The effect of a low minimum parking requirement in combination with carsharing on the use of carsharing and car ownership

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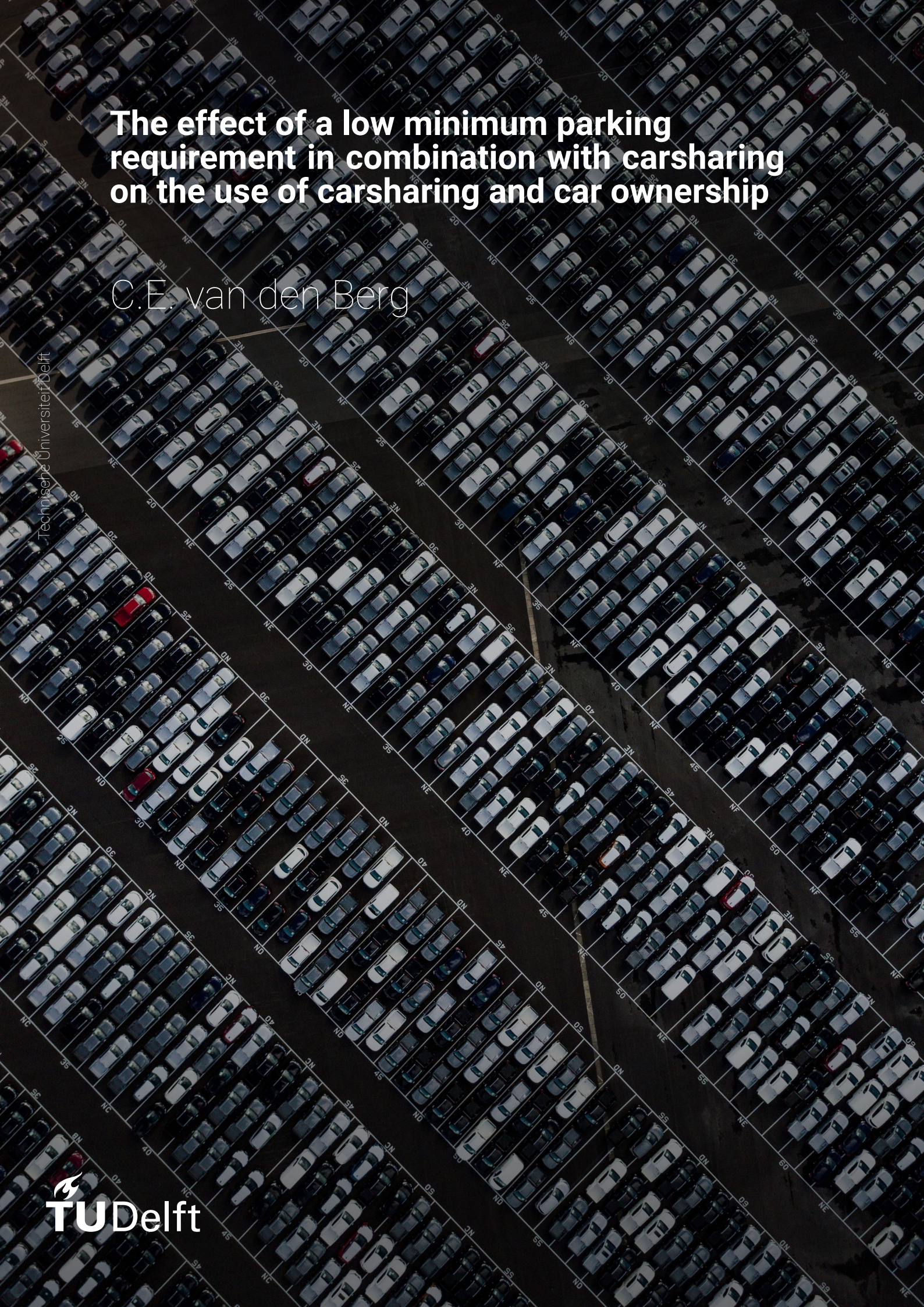

TU Delft

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by

C.E. van den Berg

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TU Delft

REBEL

Preface

In front of you lies my thesis as part of the MSc Transport, Infrastructure and Logistics at Delft University of Technology. For the past six months, I have been working on my thesis at Rebel. Half a year ago, I believed that the number of users of shared cars was too low, mainly because shared cars will contribute to achieving the climate goals and also ensure better traffic flow on the road. Therefore, I chose this topic. With the closed Green Deal there will from now on be more residential buildings that offer a shared car, during my research, it turned out that only a few residential buildings exist with shared cars and a low parking requirement. This made the investigation a lot more complicated. However, parking requirements in combination with carsharing is a hot topic, this made conversations with organisations more interesting. It was exiting to discover the new projects and to get to know the concept.

