulering.	Parking
	E	Dus als er genoeg parkeerplek is […] ja waarom zou je overstappen, waarom zou je die keuze maken […] maar het moet wel gaan klemmen wil je mensen over laten stappen.	Parking
	E	er is genoeg ruimte, nou ik betaal, volgens mij is het 3,75 per maand voor mijn auto voor de parkeervergunning, ja ik vind het prima en ik ga gewoon zo door.	Parking
	F	hoe bepalend, die condities zijn mijn eerste vragen altijd. Moeten mensen betalen, krijgen ze een parkeerplaats, moeten ze ervoor betalen, zo ja, hoeveel, en hoeveel zijn er dan te vergeven.	Parking
	G	zodra je een auto gewoon vrij gemakkelijk kunt gebruiken, gebruiken mensen hem.	Parking

Barrier	Interview	Passage	Assigned Code
	H	Want ook de locatie an sich, is nou niet een dusdanige plek dat het gestuurd is om daar juist deelmobiliteit toe te passen omdat er bijvoorbeeld heel weinig parkeerplaatsen zijn of iets dergelijks.	Parking
	J	als er geen parkeerregime is in het gebied, hoef je ook niet te beginnen met deelmobiliteit, er moet wel een bepaalde schaarste zijn, flankerend beleid aanwezig zijn.	Parking
	L	eigenlijk ben je binnenstedelijk aan het ontwikkelen, maar zaten we wel in een gebied wat nog geen gereguleerd parkeerbeleid had. Dus zonder dat betaald parkeren is het wel heel lastig om zo een systeem goed uit te rollen, deelmobiliteit.	Parking
	C	er zit ook ontzettend veel verschil in het verplaatsgedrag als je in de stad woont, de 15 minuten stad […] dat maakt allemaal heel veel anders uit dan als je op het platteland woont met deelmobiliteit aan komt zetten.	Proximity of functions
	C	En in die gereedschapskist, wat moet je daarbij denken, daar zit de STOMP-methodiek in, zijn acceptabele loopafstanden	Proximity of functions
	G	Alles in de nabijheid, centraliteit, al die area-related factors zijn natuurlijk sky-high, waardoor mensen ook niet een auto nodig hebben, in ieder geval minder.	Proximity of functions
	H	Lopen is eigenlijk net iets te ver [...] [anonymized]zelf ligt zeg maar hier, een stuk verder op. Ja dat is toch al gauw een kwartier, twintig minuten lopen zeg maar, ook naar voorzieningen.	Proximity of functions
	J	stel je zit in een dorp en de enige winkel gaat ook nog eens weg, ja dan ben je afhankelijk van de auto en ga dan vooral de auto faciliteren	Proximity of functions
(Perceived) Costs	B	Ons model is een soort progressief, dus als je heel veel rijd dan ga je gewoon per uur, ga je veel minder betalen. Dus dan is het nog steeds eigenlijk wel haalbaar om in een deelauto te rijden als je dat zou willen.	Price
	C	Ik hoor nooit en te timmer discussie over, terwijl het wel heel gevoelig is, over de [costs associated with] vergelijking deelmobiliteit en eigen autobezit.	Price
	E	ja mensen dan toch wel die eigen auto hebben die ze dan, toch net kunnen betalen […] dat het dan lastig wordt om naar zo een flexibel systeem met ook nog […] als je schade rijdt, er eigen risico aan vast zit	Price
	F	Deelauto's werden echt een beetje gepresenteerd als een doekje voor het bloeden [...] maar dan hebben mensen […] hoeveel duurder het is dan mijn eigen auto, en weet je wel hoever ik moeten lopen nu voor mijn parkeerplaats.	Price
	F	Die kosten [for a private car] zijn niet zichtbaar maar het is een, ja het is een hele moeilijke.	Price
	F	En als je dan op prijs gaat zeggen van, het is zo goedkoop en goedkoper dan je eigen auto, dan kom je vaak in de vinderij, in de verkeerde overwegingen hoek van de keukentafel.	Price
	F	Ja, nou ja, wij zien een omslagpunt tussen, dat is denk ik hetzelfde als met [anonymized], tussen de twee, drie keer per week.	Price
	G	maar je ziet dus wel dat mensen heel financieel gedreven zijn.	Price
	I	mensen willen wel een soort, dat geldt voor alles, niet alleen voor deelvervoer, ze willen waar voor hun geld.	Price

Barrier	Interview	Passage	Assigned Code
	L	als je zelf je auto hebt en je gaat een kratje bier halen, dan pak je je auto en dan rijd je naar de supermarkt en dan denk je er niet over na [...] Als die deelauto er staat om dat kratje bier te halen, dan wordt je kratje bier opeens duurder, want dan moet je een tientje betalen of zo	Price
	L	Autokosten privé zitten gewoon in je maandlasten maar autokosten voor een deelauto zijn heel, heel feitelijk reken je die af.	Price
(Perceived) Reliability	A	betrouwbaarheid van die beschikbaarheid dat dat wel essentieel is om het te laten slagen.	Availability
	A	niet alleen de zichtbaarheid en bereikbaarheid maar de beschikbaarheid is denk ik ook essentieel […] Dus dat je met die partijen in ieder geval afspreekt […] dat je er wel altijd eentje kan pakken zeg maar.	Availability
	B	er zijn een hele hoop bedenkingen die mensen altijd hebben bij deelmobiliteit […] Eén van de belangrijkste dingen is natuurlijk van, is de auto wel beschikbaar als ik hem nodig heb.	Availability
	B	En onze praktijk is het eigenlijk bijna nooit dat mensen misgrijpen maar toch zijn mensen er heel erg bang voor.	Availability
	C	de klantwenspiramide, en die gaat uit van betrouwbaarheid […] Nou dat is deelmobiliteit nog op dit moment onvoldoende goed doorontwikkeld.	Availability
	E	maar aan de andere kant ook een soort betrouwbaarheid en volgens mij zag ik hem net ook al ja, *availability*, hoort daar wel bij, dat je ervan op aankan, dat het aanbod betrouwbaar is voor jou.	Availability
	E	Maar is dat dan zichtbaar voor die bewoners, dus in principe Amber […] binnen 3 uur staat daar een deelauto […] Maar heb jij dan het gevoel dat het betrouwbaar is?	Availability
	F	het [Greenwheels] is voor iedereen […] dat is fijn en het is ook wel weer een afbreuk, want hoe zeker ben je dan, hoe netjes gaan we met de spullen om, kan ik mijn, kan ik er op vertrouwen dat hij er echt is als ik hem nodig heb.	Availability
	I	Dus de zekerheid en het weten, ik heb hem of ik kan vertrekken, of ik kan aankomen, dat zit toch wel vast aan die auto. En dat is natuurlijk bij die deelauto, ondanks met al die toezeggingen en natuurlijk een klein beetje die scepsis	Availability
	I	Herkenbaarheid, de vastigheid, dat is voor mensen ook wel belangrijk. Ik hoef daar maar naartoe te lopen en ik heb iets. Dus voor heel veel mensen is dat toch ook een soort een dingetje.	Availability
(Perceived) Ease-of-use	B	En dat zijn hele simpele dingen, dus bijvoorbeeld iemand vind het lastig om de app te downloaden, met name oudere mensen vinden dat soms spannend	Service
	B	Of ze vinden het spannend om voor de eerste keer in een elektrische auto te rijden, of ze weten niet hoe de laadkabels aangesloten moeten worden op de paal, hoe dat precies werkt	Service
	C	maar ik ben ook niet de domste, maar zelfs dat was gecompliceerd, om die apps op een nette manier te doen	Service
	D	Ja met name ook met elektrische auto's, dat is vaak ook nieuw voor mensen, van oke, hoe werkt dat dan en hoe laad je, überhaupt het inpluggen van zo een stekker of zo kan misschien al een drempel zijn.	Service
	D	Want ik denk dat het zo laagdrempelig en makkelijk mogelijk maken van dus die deelmobiliteit wel één van de belangrijkste schakels is om het daadwerkelijk te laten slagen.	Service
	D	Het moet zo simpel, *one-stop-shop* zijn eigenlijk, het moet zo simpel mogelijk zijn. Dus als de positie van die auto's of voertuigen dan helpt, ja dan zou dat zeker denk ik wel bijdragen.	Service