First and foremost, I would like to thank my graduate committee for all their help throughout this process. I want to thank my daily supervisors, Jan Anne Annema and Goncalo Correia, who have provided guidance and detailed feedback at every meeting. Next, I would like to thank Professor Bert van Wee for all sharp comments during this project. A special thanks to Aafke for all the meetings, her excellent feedback and compassion. Thanks to all of you, I was motivated to improve the quality of my research continually and to obtain a lot of new knowledge on the subject.

Besides the research, it was a wonderful opportunity to work on my master's thesis research at Rebel. I would like to thank my colleagues at Rebel. The past half year has been a lot better thanks to you. I enjoyed the lovely lunches and 'vrijdagmiddagborrels'.

I also want to thank all the respondents and participants of the interviews who took the time to fill in the survey and were able to talk with me. Without your cooperation, I could never have completed this research.

Finally, I want to thank my friends and family, for their advice, but moreover, they supported me morally during this research. My friends and sister, who have read parts of my thesis, thank you. My parents, who supported me (not only financially) my whole student time. Last, I want to thank Gijs, who has always supported and helped me even though he was not here and busy with his graduation.

C.E. van den Berg
Rotterdam, June 2019

Executive Summary

Research Context

The population in the Netherlands continues to grow, especially the number of residents in larger municipalities continues to increase (Kooiman et al., 2016). As a result, the number of cars in cities is growing, which causes more traffic jams and air pollution. Due to population growth, municipalities also have to deal with urban densification and transformation. At the same time, the public space is under pressure. Besides, municipalities want more green areas and playgrounds for children. Parked cars now occupy this space (van den Eerenbeemt, 2018). For these reasons, among others, municipalities therefore want to reduce car ownership.

In February, 2018 the 'City Deal[1] about electrical carsharing[2] in urban area development' was signed. This agreement stated that in seven cities in the Netherlands, have to deliver at least two innovative housing projects over the next three years. These projects shall deliver a total of 200 shared electric cars and more than 5,000 houses. . This may result in need of less parking spaces (Rijksoverheid, 2018).

One of the possible solutions to decrease the number of private cars is to change parking regulations, especially a reduction of the minimum parking requirements[3] for buildings is mentioned (Gragera & Albalate, 2016). In addition, carsharing is often seen as a solution to decrease the number of private cars. One of the ways to reduce parking requirements is through carsharing. Rotterdam, Amsterdam and Utrecht have included an exemption in the parking requirements; when developers offering shared cars for a minimum of 10 years, the parking requirement is expected to be reduced by 20% (Gemeente Rotterdam, 2018). However, it has not been researched what impact parking requirements in combination with providing carsharing have on car ownership.

Research Problem

This study provides new insights into carsharing usage and car ownership in residential developments by providing dedicated carsharing [4] and a low minimum parking requirement.

Many researchers (Liao et al., 2018; Millard-Ball et al., 2006; Shaheen & Cohen, 2007) expect that there will be a relationship between the number of parking spaces and carsharing use, but this has not been investigated. Therefore this study analyses this effect. In addition, many studies look at the effects of carsharing on car ownership or at the effect of parking requirements on car ownership. However, what now appears is that in many cities carsharing will be provided in areas with a low number of parking spaces. For these specific cases, it is necessary to study the effects together on car ownership. The only research, to the author's knowledge that combines carsharing and parking supply in its research, is Engel-Yan & Passmore (2013).

However, travel behaviour and cities are both very complex systems. Travel behaviour may be the result of indirect effects, and the dependent variables (car ownership and use of carsharing) may be the interdependencies. Several studies (Christiansen et al., 2017a;b; Groote et al., 2016; Guo, 2013) have concluded that there is a relationship between the number of parking spaces and car ownership. As well, several studies (Cervero et al., 2007; Firnkorn & Müller, 2011; Giesel & Nobis, 2016; Klincevicius et al., 2014; Lane, 2005; Le Vine & Polad, 2017; Martin et al., 2010; Momo, 2009; Shaheen & Cohen, 2012) concluded that there is a relationship between carsharing use and car ownership. These studies show that carsharing members reduce their vehicle holding. Although no scientific research has investigated the direct and indirect impact of residential buildings with low parking requirements in combination with providing carsharing on car ownership and use of carsharing, which seems to be a promising development according to several parties.

[1] The City Deal 'electric sharing mobility in urban area development' is the starting point for a 3-year program, in which 2 ministries, the province of South Holland, the 7 cities and large private parties will gain experience together in sharing electric cars in combination with solar energy generated by homes. In each city at least 2 building projects will participate in the coming 3 years.

[2] 'Carsharing' refers to a model where cars can be rented for shorter periods of time, there are different forms of carsharing, for example, Peer-to-Peer (SnappCar) or B2C (GreenWheels).

[3] A parking requirement is the minimum number of parking spaces that should be realised for a particular function of a building that is set by the municipality: such as a home, office or facility.

[4] Dedicated carsharing refers to shared cars that must be parked back at the dedicated space.

Given the challenges of the cities, the fact that carsharing is seen as a solution in urban development and the lack of insight into the combination of providing carsharing and a low parking requirement: The research goal is to determine the effect of combining the two opportunities, a reduction of the minimum parking requirement and providing carsharing on the change of car ownership and the use of carsharing of residents (See Figure 1).

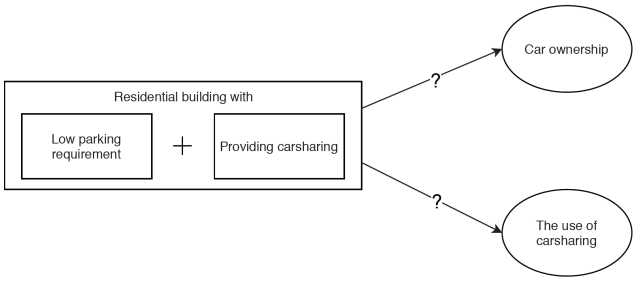


Figure 1: Visualisation of the effects investigated

For this study, the main research question is as follows:

What is the effect of a low minimum parking requirement in combination with dedicated carsharing at a residential building on car ownership and the use of carsharing of households?

Research Approach

To give a substantive answer to the main research question, a combination of qualitative and quantitative methods are used. An overview of the different methods used can be seen in Figure 2.

First, a literature review is conducted to identify scientific gaps. Besides, the literature review indicated factors that may influence car ownership and use of carsharing. The literature review aimed to research the effects. The factors that influence the dependent variables according to the literature are placed in a theoretically conceptual model. The conceptual model (Figure 3) visually represents the cause-effect relationships theoretically. Also, the conceptual model is used to make a simplified conceptual model to quantify the relationships with the collected data, because not all factors can be measured in this study.

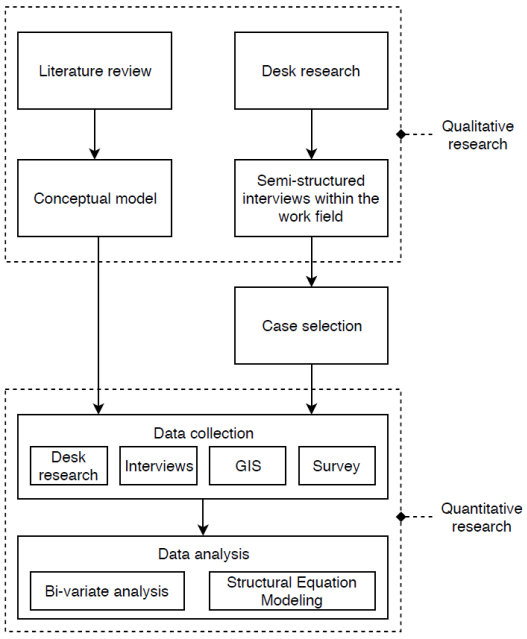


Figure 2: Methodology

Second, to test the conceptual model, insights from practices are gained. Desk research is used to identify projects in current practice. Four residential buildings were chosen for interviews to gain more insights. The projects were chosen, because they were all situated in different cities, had different developers and different carsharing providers. Interviews were held with municipalities, developers and carsharing organisations. The interviews gave insight into the goals and experiences of the stakeholders with the low parking requirement in combination with dedicated carsharing.

Thirdly, to analyse the conceptual model, data of the projects was needed. To see differences in households with and without a low parking requirement and dedicated carsharing, data was collected for both groups. Six control cases (without the combination) were located in the same area as the two selected cases (with the combination). A data collection of the built environment was performed using a Geographical Information System and desk research. Socio-demographic characteristics of households have been collected through a survey. In this survey, questions about the households' car ownership and use of carsharing before and after the residential move were asked.

Lastly, the outcomes of the survey, combined with the collected built environment data, were statistically analysed.

Main findings

The purpose of this research is to determine the effect of a low minimum parking requirement in combination with dedicated carsharing at a residential building on car ownership and the use of carsharing of households. The main findings of factors that influence car ownership and use of carsharing will be discussed with the use of the conceptual model. In addition, the main findings of the stakeholders are described. Last, the main findings concerning the conceptual model based on the study sample are given.

The literature reviewed that more factors influence car ownership and use of carsharing. The four dimensions that are mentioned most are socio-demographic characteristics, residential relocation, attitudes and built environment. The relationships between these dimensions and the dependent variables 'change of car ownership' and 'use of carsharing' can be described in many ways. Figure 3 shows the created conceptual model that describes the relationships between socio-demographic characteristics and change in the use of carsharing through intermediary factors theoretically, the model was established with different theories and models (Cao et al., 2009; Heinen et al., 2018; Van Acker & Witlox, 2010). The relationships in the conceptual model will be explained below. Numbers represent the relationships, and the factors are shown in bold in the text.