Barrier	Interview	Passage	Assigned Code
	D	ik zelf ook wel een keer ervaren in Rotterdam dat ik een deelauto wilde pakken en dat die dus in een garage stond en dat het echt ellenlang zoeken was van waar staat dat ding dan	Service
	E	Dus als je echt met hubs gaat werken dan moet het wel echt heel fijnmazig zijn want anders haken ze af, dus dan gaan ze niet lopen	Service
	F	geen moeilijke bochten, heel duidelijk. Mensen die niet vaak auto rijden vinden parkeren echt spannend […] Nou dit is een hindrance	Service
	F	elektrisch vind ik spannend, laadkabels. Ze zullen niet zo hard zeggen maar het zijn gewoon wel manieren om het mensen [makkelijker te maken]	Service
	F	de groep in het midden, dat zijn meer de, het is gemak. En in gemak deel zit vaak meer de tweede auto en niet de eerste. Om echt je eerste eigen auto weg te halen, dan moet het service niveau zo veel hoger liggen	Service
	F	Dus ruimtelijk gezien willen we […] geen krappe bochtjes, pilaren, toestanden, gewoon gemak.	Service
	G	het is voor iedereen een drempel alleen voor sommige groepen is die drempel groter, en dan moet je met name denken inderdaad aan wat oudere mensen die dus überhaupt geen smartphone hebben.	Service
	G	ook aan mensen die dus minder technisch onderlegd zijn, of misschien een minder hoog opleidingsniveau hebben en minder gewend zijn om met technologische dingen te werken. Die groep is wel vrij klein hoor die laatste, maar ja dat heeft zeker wel een effect	Service
	G	Je noemt bijvoorbeeld prijs, maar comfort bijvoorbeeld is ontzettend belangrijk.	Service
	H	die deelauto, het is met een app reserveren. Je moet wel een stap extra doen. Je moet hem reserveren en dan zie je of dat je hem kan gebruiken ja of nee	Service
	J	Maar inclusiviteit heeft ook iets te maken met […] digibeten, want we gaan er allemaal van uit dat iedereen een smartphone kan bedienen.	Service

Table A4.3 – CIMOs for SQ2 (Stimulating SBCS Use)

Barrier	CIMO	Interview	Passage	Cluster
Unawareness	Communicate sustainable area identity	B	Maar als je daar nog iets meer omheen bouwt van, hoe gaan wij ervoor zorgen dat deelmobiliteit eigenlijk onderdeel wordt van het woonconcept […] dan wordt het natuurlijk veel aannemelijker dat mensen ook dat gaan gebruiken.	Area identity
		B	Kijk als je een wat groenere wijk hebt, met groen bedoel ik dan bijvoorbeeld mensen die meer GroenLinks-achtig stemmen bijvoorbeeld, dan heb je gewoon veel meer tractie in zo een wijk	Area identity
		F	wat we met [anonymized] hebben gedaan, heel duidelijk neergezet als een duurzame wijk [...] iedereen die daar woont past in een soort *value and belief* waardensysteem waarvan ze wisten, ik vind het tof om hier te wonen dat ik niet twee auto's heb en dat ik alles op de fiets.	Area identity
		F	Hoe beter jij duidt wat voor soort gebied het is waar je gaat wonen, zoals nu Utrecht met het nieuwe [anonymized] doet, iedereen weet, als ik daar kom wonen, is mobiliteit anders geregeld	Area identity
		L	Dus we hebben we geprobeerd te borgen dat het wel echt iets is wat hoort bij wonen in dit [anonymized]	Area identity
		L	zo een terrein als [anonymized] waarbij je ook die duurzaamheid sterk hebt, waarbij je stedelijk wil wonen […] Daar merk je dat daar ook een bepaalde doelgroep heen trekt […] dan ook die deelmobiliteit wat meer omarmt.	Area identity
		B	Het één na belangrijkste voordeel voor de mensen is altijd dat ze duurzaam willen zijn, dat is dus ook wel een klein beetje afhankelijk in welke gebied je dat gaat uitzetten.	Target group
		D	ik denk ook wel dat er steeds meer mensen, net zoals vliegschaamte, het ook wel belangrijk vinden om niet vanuit de zorgen voor de wereld, maar meer naar buiten toe te willen laten zien, willen zeggen, ik ben duurzaam bezig.	Target group
		D	dan is het wel belangrijk dat je dus bewoners, die je wilt aantrekken, of waar deelmobiliteit mogelijk een prikkel zou kunnen zijn, dat je die dan ook aantrekt.	Target group
		H	de doelgroep is wel in die zin een bijzondere doelgroep. Ook over het, die nadenken over mobiliteit, die nadenken over hoe kan ik spullen delen	Target group
		H	Het samen dingen doen, het delen van spullen, ja daar heb je wel een specifieke doelgroep voor nodig.	Target group
		I	Nee, we gaan woningen bouwen voor een groep mensen […] En die heeft deze kenmerken, en dat is niet alleen maar of ze oud of jong zijn, maar het is oud met inkomen, of oud met auto of jong met kinderen.	Target group
		J	Want als dat een doelgroep is die in ieder geval op zijn minst *open-minded* is naar deelmobiliteit, dan durf ik wel een uitspraak te doen over wat voor percentage deelauto's daar mogelijk zijn	Target group
		J	Ik vond dat wel goed he, dat ze op die specifieke doelgroepen richten, want dat waren allemaal mensen die geloven in *sharing*.	Target group

Barrier	CIMO	Interview	Passage	Cluster
		J	Als jij ook wil dat, bijvoorbeeld de groente, het groente en fruit in de winkels binnen Eindhoven zijn geproduceerd, dan heb je iets van een nabijheid, een community, meer een ideologische inslag. Dan kan je je ook voorstellen dat die mensen eerder genegen zijn om in hun community een deelauto [...] kunnen opnemen	Target group
	Communicate benefits for users	B	En het derde punt is ruimte op straat, dus dat je de kwaliteit van je woonomgeving veel verder kan verbeteren.	Benefits
		B	de belangrijkste reden van mensen om mee te doen, het belangrijkste voordeel voor mensen is dat ze geld besparen.	Benefits
		D	Of dan deelmobiliteit daar aan heeft bij gedragen, ik twijfel of dat bij gebruikers of bewoners van zo een ontwikkeling, of die daar [more space for facilities through shared mobility] besef bij hebben.	Benefits
		E	het echt zo duidelijk en ook zichtbaar te maken, dan beginnen er wat kwartjes te vallen. Maar als je zegt, ja er niet veel parkeerruimte, dan denken ze ja, maar ik kan mijn auto wel houden.	Benefits
		F	nu die hier voor mijn deur staat, oh dan ga ik wel met de deelauto, zo werkt het niet. Je zult meer moeten doen wat de *benefit* is voor een individueel gezin of starter of wat dan ook	Benefits
		F	Als je het niet verteld dan wordt het eerder, kom hier wonen óndanks het feit dat er weinig parkeerplaatsen zijn en ondanks het feit dat er deelmobiliteit is, óf kom hier wonen en het is super tof dankzij dat we allemaal *shared services* […] hebben	Benefits
		F	dat ze kunnen zien van, ik lever misschien in op het gemak en het comfort van een tweede auto, maar ik krijg er wat voor terug in de vorm van die wijk. Het wordt mij uitgelegd en ik snap dat het niet allebei kan	Benefits
		F	Dan zien mensen pas concreet wat het oplevert, dat als je een reductie op de parkeernorm effectueert, dat daar dus groen voor terug komt.	Benefits
		F	En als je dan op prijs gaat zeggen van, het is zo goedkoop en goedkoper dan je eigen auto, dan kom je vaak in de vinderij, in de verkeerde overwegingen hoek van de keukentafel.	Benefits
		G	En het is ook handig om te laten zien dan wat je daarvoor terugkrijgt. Dat kan bijvoorbeeld zijn een groenere omgeving	Benefits
		L	*En wat is dan een beetje de toon aanslaat als je dat probeert te communiceren naar toekomstige bewoners?:* Ja, dat het goedkoop is.	Benefits
		D	qua communicatie is het misschien belangrijk dat je vanuit drie mogelijke hoofdredenen of zo communiceert.	Communication content
		D	als er geen optie is om je auto te stallen, ja, dan kan je je auto mee willen verhuizen maar dan kies je er misschien ook voor om daar überhaupt niet te gaan wonen. Maar dan moet je dat dus wel duidelijk communiceren.	Communication content
		F	En daar zit een rol van de ontwikkelaar en ook van de gemeente in, waarbij je moet gaan uitleggen dat daar geen plek is […] voor de tweede eigen auto	Communication content