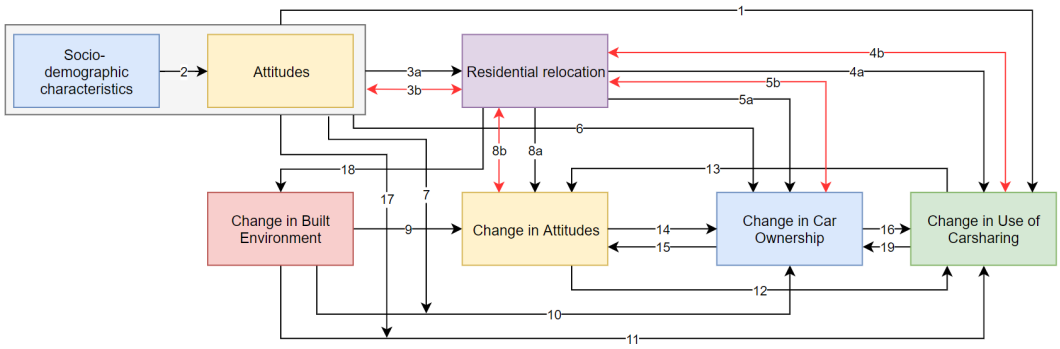


Figure 3: A Conceptual Model describing the relationships between socio-demographic and change in use of carsharing through intermediary factors (a black single-headed arrow represent causation, the red double-headed arrow represents correlation)

Studies about the influence of **socio-demographic characteristics** on **carsharing** are scarce. To make a conceptual model based on theory, theories about travel behaviour is used. Travel behaviour is the study how people use transport, for example, carsharing use, theories about the change of travel behaviour are widely researched and are therefore used here to describe the dependent factor **use of carsharing**. It is known from the literature that travel behaviour is dependent on **socio-demographics** [1]. The typical carsharing member is young; their household type is single or exists of households with young children. Besides, members are mostly highly educated, employed and have a high income. It appears that **socio-demographic characteristics** are often interdependent. For example, having a job has an impact on income, and therefore on having a car, which affects travel behaviour. The literature review shows that age, income, household type, employment status, and education level are all related to each other and influence **car ownership** [6]. In addition, the **residential (re)location** is also related with **socio-demographic factors** [3b]. Personnel preferences and **attitudes** for housing unit characteristics and **built environment** play a role with choosing the **residential location** [3a]. **Attitudes** are psychological constructs, mental and emotional. **Attitudes** are independent, however **attitudes** can depend on **socio-demographic characteristics** [2]. **Attitudes** and **socio-demographic** influence the same factors, and are therefore represented in one box in this conceptual model. **Residential relocation** often happens simultaneously with other life events [5]. Attitudes can also vary over time, in the conceptual model, a factor **change in attitudes** is therefore included. The change in attitudes can depend on the residential relocation [8a, 8b], on the change in car ownership [15], and the change in the use of carsharing [13]. By all means, the **residential relocation** might increase or decrease the **car ownership** of a household (Toasin et al., 2014) [5a]. Besides, this relation might correlate [5b]. The same applies to the relations between residential relocation and change in the use of carsharing [4a, 4b].

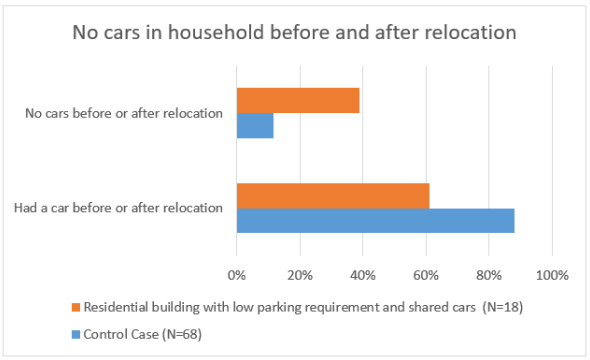
A **residential relocation** will cause a **change in the built environment** [18]. Several studies (Burkhardt & Millard-Ball, 2006; Cervero, 2003; Jorritsma et al., 2015; Shaheen & Rodier, 2015) indicated that the **use of**

[5]Moments in life that have a strong influence on (the financial needs of) a person or household, such as: leaving home, moving out, cohabiting/getting married, having children, breaking up, retirement.

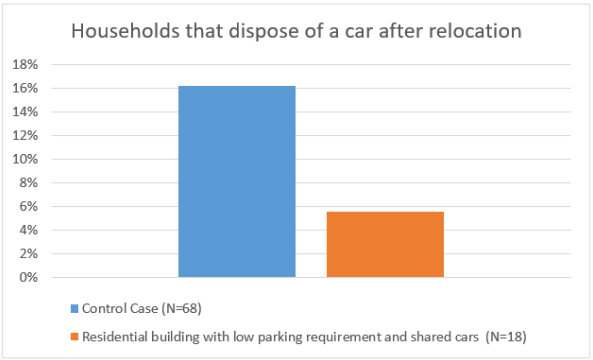
shared cars is higher in densely populated areas and in the very strongly urban areas. Previous studies found a significant relation **between built environment** and travel behaviour [11]. Self-selection may disturb this association, self selection is "the tendency of people to choose locations based on their abilities, needs and preferences" (Litman & Steele, 2018). In the conceptual model, several indirect relations between **change in built environment** and **change in use of carsharing** are indicated. These indirect relationships ensure that self-selection is included in the model. Heinen et al. (2018) concluded that there is no single perfect conceptualisation that applies for everyone, therefore all options are included in this conceptual model. For example, **attitudes** can have an influence on the relationship self between **built environment** an **use of carsharing** [17]. Another example is the **change in attitudes** that indirect influence **built environment** and **use of carsharing** [9, 12, 14, 16]. The same applies for **change in built environment** and **change in car ownership** [7, 10, 9, 14].

The conceptual model shows that use of carsharing and change in car ownership can be described by many other factors and in many ways. So in addition to parking requirements and offering shared cars, more factors must be taken into account. It appears that it is very complex to describe how the change is influenced, and measuring it is therefore very difficult. This is confirmed with the results of the interviews with carsharing providers, municipalities and developers. The carsharing organisations indicated that the preferences of people are essential; if this is properly anticipated, the use of shared cars can be increased. Besides, municipalities and developers focus on specific socio-demographic factors, mid-tenants and young urban people. These people are also seen as typical users, according to literature. The experiences concerning the use of shared cars vary. Two organisations experienced low use, and two experienced a high use. In addition to experiences with carsharing, the experiences concerning the use of parking spaces vary (which indicates the factor car ownership). Many parking spaces seem to be empty that belong to residential buildings. However, there are also examples showing that the garage is full. It appears that the effects of the cases interviewed differ, and besides, the effects may also be influenced by other factors such as those in the conceptual model.

It is difficult to indicate whether parking standards and the offering of shared cars affect car ownership and use of carsharing. Therefore, data were collected to measure the effects and see the differences between the two groups. The results of the descriptive statistics of the collected data of the cases show small differences between the two groups (households that live in buildings with a low parking requirement and carsharing, and buildings without) in relation with car ownership. The following differences are not significant but show the descriptive of the two groups. The descriptive aims to summarise the sample, but cannot be used to learn about the population. In the sample, a higher percentage of the households in the selected cases did not have a car before they moved, and they had fewer cars compared to the control cases (Figure 4a). However, a higher percentage of households dispose of their car in the control cases (Figure 4b). Although, none of the respondents indicated that they had disposed of the car because they were using a shared car, and only one household indicated that they had no parking space and therefore had disposed of the car. However, four households did give up their car and join carsharing.



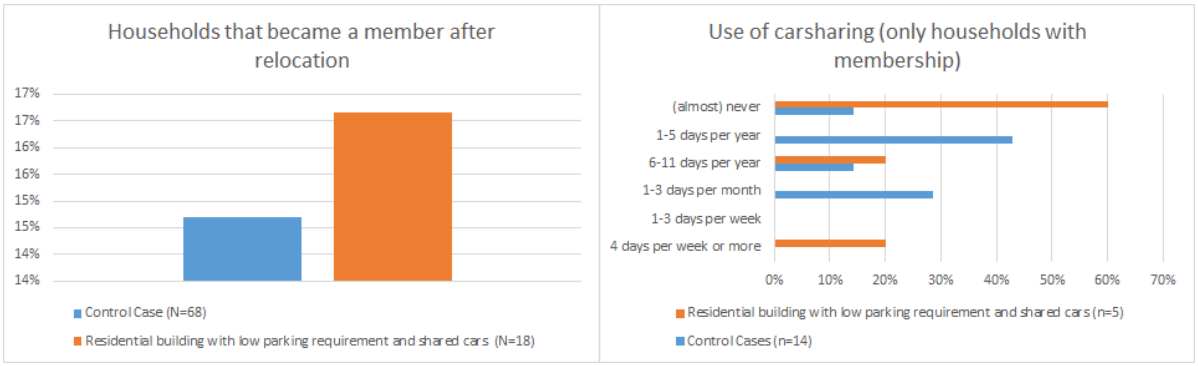
(a) Households with no cars before or after relocation



(b) Households that dispose a car after relocation

Figure 4: Comparison between selected and control cases

In relation to carsharing, a higher percentage of the households in the selected cases have a membership (Figure 5a). However, a big part of these members does rarely use shared cars (Figure 5b). In the sample, three accessors (households that had no car and joined carsharing) were present. However, it is not known how their travel behaviour used to be.