Barrier	CIMO	Interview	Passage	Cluster
		F	Deelauto's werden echt een beetje gepresenteerd als een doekje voor het bloeden [...] maar dan hebben mensen […] hoeveel duurder het is dan mijn eigen auto, en weet je wel hoever ik moeten lopen nu voor mijn parkeerplaats.	Communication content
	Communicate throughout customer journey	C	dan maken we vanaf begin af aan duidelijk aan de toekomstige bewoners dat je hier in een autoluwe wijk woont, wat leefbaar is, wat heel veel ruimte biedt voor voetgangers en voor fietsers, en wat ook nog heel veel ruimte biedt aan duurzaam groen.	Communication timing
		D	En wat daarin denk ik een belangrijke is, is dat je als ontwikkelaar ook in het gehele verkooptraject van je woningen, of verhuurtraject [communiceert]	Communication timing
		E	ook van tevoren goed communiceren dat bewoners er ook op voorbereid zijn.	Communication timing
		E	ik denk wel echt die communicatie, en ook vooraf mensen bevragen van, waar hebben jullie behoefte aan of hoe maak je nu die ritten	Communication timing
		F	De eerste fase is [...] ik wil een nieuwe woning [...] Dan is het niet per se deelvervoer of [anonymized]of wat het ook precies wordt, relevant. Wat dan relevant is, wat zijn mijn smaken. Is parkeren hier geregeld, is er een regime, hoe zit het OV, zijn er mooie fietspaden, wat zijn de uitvalswegen.	Communication timing
		F	De tweede fase is [...] ik neem een optie [...] Dan moet je al wat concreter zijn [...] hoe ziet parkeren eruit voor jou, en dan betekent het ook dat je iets concreter moet zijn van wat mag ik dan, als ik geen parkeerplaats afneem, wat zijn dan mijn smaken. Zijn het 5 auto's of 8 hoeft niet, maar er moet deelvervoer zijn.	Communication timing
		F	Als hij de koop sluit […] Dan moet je op dat moment wel heel duidelijk weten wat je daar exact gaat aanbieden.	Communication timing
		F	Als mensen dat doen zonder dat ze het weten hebben ze eigenlijk al een plan van nou, ik zet die auto wel daar neer, we zetten hem op het stoepje of er komt zoveel straatparkeren	Communication timing
		F	Bij de sleuteloverdracht is het super belangrijk om die mensen, te zorgen dat ze de app downloaden.	Communication timing
		J	eigenlijk moet dan je mobiliteitsconcept al onderdeel zijn van je marketing richting mensen om daar te komen wonen.	Communication timing
		B	Je kan nooit meer achteraf zeggen tegen die huishouden van, jullie moeten een paar tientjes per maand gaan bijdragen aan het potje deelmobiliteit, want dat krijg je nooit meer geregeld.	Life-events
		B	Dus dat soort dingen [SBCS subscriptions] moet je wel eigenlijk aan de voorkant goed bedacht hebben, wat je daarmee wil, of je er iets mee wil	Life-events
		E	Je hebt een hele nieuwe situatie en volgens mij is dan ook het moment om een beetje te denken van, oke kan dat ook anders	Life-events
		E	Natuurlijk zijn er mensen die bewust bezig zijn met hun gedrag en zo een verhuismoment kan een trigger zijn	Life-events

Barrier	CIMO	Interview	Passage	Cluster
		F	Maar achteraf mensen uit de eigen auto krijgen dat is echt verdraaid lastig, daarom is dat begin zo belangrijk […] Mensen zijn routinedieren, ik ook, jij ook.	Life-events
		F	Als mensen eenmaal die routine hebben is dat heel moeilijk om dat terug te draaien.	Life-events
		I	Dus je hebt iets met gewoontegedrag, je hebt iets met mensen vastgeroest zijn in een soort patronen	Life-events
		J	De alternatieven moeten vanaf dag 1 kwalitatief hoogwaardig aanwezig zijn. Want 90% van mobiliteitsgedrag, of 95% zelfs, is gewoontegedrag	Life-events
		J	wanneer denk je [...] bewust na over gedrag is wanneer iets in je leven verandert […] Dat geldt ook in zo een gebied, dat de verhuisbeweging is bijna het belangrijkste moment om je gedragsverandering te beïnvloeden	Life-events
Attractiveness of alternative	Parking subscriptions	B	Wij zien wel dat in wijken waar weinig parkeerruimte is, daar is meer vraag naar deelmobiliteit. Dus als parkeren heel moeilijk is, of als het heel duur is, gaan mensen natuurlijk ook naar alternatieven kijken.	Parking costs
		E	er is genoeg ruimte, nou ik betaal, volgens mij is het 3,75 per maand voor mijn auto voor de parkeervergunning, ja ik vind het prima en ik ga gewoon zo door.	Parking costs
		F	wat volgens mij meer de formule is, de condities voor deelmobiliteit. Daar zit OV maar daar zit vooral in, kost een parkeerplaats bij jullie wat. Krijg jij gratis een parkeerplaats van BPD als je een huis koopt of moet je hem huren	Parking costs
		F	Dus als mensen gratis een parkeerplaats of twee krijgen omdat je vanuit commerciële overwegingen de penthouse en de dure eengezinswoningen met twee parkeerplekken wil verkopen, die mensen doen dus niet mee.	Parking costs
		F	Maar als je hem inprijst, die parkeerplaats, heel concreet je hypotheekbedrag gaat omhoog als jij die tweede of die eerste parkeerplaats wil kopen, of je moet je inschrijven en hopen dat je een parkeerplaats toegewezen krijgt	Parking costs
		F	Wij zijn erg voorstander van progressief, dus dat de tweede auto gewoon 10 keer zo duur wordt als de eerste auto	Parking costs
		I	uiteindelijk als je dan ook nog een zeer ongunstige omgeving creëert met hoge parkeerkosten, met parkeren op afstand	Parking costs
		I	als de gemeente zegt van nou, wij willen graag die deelmobiliteit faciliteren, dan moeten ze ook zorgen vanuit hun kant […] Dat er misschien wat minder [parking facilities] aanbod is […] of wat hogere vergunningstarieven.	Parking costs
		J	En maak nou onderscheid, dat was gewoon puur een onderhandeling tussen kortlopende en langlopende abonnementen.	Parking subscription
		J	maar een stuk abonnementen zijn langjarig, een paar zijn jaarlijks en die vervallen dan, en het eerste recht van, na verval, heeft de mobiliteitsdienstverlener.	Parking subscription
		L	je kan natuurlijk niet één parkeerplaats uitgeven bij één appartement, dat het dan helemaal scheef gaat met je dubbelgebruik.	Parking subscription

Barrier	CIMO	Interview	Passage	Cluster
		A	[...] als je in de stad ontwikkelt, dat je dan geen vergunning kan krijgen voor het openbaar gebied omdat het parkeren in principe moet worden opgelost in het plangebied zelf.	Parking regulation
		A	dan zal dat [regulated parking] denk ik een grote invloed hebben op ook het gebruik van deelmobiliteit. Omdat als je dat niet hebt, dan is er, ja dan kunnen mensen natuurlijk alsnog gewoon hun eigen auto nemen.	Parking regulation
		J	Bij [anonymized] heb ik ook gezegd van eigenlijk moet je dus geen parkeerplaatsen meer verkopen, moet je ze alleen maar verhuren, want dan kun je ook zwerfplekken, dan kun je ook medegebruik kun je veel beter toelaten.	Parking subscription
		J	Want als jij gewoon geen parkeerregime hebt en je kan niet parkeren in je plot, dan zet je hem toch aan de andere kant van de straat of bij de buren in de wijk.	Parking regulation
		C	er zit ook ontzettend veel verschil in het verplaatsgedrag als je in de stad woont, de 15 minuten stad […] dat maakt allemaal heel veel anders uit dan als je op het platteland woont met deelmobiliteit aan komt zetten.	Proximity of functions
		C	En in die gereedschapskist, wat moet je daarbij denken, daar zit de STOMP-methodiek in, zijn acceptabele loopafstanden	Proximity of functions
		F	Bij locatie wat ertoe doet zijn voorzieningen, dat zien wij echt	Proximity of functions
		G	Alles in de nabijheid, centraliteit, al die area-related factors zijn natuurlijk sky-high, waardoor mensen ook niet een auto nodig hebben, in ieder geval minder.	Proximity of functions
		G	Die 5 D's zijn: [...][4] destination accessability, dus hoe goed zijn eigenlijk bepaalde bestemmingen ook bereikbaar […] ook bijvoorbeeld winkelcentra, subwinkelcentra, wijkcentra, supermarkt, scholen	Proximity of functions
	Stimulate other modes	G	Die 5 D's zijn: […] [2] *diversity*, dat is dus land-use mix	Proximity of functions
		H	Lopen is eigenlijk net iets te ver [...][anonymized]zelf ligt zeg maar hier, een stuk verder op. Ja dat is toch al gauw een kwartier, twintig minuten lopen zeg maar, ook naar voorzieningen.	Proximity of functions
		J	als wij dan zien dat gewoon de dagelijkse voorzieningen zitten, dus een winkel, een school, een huisarts [...] want de meeste bewegingen zijn sociaal-recreatief [...] dan zeggen we ja nou, dan geloven we wel dat dat een goede indicator is voor lopen en fietsen.	Proximity of functions
		E	de Vestdijk als voorbeeld. Daar ging gewoon een driebaansweg, een autoweg doorheen [...] door daar een andere keuze in te maken, meer groen, veel bredere voetpaden, veel bredere fietspaden [...] dan wordt de keuze ook anders	Other modes
		F	de eigen auto overbodig maken, in onze overtuiging, is dat je het multimodaal doet.	Other modes
		F	Gebruik het [shared mobility] wanneer je het nodig hebt, en als andere manieren, Stappen, Trappen, OV beter zijn, doe dat vooral.	Other modes

Barrier	CIMO	Interview	Passage	Cluster
		G	Die 5 D's zijn: [...][3] design, dus dat zit bijvoorbeeld op de design van de infrastructuur, dus heb je goede voorzieningen voor fietsen en lopen [...] maar ook *aesthetics* dus ook wel design van loopomgeving	Other modes
		G	Sterker nog, als je kijkt naar de concurrentiepositie dan zal je zien dat deelmobiliteit ook best veel wegpakt eigenlijk van openbaar vervoer en van fietsen.	Other modes
		G	En die combinatie van al die alternatieven samen, die maakt dat je op een gegeven moment niet per se meer een auto nodig hebt. En op die manier draagt deelmobiliteit dus altijd nog bij aan, eigenlijk de aantrekkelijkheid van het alternatief.	Other modes
		J	En het zijn eigenlijk communicerende vaten in mijn ogen. Dus als de kwaliteit van S-T-O-M goed is, dan kan de P omlaag. Is de kwaliteit van S-T-O-M niet goed, dan moet je de P hoger houden.	Other modes
		J	En het fietsparkeren, die is nog vaak veel kwetsbaarder omdat je het fietsparkeren, als je die kwaliteit wilt geven, dan moet het op de begane grond met één deur tussen de garage en het fietspad	Other modes
		J	als je echt vindt dat de T van Trappen hoogwaardig in je plan moet zitten, dan moet je eigenlijk vinden wij altijd de fietskelder overdimensioneren.	Other modes
		K	Stimulating walking and cycling in urban area development may cause people to use their cars less frequently and thus to get rid of them entirely. Therefore, stimulating walking and cycling indirectly stimulates shared mobility use.	Other modes
(Perceived) costs	Subsidize trialability	A	Dus één dag per maand die auto kunnen gratis kunnen pakken. En daarmee […] stimuleer je mensen voor het eerste gebruik.	Trialability
		A	onbekend maakt onbemind zeg ik maar […] als je dat eerste gebruik gratis maakt, of dat hele incidentele gebruik gratis maakt, dan kun je daarmee ook wel stimuleren dat ze het nog vaker gaan gebruiken.	Trialability
		E	Ja ik zit dan toch te denken aan die uitprobeermogelijkheid, tegoed, eigenlijk om ze die eerste stap te laten zetten.	Trialability
		I	dus het is bekendheid en het is ervaring opdoen he. Nou ik weet ik ook van andere onderzoeken dat bijvoorbeeld het proberen is één van de mogelijkheden om mensen kennis te laten maken	Trialability
		J	misschien moet je wel een probeerarrangement doen, dat je zegt, iemand die nog nooit deelmobiliteit heeft gebruikt, de eerste rit die je gaat maken gaan we de auto eens even uitleggen, kijken hoe het werkt, dat zo een mobiliteitsregisseur kunnen doen.	Trialability
		L	iedereen krijgt het eerste jaar daarin een soort toegift van, om dat wat laagdrempeliger te maken. Dus als je geen deelauto gebruikt heb je in basis geen kosten.	Trialability
	Mandatory contribution	B	Ons model is een soort progressief, dus als je heel veel rijd dan ga je gewoon per uur, ga je veel minder betalen. Dus dan is het nog steeds eigenlijk wel haalbaar om in een deelauto te rijden als je dat zou willen.	CS costs
		B	de meeste mensen die weinig rijden die sparen natuurlijk het meeste geld uit.	CS costs

Barrier	CIMO	Interview	Passage	Cluster
		B	er zijn natuurlijk allerlei manieren waarop je dat kan beïnvloeden maar ik denk toch dat, ik denk dat een financiële prikkel wel heel veel helpt.	CS costs
		B	En dat [2 shared cars on 10 households] kan eigenlijk alleen maar omdat het aan de voorkant financieel al geregeld is.	CS costs
		D	ja je kan een partij selecteren maar als het dadelijk onbetaalbaar wordt, of niet een reëel bedrag is wat bewoners per maand gaan betalen, ja dan is het systeem ook niet per se heel houdbaar	CS costs
		F	Ja, nou ja, wij zien een omslagpunt tussen, dat is denk ik hetzelfde als met [anonymized], tussen de twee, drie keer per week.	CS costs
		F	dat wij een bijdrage vragen aan de ontwikkelaar. En die bijdrage is gebaseerd op de verplichting die er misschien is, hoe lang deelmobiliteit, ongeacht het gebruik, moet aangeboden worden.	CS costs
		G	maar je ziet dus wel dat mensen heel financieel gedreven zijn.	CS costs
		I	We hebben varianten daar in van [...] erg lage kosten […] als je dat dan alles, in de meest optimale vorm […] 70% van de mensen die dan in jouw ontwikkeling gaan wonen die is dan bereid om een auto [weg te doen]	CS costs
		I	mensen willen wel een soort, dat geldt voor alles, niet alleen voor deelvervoer, ze willen waar voor hun geld.	CS costs
		J	de gemiddelde deelmobiliteitsleverancier die verdient op dit moment net voldoende om zijn assets terug te betalen.	CS costs
		L	En wij hebben wel kosten, ik geloof dat, wij betalen €65.000 aan [anonymized] voor een exploitatie van de eerste vier jaar.	CS costs
		L	Ik hoop dat we dat hier georganiseerd hebben door het heel laagdrempelig en gratis, of nou ja, geen kosten, dus alleen gebruikskosten aan de voorkant.	CS costs
		A	En wat wij hier ook doen […] als ontwikkelaar is dat we dus al een abonnement voor elke bewoner beschikbaar stellen. Dat hebben wij eigenlijk afgekocht bij de aanbieder.	CS subscription
		B	zij hebben een vast bedrag wat ze per maand aan [anonymized] in rekening brengen voor het gebruik van die woningen eigenlijk. En in dat vaste bedrag, daar zit een component voor de warmtepomp in, er zit een component in voor de zonnepanelen en er zit ook een component in voor de deelauto.	CS subscription
		B	Maar het voordeel is ook dat van de vaste kosten, is zeg maar zo een 50 tot 60 procent, is al gedekt vanuit eigenlijk die aannemer. En de gebruikskosten die worden nog in rekening gebracht naar de mensen die de auto gebruiken.	CS subscription
		B	Maar dus, dat zijn communicerende vaten, dus als je aan de voorkant een soort vaste *fee* in rekening kan brengen, dan kan je natuurlijk de gebruikerstarieven structureel verlagen.	CS subscription
		B	als iedereen een klein beetje van die last draagt dan is de voorziening voor iedereen beschikbaar en daardoor hoef je bijvoorbeeld geen 700 parkeerplaatsen […] en daardoor kan je bijvoorbeeld meer groen aanleggen	CS subscription

Barrier	CIMO	Interview	Passage	Cluster
		D	met die extra verdiensten [for UADs through implementing shared mobility] betalen wij de abonnementen van de bewoners de eerste 6 maanden af. Dan verlaag je die drempel voor bewoners om dus mogelijk zelf dat abonnement te gaan betalen of iets dergelijks	CS subscription
		D	Dus als je een model creëert waarbij iedereen bijdraagt, en als is het €10 per maand […] als je met 700 huishoudens zit, heb je behoorlijk wat *cash flow* iedere maand om daar mobiliteit tegenover te zetten.	CS subscription
		D	het mobiliteitsbudget […] dat je dat dus ook echt meeneemt in een soort vaste kosten, in die zin blijven we Nederlanders en heb je toch ook altijd een beetje van, als ik ergens voor betaal dan wil ik er ook gebruik van maken of zo.	CS subscription
		F	jongens als dit zo doorgaat, ja dan verbrandt je eigenlijk het geld wat je als ontwikkelaar ons hebt gegeven, want niemand maakt er gebruik van, dat is zonde.	CS subscription
		F	dat je eigenlijk concreet kan zeggen, jongens als je hier komt wonen krijg je van ons 12 maanden lang, €30 korting […] Dat werkt heel goed, dat laten mensen niet heel snel liggen, die denken ja, dat is toch €360 per jaar.	CS subscription
		H	hebben we ook een abonnement meegekocht, een basisabonnement. Dat zit bij de koopprijs in.	CS subscription
		L	we hebben het wel direct meeverkocht dus er zit wel een brochure al bij de koopovereenkomst en in de akte staat dat er parkeerplaatsen zijn voor deelmobiliteit	CS subscription
		L	wat wil je verplichten aan de kopers, wat niet, wat kan je van je provider verwachten, dat is best wel nog uitzoeken.	CS subscription
(Perceived) reliability	Offer to closed user groups	A	[SBCS in public domain] zorgt er dus ook voor en dat heb ik ook wel met die deelmobiliteitsaanbieder besproken, dat dus ook mensen uit de omgeving daar gebruik van kunnen maken.	Access
		A	in de wijk hiernaast er nog veel meer wordt ingezet op deelmobiliteit en dat je daarmee wellicht ook, dat kan dan ook een achtervang zijn zeg maar voor de bewoners.	Access
		B	En wat ons, zeg maar onderscheidt, is dat wij deelmobiliteit aanbieden vanuit, zeg maar besloten groepen.	Access
		D	Terwijl je bij een station-based, een wat meer gesloten systeem, bijvoorbeeld ook andere mogelijkheden hebt, als het reserveren van voertuigen	Access
		E	Dan [access for locals and plan area] wordt het én aantrekkelijker voor de marktpartijen, want er zijn gewoon meer gebruikers die van die deelauto's of deelvoertuigen gebruik maken, én voor de buurt, ja dan help je die transitie misschien ook een beetje op gang.	Access
		E	Maar is dat dan zichtbaar voor die bewoners, dus in principe Amber […] binnen 3 uur staat daar een deelauto […] Maar heb jij dan het gevoel dat het betrouwbaar is?	Access
		F	het [Greenwheels] is voor iedereen […] dat is fijn en het is ook wel weer een afbreuk, want hoe zeker ben je dan, hoe netjes gaan we met de spullen om, kan ik mijn, kan ik er op vertrouwen dat hij er echt is als ik hem nodig heb.	Access