(a) Households that became a member after relocation (b) Use of carsharing (only households with membership)

Figure 5: Use of carsharing - Comparison between selected and control cases

Further, there are no notable differences in the use of carsharing. The correlations between the dependent variables and the distinction of the two groups do not show any significant associations. However, this sample shows some small differences. It must be noted that this is only the direct effect; it was intended to make a structural equation model to analyse the pure effect. Despite the model fit was overall good, it did not succeed to test the hypotheses with the use of multi-group analysis. This is devoted to the sample size.

Conclusion

To conclude, this research has shown that different factors influence car ownership and use of carsharing. Because of this, the relation between 'a low minimum parking requirement and offering carsharing' and the use of carsharing and car ownership, needs to be investigated indirectly. However, the factors that will have the most influence are socio-demographic factors, attitudes, residential relocation and built environment.

The effect of a low minimum parking requirement in combination with dedicated carsharing at a residential building on car ownership and use of carsharing, appears in this sample as follow. The number of cars per households in a building with a low parking standard is lower. However, it often appears that people did not have a car beforehand. The residential buildings will therefore mainly attract people who did not already have a car. A low parking standard has no visible influence on the disposal of a car; when households dispose of their car this is not because they use a shared car. Moreover, offering a shared car does not have a clear influence on its use. However, no significant differences were found between the two groups. Besides, the use of the shared car and the car ownership of households may be explained by other factors.

The results of this research are merely based on the selected cases. This means that the results are based on the features of these specific case. By using the selected cases, it means that the results are based on the insights gained from studying only these. Besides, the cases differ in several ways that are not included in the analysis. For example, the number of shared cars and parking policies. Therefore, the results can be different when using other cases. Moreover, the results of the data analysis are dependent on more factors that could be included in the study. Therefore, the use of shared cars or car ownership could also depend on factors other than those included in the study. Furthermore, the results are based on the residents who live there, while other people could give different results.

As discussed, the conceptual model shows that there are many indirect effects, therefore a Structural Equation Model would fit very well this study. However, the sample size was too small to build a Structural Equation Model. At the start of this study, the author could not have known that the number of respondents could not be achieved. It was thought that more cases met the selection requirements, two of the cases appeared to have no shared car or no low parking standard and could therefore not be included. Due to the small sample size, no significant differences could be found between the two groups, while these are probably there.

Theoretical and Societal Contribution

The research has both a theoretical and social contribution. Scientifically, it contributes to the mapping of the effects on car ownership and carsharing use utilising the conceptual model presented. The research shows how the conceptual model can be used to measure the effects. In addition, the study shows the experiences of the stakeholders involved in the first projects set up in the Netherlands. With providing surveys among

residents, more insight was obtained into why changes in car ownership take place.

As for its societal contribution, the results of the case studies and the experiences of the stakeholder groups provide an overview of the characteristics of the residents and their experiences. Moreover, the findings relate to the selected projects, but most findings can be used for future comparable projects.

Suggestions for future research

Overall, this study provides a starting point for having insights into the effects of residential buildings with a low parking requirement and providing carsharing on the use of carsharing and car ownership. There is more research needed for the interrelationships between the specific variables. More locations must be analysed, so differences between built environment factors and policies can be determined. Besides, more respondents must be collected. A structural equation model can be made when having a larger sample, in which significant direct and indirect relationships can be found. In this way, it can be proved whether the low parking standard in combination with shared cars at a residential building influences car ownership and use of carsharing.

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List of Abbreviations

B2B	Business to Business
B2C	Business to Consumer
BE	Built Environment
CBA	Cost-benefit Analysis
CFA	Confirmative Factor Analysis
CS	Carsharing
EV	Electric Vehicle
GHG	Greenhouse Gas
GIS	Geographical Information System
HBO	Hoger Beroeps Onderwijs (Higher Vocational Education)
MaaS	Mobility as a Service
P2P	Peer to Peer
PKT	Passenger kilometres Travelled
PT	Public Transport
RP	Revealed Preference
SEM	Structural Equation Modeling
SP	Stated Preference
TB	Travel Behavior
VKT	Vehicle-kilometres travelled
WO	Wetenschappelijk Onderwijs (Academic Education)

List of Definitions

B2B-carsharing	Shared cars are owned by a business provider that makes them available to companies or shared cars owned by companies that make these available to their employees
B2C-carsharing	A business provider owns shared cars and makes the cars available for customers
Free floating	The car can be parked in any parking space
Maximum parking requirement	The maximum number of parking spaces that may be built for a certain function of a building: such as a home, office or facility
Minimum parking requirement	The minimum number of parking spaces that must be realised for a particular function of a building: such as a home, office or facility
One way	The consumer can find a shared car with using the mobile phone, the car can be parked at the end of the trip at the destination
Peer2Peer-carsharing	Shared cars are owned by consumers who make them available to other consumers via an online marketplace
Round-trip	The round trip shared car has a fixed parking place, the consumer will bring the car back at the place of departure
Station based	The car can only be parked in a particular parking space

1 Introduction

The population in the Netherlands continues to grow, especially the number of residents in the larger municipalities continues to increase (Kooiman et al., 2016). As a result, the number of cars in cities is growing, which causes more traffic jams and air pollution. Due to population growth, municipalities have to deal with urban densification and transformation. At the same time, the public space is under pressure. Besides, municipalities want more green areas and playgrounds for children. Parked cars now occupy this space (van den Eerenbeemt, 2018). For these reasons, among others, municipalities therefore want to reduce car ownership.

One of the possible solutions mentioned to decrease the number of private cars is to change parking regulations, especially a reduction of the minimum parking requirements for buildings[1] is mentioned(Gragera & Albalate, 2016). In addition, carsharing is often seen as a solution to decrease the number of private cars. One of the ways to reduce parking requirements is through carsharing. However, it has not been researched what impact parking requirements in combination with providing carsharing have on car ownership. The gaps found in the literature are further discussed in Section 1.1.

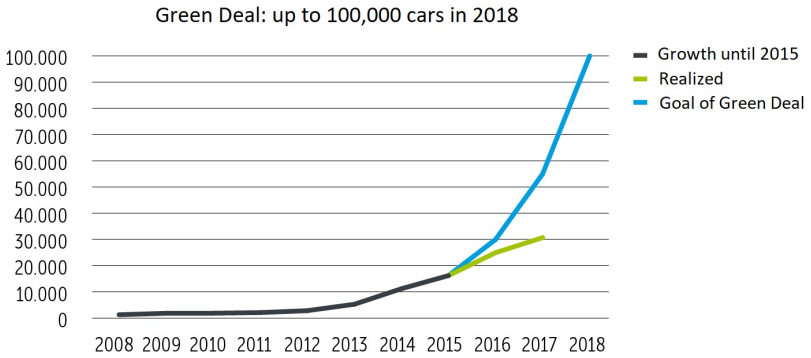


Figure 1.1: Graph of growth of shared cars (CROW-KpVV, 2018a)

The topic of carsharing[2] attracts more interests, and there are also increasingly more opinions and visions about the success of it. Many researchers expect that carsharing contributes to achieve climate goals and also make it possible that the congestion on the road decrease. The number of shared cars is still increasing in the Netherlands, last year (2018) 41,000 shared cars are available and used by 400,000 people. That is an increase of 10,000 cars compared to the previous year (CROW-KpVV, 2018b), see Figure 1.1. The largest part of these sharing cars are so-called "car sharing platforms" cars, or peer-to-peer sharing cars. These cars are private cars that people offer to share through providers such as SnappCar. This type of shared car is growing

[1] A parking requirement is the minimum number of parking spaces that should be realised for a particular function of a building: such as a home, office or facility.

[2] 'Carsharing' refers to a model where cars can be rented for shorter periods, there are different forms of carsharing, for example, Peer-to-Peer (SnappCar) or B2C (GreenWheels)

very fast because it is easy to participate. Moreover, providers such as SnappCar are putting much energy into expanding their network. However, the growth is not limited to the "car sharing platforms"; all other forms of car sharing show constant growth. Well-known suppliers of shared cars are SnappCar, Greenwheels, MyWheels, Car2Go and WeGo. The Dutch government has closed 'The Green Deal' which states that in 2021, 700,000 car sharers must share a total of 100,000 cars (Green Deal, 2018). Research indicates that when people switch to shared cars, they drive fewer kilometres (Nijland & van Meerkerk, 2017). Besides, when more people use shared cars, and the number of private cars decreases, less number of parking spaces are needed.