Barrier	CIMO	Interview	Passage	Cluster
		E	je moet wel genoeg hebben, dus dat je ook het gevoel hebt van oh ja, dat zijn die deelauto's.	Reliability
		F	als er 1, 2 of 3 Greenwheels in een hele woonwijk staan, achteraf toegevoegd, dit is even waarom ik het uitleg, dat betekent niet dat er meteen 11 mensen, in de data zie je dat wel, dat 11 mensen de volgende dag zeggen, dan doe ik mijn auto weg	Access
		L	En er is ook een Greenwheels hier [...] En mensen met een [anonymized]app […] die kunnen ook met hun app in een Greenwheelsauto, dus dat versterkt elkaar dan ook weer.	Access
		I	Dus al die negatieve ervaringen, dat duurt echt lang voordat je dat weer in het positieve	Reliability
		E	als je één keer misgrijpt, nou dan duurt het echt wel even voordat je nog een keer een poging doet.	Reliability
		D	Met […] free-floating, heb je gewoon een te grote groep aan gebruikers. Enerzijds is het natuurlijk gunstig want je hebt veel aanbod maar soms moet je ook wel even lopen. Maar dus het risico dat er dus geen aanbod is, is er ook.	Reliability
		L	nu is echt het idee van de eerste hub gaat open met 3 auto's, om ook goede beschikbaarheid te hebben.	Reliability
		F	Ik wil niet dat klanten misgrijpen want dat doet afbreuk aan het merk	Reliability
		K	Availability of cars is very important to stimulate use. Often, it was found better to place an extra car so that people cant *miss* when they need one. This higher reliability of availability will stimulate adoption in the long run which increases profitability. If there is only one car, people will miss more often and stop using shared mobility entirely.	Reliability
Ease-of-use	Short walking distance	B	mensen willen niet meer dan 3[00], 400 meter lopen voor een eigen auto.	Proximity of vehicle
		B	de parkeerplaatsen voor de bewoners, die ga ik gewoon wat verder weg neerleggen, de deelauto's die komen midden in de wijk te staan [...] dan moeten ze 5 minuten lopen voordat ze bij hun auto zijn	Proximity of vehicle
		E	je parkeert op bepaalde parkeerkoffers zeg maar en het centrale punt is eigenlijk de mobiliteitshub, die kom je als eerst tegen en daar kun je gebruik van maken.	Proximity of vehicle
		E	dat een partij als Cargoroo […] zij zeggen […] wij moeten bij de huizen zitten, we moeten bij onze gebruikers zitten, want zij moeten die boodschappen thuisbrengen, en dan wil je hem meteen kwijt	Proximity of vehicle
		E	ook dat het [shared mobility] […] zichtbaar en dichtbij waar jij moet zijn, bij de voordeur. Eigenlijk moet het de logische plek zijn.	Proximity of vehicle
		E	Ook bijvoorbeeld in een stationsgebied, wil je eigenlijk dat de deelvoertuigen vooraan staan […] Want die wisselen gewoon heel veel, die rouleren, als je daar gebruik van maakt moet je eigenlijk beloond worden	Proximity of vehicle
		E	Dus als je echt met hubs gaat werken dan moet het wel echt heel fijnmazig zijn want anders haken ze af, dus dan gaan ze niet lopen	Proximity of vehicle
		F	Wij vinden het heel fijn als de hub op de beste plek in de parkeergarage staat, dat iedereen elke dag ziet	Proximity of vehicle

Barrier	CIMO	Interview	Passage	Cluster
		H	Deelauto's staan ook dicht bij de ingang en c.q. de uitgang met laadpalen die we hier ook hebben neergezet. Dus die hebben we hier gepositioneerd, dus dicht bij dus, tussen haakjes makkelijk in gebruik.	Proximity of vehicle
		H	moet er niet aan denken dat ik naar het einde van de straat moet lopen om mijn auto te pakken zeg maar.	Proximity of vehicle
		A	Hier zitten de deelauto's, die liggen dan gewoon op maaiveld. Dus alle parkeerplaatsen zijn gebouwd opgelost behalve de parkeerplaatsen voor deelauto's, die zijn gewoon op maaiveld.	Proximity of vehicle
		I	We hebben varianten daar in van [...] de plek van de deelauto waar je hem op moet halen is voor de deur, dus maar een minuut, of minder dan een minuut lopen […] als je dat dan alles, in de meest optimale vorm […] 70% van de mensen die dan in jouw ontwikkeling gaan wonen die is dan bereid om een auto [weg te doen]	Proximity of vehicle
		A	Dus dat zijn ook de enige auto's die zichtbaar zijn in het openbaar gebied.	Visibility
		A	Dat [visibility and accessability] is ook een reden waarom we hem hier in de openbare ruimte hebben staan.	Visibility
		A	Maar ze zijn wel heel zichtbaar. En ik denk zeker dat dat helpt.	Visibility
		A	Hier zitten de deelauto's, die liggen dan gewoon op maaiveld. Dus alle parkeerplaatsen zijn gebouwd opgelost behalve de parkeerplaatsen voor deelauto's, die zijn gewoon op maaiveld.	Visibility
		B	wij maken heel vaak gebruik van de openbare ruimte.	Visibility
		D	ik zelf ook wel een keer ervaren in Rotterdam dat ik een deelauto wilde pakken en dat die dus in een garage stond en dat het echt ellenlang zoeken was van waar staat dat ding dan	Visibility
		E	ook dat het [shared mobility] gewoon goed toegankelijk is, zichtbaar […] Eigenlijk moet het de logische plek zijn.	Visibility
	Visibility	F	Wij vinden het heel fijn als de hub op de beste plek in de parkeergarage staat, dat iedereen elke dag ziet [...] naast de lift, op de mooist verlichte plek van de fietsenstalling, niet het hoekje wat nog over is in het ontwerp, van nou, dan zetten we daar wel de e-bikes neer. Nee, bij elkaar, zichtbaar	Visibility
		F	Dus ruimtelijk gezien willen we goede signing, dat mensen het kunnen vinden, goed verlicht, geen krappe bochtjes, pilaren, toestanden, gewoon gemak.	Visibility
		L	[anonymized]wilden ze bij elkaar hebben, voor beheer en onderhoud, maar ook zichtbaarheid en ja dat het gewoon duidelijk is dat daar de deelauto's moesten komen.	Visibility
		L	er wordt wel een bord opgehangen, en wat bordjes in de lucht, dus die aan het plafond hangen, dus er staat dan wel "gereserveerd, [anonymized]", en er komt wel een soort *signing* aan de wand. En we hebben de parkeerplaatsen zelf een iets ander kleurtje gegeven	Visibility
		D	Het moet zo simpel, *one-stop-shop* zijn eigenlijk, het moet zo simpel mogelijk zijn. Dus als de positie van die auto's of voertuigen dan helpt, ja dan zou dat zeker denk ik wel bijdragen.	Ease-of-use

Barrier	CIMO	Interview	Passage	Cluster
		F	geen moeilijke bochten, heel duidelijk. Mensen die niet vaak auto rijden vinden parkeren echt spannend […] Nou dit is een hindrance	Ease-of-use
		F	Als mensen een inschatting maken, tussen al die pilaren, dan moet ik in andermans auto, en ik heb een eigen risico, dan moet ik hem daartussen,	Ease-of-use
		F	Dus ruimtelijk gezien willen we […] geen krappe bochtjes, pilaren, toestanden, gewoon gemak.	Ease-of-use
		B	En dat zijn hele simpele dingen, dus bijvoorbeeld iemand vind het lastig om de app te downloaden, met name oudere mensen vinden dat soms spannend	Apps
		C	die [KiM] hebben gewoon een analyse gemaakt dat eigenlijk, de *inner circle […]* jonge mensen […] die zijn ook allemaal van de universiteit af, en die zijn meegegaan met apps en deelmobiliteit, en dat soort dingen.	Apps
		C	die [KiM] hebben gewoon een analyse gemaakt dat eigenlijk, de *inner circle*, de hoogopgeleide mensen […] die zijn ook allemaal van de universiteit af, en die zijn meegegaan met apps en deelmobiliteit, en dat soort dingen.	Apps
		C	maar ik ben ook niet de domste, maar zelfs dat was gecompliceerd, om die apps op een nette manier te doen	Apps
		G	het is voor iedereen een drempel alleen voor sommige groepen is die drempel groter, en dan moet je met name denken inderdaad aan wat oudere mensen die dus überhaupt geen smartphone hebben.	Apps
		G	ook aan mensen die dus minder technisch onderlegd zijn, of misschien een minder hoog opleidingsniveau hebben en minder gewend zijn om met technologische dingen te werken. Die groep is wel vrij klein hoor die laatste, maar ja dat heeft zeker wel een effect	Apps
	Assistance	J	Maar inclusiviteit heeft ook iets te maken met […] digibeten, want we gaan er allemaal van uit dat iedereen een smartphone kan bedienen.	Apps
		B	Maar wij vragen het in zo een interessepeiling vragen we dat ook altijd aan mensen van, vind je het leuk om te helpen bij het succesvol uitrollen van deelmobiliteit	Assistance
		B	Of ze vinden het spannend om voor de eerste keer in een elektrische auto te rijden, of ze weten niet hoe de laadkabels aangesloten moeten worden op de paal, hoe dat precies werkt	Assistance
		B	als wij gewoon 4 ambassadeurs hebben [...] dan kunnen we gewoon tegen die mensen zeggen van, als je het vervelend vindt om met de elektrische auto op stap te gaan [...] dus ik kan voor jou een afspraak maken met iemand die met je meegaat, dan kan je eens kijken hoe het werkt.	Assistance
		D	misschien is voor de één een app makkelijker dan voor de ander. Dus misschien zou je bij oplevering [...] een soort *get-to-know shared mobility* of een soort bewoners kennismaking waarbij je dan het samen gaat proberen en waarbij je ook inderdaad hulp krijgt	Assistance
		D	Ja met name ook met elektrische auto's, dat is vaak ook nieuw voor mensen, van oke, hoe werkt dat dan en hoe laad je, überhaupt het inpluggen van zo een stekker of zo kan misschien al een drempel zijn.	Assistance

Barrier	CIMO	Interview	Passage	Cluster
		F	elektrisch vind ik spannend, laadkabels. Ze zullen niet zo hard zeggen maar het zijn gewoon wel manieren om het mensen [makkelijker te maken]	Assistance
		J	Nou dat [mobiliteitsregisseur] zou bijvoorbeeld een partij als een [anonymized] kunnen zijn maar je zou ook kunnen zeggen, nee wij zetten vanuit het complex zelf een regisseur neer die ook de openbare orde, of de openbare ruimte in de gaten houdt	Assistance
		B	Maar soms is het in een gebied waar veel sociale cohesie is en wat landelijk gelegen is makkelijker om het voor elkaar te krijgen dan in de grote stad waar je eigenlijk vrij anoniem bent.	Assistance

Table A4.4 – CIMOs for SQ3 (Facilitating Flexible Supply)

CIMO	Interview	Passage	Cluster
Reserve space based on the amount of households per shared vehicle	A	eventueel nog een schaalbaarheid hebben ook zelfs in de garage zelf. Alleen dan betekent het dat iemand zijn parkeerplek moet verkopen aan een deelmobiliteitsaanbieder. Dus dat zou wel betekenen dat die aanbieder dan wel veel moet betalen omdat hij het dan dus natuurlijk aan iemand anders verkoopt.	Space reservation
	A	Ja dus we hebben er nu 9 […] En er zijn wel 15 plekken gereserveerd hier. Dus in die zin kunnen we nog opschalen, naar 15.	Space reservation
	B	Maar als je het over een vastgoedproject hebt, dan heb je natuurlijk vaak dat er parkeerplaatsen gereserveerd zijn, en dan zou je dus eigenlijk in het project zelf extra parkeerplekken moeten hebben voor de deelauto.	Space reservation
	D	Dus dat je die ruimte wel beschikbaar hebt, en al staat het dan een tijdje leeg, oke, dat accepteren.	Space reservation
	D	Dus dat je qua ruimte misschien inderdaad op de 10 plekken die je hebt gereserveerd voor de deelauto of de deelmobiliteit, dat je misschien in het begin er drie hebt staan, op een gegeven moment 6, en dan uiteindelijk 10.	Space reservation
	E	als een ontwikkeling, ik zeg maar iets, 10 deelauto's neerzet, moet er op dag één, moeten er 10 deelauto's staan? Nou ja, dat lijkt me een beetje onlogisch	Space reservation
	E	je moet wel genoeg hebben, dus dat je ook het gevoel hebt van oh ja, dat zijn die deelauto's.	Space reservation
	F	ik durf daar nog geen voorspellingen op te doen of dat, of die 5 allemaal gaan, rendabel genoeg gaan zijn [...] Maar als dat heel erg lukt, dan kunnen we tot in ieder geval 2 erbij opschalen omdat daar nu al bij wijze van spreken het bordje deelvervoer staat.	Space reservation
	F	zorg ervoor dat die ruimte er is. Er zijn ook zat plekken dat we echt best wel willen opschalen maar er is gewoon geen parkeerplek, want alles is verkocht.	Space reservation
	G	enerzijds wil je heel compact en efficiënt bouwen, en anderzijds moet je flexibiliteit hebben om dat misschien het gebruik in de loop der tijd verandert.	Space reservation
	G	je gebruikt je ruimte vrij intensief. Het nadeel daaraan is dat je eigenlijk heel weinig ruimtelijke overmaat hebt. In de planologie een term die zegt, die aangeeft dat je eigenlijk nog een beetje flexibiliteit hebt in je ontwerp om dus nog dingen aan te passen aan toekomstige veranderingen in behoeften.	Space reservation
	J	bij deelmobiliteit ook niet meer hebben over aantallen parkeerplaatsen maar over een aantal vierkante meters [...] want nu denken we dat het deelauto's zijn maar wie weet denken we over een paar jaar dat het allemaal van die [...] worden, van die kleine autootjes want dan passen er twee op een parkeerplaats	Space reservation
	L	Ik heb ook met [anonymized] en de VVE vastgelegd dat als [anonymized] er maar 2 auto's heeft staan, dat niet die andere 5 leeg staan, ik vind dat echt zonde, dus daar moet wel een samenwerking zijn […] En het parkeersysteem moest daar op worden aangepast	Space reservation
	A	Maar er zit hier dus ook nog best wel wat privé gebruik, of privé auto's in. Dus ik denk dat het daar bijvoorbeeld erg afhankelijk van is, welke ratio [shared cars per house] je toe past.	Vehicles/households ratio
	A	we hebben er nu 9. Een overeenkomst voor 9. En er zijn 950 woningen.	Vehicles/households ratio
	B	Dus ik denk zelf dat die, nou ja, dat er ongeveer bij 80 tot 100 gebruikers een knip zou moeten komen. Dus als je over die 100 heen gaat dan kan je er beter twee groepen van 50 van maken	Vehicles/households ratio

CIMO	Interview	Passage	Cluster
	B	En in die wijk hebben wij 2 deelauto's op 1000 huishoudens. Dat is eigenlijk een bestaande wijk zonder parkeerproblematiek, zonder financiële stimulans […] dat is de natuurlijke manier waarop mensen overstappen van eigen bezit naar deelgebruik.	Vehicles/households ratio
	B	je wil een iets grotere groep hebben zodat je ook meer diversiteit aan auto's kan aanbieden maar je wil de groep niet zo groot laten worden dat mensen elkaar niet meer kennen.	Vehicles/households ratio
	B	ons meest succesvolle voorbeeld is een project waarbij op 10 huizen 2 deelauto's hebben rondrijden. En daar zijn ook heel veel auto's, zijn daar verdwenen.	Vehicles/households ratio
	B	we hebben ook een projectje in Friesland met 10 huishoudens waar 2 auto's staan omdat het kan. Omdat die dat echt heel graag willen met elkaar.	Vehicles/households ratio
	C	Hij [anonymized] heeft een deelmobiliteitsarrangement aangeboden, en […] die 70 huishoudens […] die delen met elkaar 7 deelauto's, verschillende elektrische bakfietsen.	Vehicles/households ratio
	F	Iedereen is op zoek naar de heilige graal, zeg maar een soort parkeernorm voor deelauto's, het is er niet.	Vehicles/households ratio
	F	[anonymized], dat is in zuid-oost Amsterdam [anonymized], 1600 woningen, daar hebben wij 7 deelauto's staan. En het komt omdat al die jongens, die gaan óf met de metro en af en toe een keer met de scooter	Vehicles/households ratio
	F	Wat wij zien is dat de norm […] 5000 woningen moeten er 367 deelauto's komen. Nou dat is, dat is gewoon geen realiteit	Vehicles/households ratio
	F	we doen [anonymized] […] daar doen we 8 hubs op 1600 woningen, verspreid door de wijk. Iedereen in die wijk kan van die hubs gebruik maken maar woon je ergens anders in Rijswijk, dan niet […] het heeft een eigen identiteit het gebied, daar lukt het.	Vehicles/households ratio
	H	Dat [determine ratio vehicles/households] hebben we eigenlijk in dit geval in overleg met een aanbieder gedaan. In dit geval was dat [anonymized]	Vehicles/households ratio
	H	door het toepassen van 4 deelauto's op 108 appartementen.	Vehicles/households ratio
	I	Wij hebben dus die vraag [how many parking spots does on shared car replace] niet echt opgelost of kunnen oplossen want die berekening kun je niet zo makkelijk maken.	Vehicles/households ratio
	L	Dus niet beredeneren vanuit parkeerplaatsen maar meer vanuit gebruikers, van als je een groep van X gebruikers hebt, hoe groot moet die groep zijn voor één deelauto.	Vehicles/households ratio
	L	in de tender en die hebben wij ingediend met 18 deelauto's [162 households]. Uiteindelijk zijn dat er 7 geworden maximaal, maar voor toen konden we de parkeernorm alleen maar rond rekenen met 18 deelauto's dus dat was wel vrij heftig, zeker in 2018	Vehicles/households ratio
	L	is dat eigenlijk vanuit de markt werd gezien dat je één deelauto op ongeveer 25 huishoudens, dat dat reëel was.	Vehicles/households ratio
Formally establish the conditions under which	A	Dus als je heel veel grotere woningen hebt met een eigen parkeerplaats dan hoef je dat misschien iets minder hard te laten groeien.	Add/remove
	A	Dus de eerste 100 woningen zijn nu opgeleverd, en nu dus ook de eerste deelauto, die staat daar ook. En dus die deelauto's groeien mee in principe met het aantal [woningen].	Add/remove

CIMO	Interview	Passage	Cluster
vehicles are added and removed	B	Dus als er meer mobiliteitsbehoefte is dan plaatsen we bij en als er minder mobiliteitsbehoefte is dan schalen we ook af.	Add/remove
	B	Dus ik denk zelf dat die, nou ja, dat er ongeveer bij 80 tot 100 gebruikers een knip zou moeten komen. Dus als je over die 100 heen gaat dan kan je er beter twee groepen van 50 van maken, dan krijg je een soort celdelingsprincipe.	Add/remove
	B	Ja wij monitoren eigenlijk gewoon permanent het gebruik van deelmobiliteit. En wij passen het aanbod aan op de vraag die er is.	Add/remove
	B	Je kan natuurlijk niet helemaal afschalen, als er helemaal geen vraag meer zou zijn, er zijn natuurlijk altijd mensen die wel nog mobiliteit nodig hebben, en die mensen hebben soms ook echt hun auto voor jouw de deur uitgedaan. Dus je kan niet alles zo maar weg halen.	Add/remove
	B	Maar stel nou dat er uit die wijk geen 30 mensen meedoen maar 200 mensen meedoen, ja dan wordt die wijk als het ware in 3 of 4 clusters verdeeld.	Add/remove
	D	En ik denk qua flexibiliteit in bijvoorbeeld aanbod, is het ook weer […] belangrijk dat je dat in contracten organiseert.	Add/remove
	E	als er 10 deelauto's staan, dan weet jij, er staat altijd een deelauto voor mij dus ik heb die eigen auto nog niet nodig. Maar voor de marktpartij is het natuurlijk niet interessant om daar 10 deelauto's stil te hebben staan	Add/remove
	F	ik ga niet voor een piekmoment op tweede paasdag een extra auto neerzetten omdat iedereen toevallig dan naar de Hornbach wilde	Add/remove
	F	Je hebt wel 2[00], 300 woningen nodig om een zekere schaalgrootte te krijgen die rechtvaardigt om een extra auto, en alles wat erbij komt kijken.	Add/remove
	F	*Missed rides*, en de gelijktijdigheid daarvan, dus hoelang greep jij mis, is voor ons een hele belangrijke indicator om te zeggen, als dat te vaak voorkomt moeten wij gaan opschalen. De conditie daarvoor is wel dat het commercieel zinvol is.	Add/remove
	F	opschalen is altijd voor rekening en risico van [anonymized] maar er moet wel uit de data [...]. Als hij wordt meegenomen dan is het niet voor een uurtje, maar 2 of 3 of 4 uur, dat is commercieel belangrijk en mijn klantenbase is groot genoeg	Add/remove
	F	Voor ons is een goede indicator [voor opschaling], dat noemen wij een *missed ride,* jij wil weg, je kijkt naar de app en je kon niet weg, het was allemaal uitverkocht	Add/remove
	H	Het project is van de zomer opgeleverd, nog niet alle deelauto's zijn ook geleverd. De laatste volgt in januari, dus er staan er nu drie, en die worden op zich best goed gebruikt.	Add/remove
	J	en dan ga je natuurlijk niet meteen, stel ik wil hier voor [anonymized] 25 deelauto's neerzetten, ga je er natuurlijk niet vanaf dag één 25 neerzetten. Dan zet je er 3 neer, of zo, of 4 of 5, welk getal ook daar uit komt	Add/remove
	J	En dan kan je zeggen, maar als ik een bepaalde benuttingsgraad van deze deelauto's zie, dan ga ik gewoon bijplaatsen, dat is ook de gedachte hoe een, dat zal ook bij [anonymized] ook wel naar voren komen, gewoon bijplaatsen bij vraag en niet neerzetten.	Add/remove
	K	Scalability is ensured by monitoring the use of shared vehicles. Shared mobility providers monitor the use and can feed this back to the UAD.	Add/remove
	L	hebben we dan vervolgens een deelmobiliteithub, nu van maximaal 7 auto's maar hebben we wel afgesproken met de gemeente dat we een ingroeimodel gaan hanteren.	Add/remove
	L	je moet natuurlijk die afspraak wel goed maken met de gemeente want je hebt eigenlijk je parkeernorm doorgerekend met 7, en je zet er niet 7 neer.	Add/remove

CIMO	Interview	Passage	Cluster
	L	wij hebben nu zo vastgelegd met [anonymized] dat ze moeten doorgroeien onder bepaalde condities, daar hebben we een bedrag tegenover gezet, dat is ook zo met de VVE afgesproken.	Add/remove
	L	de laatste periode ook de meeste discussie over is gegaan met [anonymized] [...] wat is nou het moment dat [anonymized] die auto bij gaat plaatsen [...] dat hadden we gewoon goed geregeld totdat we het in een overeenkomst moesten opschrijven, toen vond [anonymized] dat toch wel heel spannend.	Add/remove
Involve users to find out the qualitative demand (types of vehicles)	C	*En daarvoor* [change types of vehicles] *zou je het eigenlijk ook een soort van constant moeten monitoren wat de wensen zijn?* Ja, ja, ja	Type of vehicle
	C	En eigenlijk zou je het dus willen katten, dat een deel van die parkeergarages voor auto's ook een deel ervoor zijn voor de fietsvoorzieningen.	Type of vehicle
	C	ik zorg gewoon dat er dan in dat deelmobiliteitsarrangement twee grote gezinsauto's, met flinke laadbakken, flink wat laadruimte, dan wordt het ingewisseld. Het deelmobiliteitsarrangement groeit mee met de levensfase van de klanten.	Type of vehicle
	C	kijk die jonge mensen die daar komen wonen willen er best wel aan beginnen, tot dat ze in een andere gezinsfase, namelijk kinderen krijgen.	Type of vehicle
	I	jongeren zonder kinderen die zijn meer geneigd om van die deelauto gebruik te maken. Dat zeggen ze, en dat zullen ze best doen, maar weten ook, op het moment dat gezinnen, jonge gezinnen kinderen krijgen […] Dat het eerste wat ze doen is een auto kopen.	Type of vehicle
	J	dus je moet eigenlijk al bij de verkoop of de verhuur van dit soort appartementen zeggen, en *by the way*, we hebben afgesproken dat drie keer per jaar bijvoorbeeld, de dienstverlener met u in contact wil treden via een enquête of via een inloopbijeenkomst om het met jullie te hebben over het aanbod.	Type of vehicle
	J	Dus stel dat dit allemaal kleine lokale ondernemers worden, die zijn misschien wel gebaat bij een gedeelde bestelbus.	Type of vehicle
	J	Je moet neerzetten wat de gebruikers willen. En het voordeel van dit verhaal is dat je de gebruikers kent want ze wonen in het complex, het nadeel ervan is dat vanwege de privacyregeling, dat zal je horen bij [anonymized], [anonymized] mag niet zomaar een bewonersbijeenkomst bij elkaar roepen.	Type of vehicle
	J	jullie moeten frequent contact hebben met alle gebruikers en als ze niet allemaal meer Aygo's willen maar allemaal willen rijden in een Tesla 3, dan is dat jullie verantwoordelijkheid om dat uit te zoeken te faciliteren.	Type of vehicle
	J	maar dan [when only analyzing use data] weet je niet goed wat de latente vraag is […] maar stel dat je zegt van, we hebben gewoon een elektrische deelbus, ja als die verhuurd is die verhuurd, dan is de benuttingsgraad van die bus is dan goed. Maar je weet niet of er nog vijf andere op dat moment ook die bus hadden willen gebruiken.	Type of vehicle
	J	maar ik ben best bereid om in deelmobiliteit te gaan zitten maar ik ga niet in één of ander frummelbakje zitten, dat is gewoon hoe ik in mijn leven sta, en de leeftijd die ik heb, dus ik wil best deelmobiliteit hebben maar dan wil ik een beetje een normale auto hebben. En iemand anders wil de goedkoopste.	Type of Vehicle
	L	als ze een kleintje en een middenklasser neerzetten en die kleine wordt altijd gebruikt en die middenklasser niet [...] dan gaan wel hun vloot aanpassen op de wensen	Type of vehicle
	L	En daar zetten ze ook een *Caddy* neer in het begin om te kunnen verhuizen en zo.	Type of vehicle
Employ adaptive	C	Laten we alsjeblieft, ook qua ontwerp en inrichting, dat die mee kunnen bewegen met die ontwikkeling. Adaptief programmeren heet zo iets.	Adaptive program

CIMO	Interview	Passage	Cluster
programming to be able to adjust to future mobility needs	D	Dus dat je hem misschien zo positioneert dat het dichterbij de fietsenstalling of bij de langzaam verkeersroutes ook is. Zodat die adaptiviteit of flexibiliteit mogelijk is.	Adaptive program
	D	En dat je dus de inrichting van die parkeergarage of mobiliteitshub zo maakt dat het dan ook veilig is om die parkeergarage of hub in te gaan met je fiets of bakfiets, terwijl er misschien ooit vroeger twee auto's stonden.	Adaptive program
	D	want vaak is in het ontwerp van garages bijvoorbeeld dat ofwel het langzaam verkeer en snel verkeer, dat dat gescheiden moet zijn. Nou als die regel er is en je wilt later dan bijvoorbeeld 2 deelauto's omzetten in 4 deelbakfietsen, of misschien wel meer, ja dan moet dat ruimtelijk ook inpasbaar zijn.	Adaptive program
	D	als er teveel auto's staan, maar bijvoorbeeld wel een grotere behoefte is aan bakfietsen, dat je dan, dat de aanbieder dan doorrekent oke, een auto kost per maand €450, een bakfiets kost per maand €80, nou dan kan ik zoveel bakfietsen inzetten voor hetzelfde bedrag als die auto kostte	Adaptive program
	D	Maar dat je misschien een soort buffer inbouwt standaard, dus dat je uitgaat van meer autogebruik, nu nog, en dat dat langzamerhand gedurende de jaren misschien meer ook gaat naar deelfiets, deelbakfiets, en andere modaliteitsgebruik.	Adaptive program
	J	bij de harde *assets* moet je ook flexibiliteit introduceren dus dat je kan schalen maar dat wil je eigenlijk ook in je gebruik en in je exploitatie	Adaptive program
	J	Dan moet je eigenlijk ook in je fysieke omgeving wat ruimte hebben gecreëerd, dus vandaar dat wij ook altijd zeggen van ja, ontwerp nou een parkeerbak niet op 2,20 meter maar op 2,70, dan kun je er altijd nog een woning van maken bij wijze van spreken.	Adaptive program
	J	dus je moet flexibiliteit in je plan inbouwen, net zoals je misschien wel, ik begreep nu ook dat er een daktuin op de parkeerbak komt, op de parkeergarage, ja dan kan je dus niet meer optoppen.	Adaptive program
	J	je kolommenstructuur moet niet zo zijn dat je er niks anders mee kan dan parkeren.	Adaptive program
	J	Maak dat je kan optoppen, kan je ook afschalen. Vandaar dat wij altijd voorstander zijn van centrale parkeervoorzieningen en niet dat ieder blok zijn eigen parkeerbak heeft.	Adaptive program
	J	niet meer hebben over aantallen parkeerplaatsen maar over een aantal vierkante meters die de beste locatie in de garage hebben, die je kan inrichten [...] want nu denken we dat het deelauto's zijn maar wie weet denken we over een paar jaar dat het allemaal [...] van die kleine autootjes want dan passen er twee op een parkeerplaats	Adaptive program
	G	Wat interessant kan zijn is of je dus private voorzieningen die worden gerealiseerd [...] parkeergelegenheid, of je die ook op zo een manier kunt integreren in het concept [...] zodat je daar flexibiliteit kunt krijgen om eventueel als die uptake dus groter wordt [...] dat je daar wel ook een gedeelde faciliteit van kan maken in plaats van alleen privaat.	Adaptive program

Appendix 6.1 – Evaluation Protocol

Evaluation Episode

Date	
Time	
Project	

Evaluation Participants

Participant Nr.	**Role**	**Name**
1	Developer	
2	Acquisition Manager	
3	Sales Manager	
4	Process controller	

Evaluation Procedure

1. Explain the purpose and set-up of the evaluation procedure
2. Explain the creation/function of the solution design
3. Discuss the context of the project which is being used for evaluation
4. Run through the entire solution design and individual interventions chronologically. Possible attention points are:
    4.1. How can the interventions be implemented (specific methods)?
    4.2. What would be needed to implement the interventions?
    4.3. What would be (side) effects of implementing the interventions?
    4.4. What are potential barriers for implementing the interventions?
5. Individually rate the evaluation properties (see following pages)
6. Individually write additional points of attention (see following pages)

Individual Rating of Evaluation Properties (Dutch)

1. *Het eindproduct helpt met het succesvol implementeren en faciliteren van station-based deelauto's in stedelijke gebiedsontwikkelingen.*

Volledig mee oneens	Mee oneens	Neutraal	Mee eens	Volledig mee eens
○	○	○	○	○

2. *Het eindproduct sluit goed aan bij de werkzaamheden en processen van projectontwikkelaars en BPD.*

Volledig mee oneens	Mee oneens	Neutraal	Mee eens	Volledig mee eens
○	○	○	○	○

3. *Het eindproduct kan eenvoudig worden uitgebreid met aanvullende interventies.*

Volledig mee oneens	Mee oneens	Neutraal	Mee eens	Volledig mee eens
○	○	○	○	○

4. *Het eindproduct is eenvoudig te begrijpen.*

Volledig mee oneens	Mee oneens	Neutraal	Mee eens	Volledig mee eens
○	○	○	○	○

5. *Het eindproduct (doel/werking/onderbouwing) is eenvoudig communiceerbaar naar andere belanghebbenden in gebiedsontwikkelingen.*

Volledig mee oneens	Mee oneens	Neutraal	Mee eens	Volledig mee eens
○	○	○	○	○

6. *Het eindproduct kan worden toegepast in alle stedelijke gebiedsontwikkelingen.*

Volledig mee oneens	Mee oneens	Neutraal	Mee eens	Volledig mee eens
○	○	○	○	○

7. *Het eindproduct sluit aan op de werkzaamheden van aanbieders van station-based deelauto diensten.*

Volledig mee oneens	Mee oneens	Neutraal	Mee eens	Volledig mee eens
○	○	○	○	○

Individual Additional Points of Attention

Appendix 6.2 – Evaluation Points

Description	Box	Action*
The solution design does not clearly indicate to what context it applies.	N.A.	A
Some area potential factors are not set in stone. They may change during the course of a development project or a UAD can actively try to change them in their favor (e.g. start a political lobby for parking regulation or the moving of a bus stop).	A2	A
The area potential factors are not very specific. For example, how are density, centrality and proximity exactly defined?	A2	C
The communication regarding SBCS services should not just be to (future) residents but also to municipalities to convince them of the validity of the UAD's mobility plans.	D1	A
To increase the practical validity, the solution design could incorporate application examples for each intervention.	N.A.	B
It may not always be feasible to execute all interventions in each urban development project.	N.A.	A
Municipalities should also be involved in the arrangements between UADs and SBCS providers regarding the quantitative supply of shared vehicles. A good mobility plan is also in the municipality's interest.	G3	A
The UAD's employees partaking the evaluation sessions were not enough aware of the activities of SBCS providers.	N.A.	B
The communicability of the solution design to external stakeholders is limited because the motivation behind the interventions is not presented.	N.A.	B
The solution design could also incorporate the interventions needed to successfully implement/facilitate other MoTs because they are interrelated.	N.A.	C
Not each urban development project will have a built parking garage, it may be some other sort of parking facility.	B1	A
The target group might change through the course of the development project, this will also change the total potential of the area.	C1	A
The solution design assumes that all SBCS providers are the same in their activities, in practice this might not be the case. For example, some providers might offer only a single type of vehicle.	N.A.	A
It is not instantly clear how the solution design should be read. For example, the connection between C1 and G1 suggests that you should go directly from the design (4^{th}) to the management (7^{th}) stage.	N.A.	A

*__A__ = The feedback is integrated in the updated solution design in Appendix 6.3, __B__ = The feedback is integrated in the solution design for BPD, __C__ = The feedback requires further research before it can be integrated in the solution design.

Appendix 6.3 – Updated Solution Design

Interventions for effectively facilitating business-to-consumer station-based carsharing (SBCS) services in Dutch urban areas in development