So more and more municipalities in the Netherlands want to reduce car ownership and car use, because of reaching climate goals, decrease congestion and of the limited space in larger municipalities (CBS, 2016). Hence, municipalities introduce a reduction in the minimum parking requirement for residential buildings. Besides, developers of residential buildings provide carsharing vehicles to their residents that can be parked at a dedicated[3] space (Ministerie van Infrastructuur en Waterstaat, 2018). Rotterdam has included an exemption in the parking standards; when offering shared cars for a minimum of 10 years, the parking requirement can be reduced by 20% (Gemeente Rotterdam, 2018). Amsterdam and Utrecht have also drawn up similar exemptions (Gemeente Amsterdam, 2017; Gemeente Utrecht, 2013). With this, municipalities suggest that offering a shared car will contribute to a lower number of cars and therefore that fewer parking spaces are required. So, it is possible that developers deliver residential buildings with a lower parking requirement and offering shared cars. These two could positively reinforce each other, although the reinforcement can also be harmful. It is possible that people get rid of their car because carsharing becomes easier. However, it may also be that these housings attract people who first cycled and walked, and now want to use carsharing. So, it is unknown what kind of people attracted to these buildings, and how their car ownership and carsharing use is changed. Therefore, the effects of a residential building with a low parking requirement and carsharing are investigated in this research.

1.1. Scientific Gaps

Chapter 3 provides a literature review and shows that studies have been done that provide components for this study. There are five important gaps found during the literature review, and this subsection justifies the scientific gaps. Besides, it indicated how these gaps are filled in this study.

Firstly, several studies (Christiansen et al., 2017a;b; Groote et al., 2016; Guo, 2013) have concluded that there is a relationship between the number of parking spaces and car ownership. Some of these studies also included other factors (built environment and socio-demographics) in their research, but only analysed those factors with the help of regression analysis or multivariate analysis. This has resulted in only direct relationships being investigated and not indirect relationships. It is known from the literature that travel behaviour cannot be determined by direct relationships only. Therefore, this research examines the direct and indirect relationships between parking spaces and car ownership.

Secondly, the same applies to the relationship between carsharing use and car ownership, which mainly shows carsharing members reduce their vehicle holding (Cervero et al., 2007; Firnkorn & Müller, 2011; Giesel & Nobis, 2016; Klincevicius et al., 2014; Lane, 2005; Le Vine & Polad, 2017; Martin et al., 2010; Momo, 2009; Shaheen & Cohen, 2012). As mentioned earlier, direct and indirect effects explain travel behaviour. However, in the studies that were found, the indirect relationships have not been investigated. The dimensions that influence car ownership mentioned in studies are socio-demographics and life events and built environment. Therefore, this study investigates which underlying factors affect car ownership and carsharing. These direct and indirect links between these factors are established in this study.

Thirdly, the study of Martin et al. (2010) shows that 60% of all households joining carsharing are carless. It could, therefore, be that people without a car are more attracted to a residential building which provides carsharing. However, Martin et al. (2010) researches only people with a membership. Though, there is no research about whether people without a car live in the apartments described but have no membership. Therefore, this study looks at both households with membership and without. So differences in car ownership between these two groups can be viewed. Besides, it appears that members are often highly educated, live in highly urban areas, are young singles or are households with young children (Burkhardt & Millard-Ball, 2006; Cervero, 2003; Jorritsma et al., 2015; Millard-Ball et al., 2006; Shaheen & Rodier, 2015). It is examined what kind of households live in these types of buildings.

In addition, many researchers (Liao et al., 2018; Millard-Ball et al., 2006; Shaheen & Cohen, 2007) expect that there will be an effect between the number of parking spaces and carsharing use, but this has not

[3] Dedicated carsharing refers to shared cars that must be parked back at the dedicated space

been investigated. Therefore this study measures this effect. In addition, many studies look at the effects of carsharing on car ownership or at the effect of parking requirements on car ownership. However, what now appears is that in many cities carsharing will be provided in areas with a low number of parking spaces. Therefore, it is needed to study the effect on car ownership together. The only research, to the author's knowledge that combines carsharing and parking supply in their research, is Engel-Yan & Passmore (2013). This research uses linear regression and does include the built environment. However, also, this research has only investigated direct relationships. The research does use a control group, with homes without the concept. However, this study does not include the differences over time and whether there is a change before and after moving. Though, studies have shown that a change in travel behaviour is often in conjunction with other life events such as a relocation. Therefore, in this thesis, the comparison between before and after a residential move to a building with dedicated carshare vehicles are examined. Moreover, the study of (Engel-Yan & Passmore, 2013) was performed for a city in Canada in 2013. However, research is needed for local context related to cultural differences. In addition, the research is outdated, and there are new developments around car sharing at the moment. Therefore, cases are chosen in the Netherlands in this thesis, and data from 2019 is used. With this data, the direct and indirect effects can be measured.

Lastly, in the Netherlands, the parking requirements drawn up by CROW can be used as a guideline without further justification (van Bommel & Guner, 2011). However, research by Shoup (1994) has shown that 98% of California cities build too many parking spaces. A study by BPD looked at how parking standards in the Netherlands are determined in the municipality (BPD, 2018). They concluded that several factors (for example, a difference in the size of houses) had to be taken into account for determination of the parking requirements because they indicate differences in car ownership within these factors. After the publication of the report of BPD's investigation, municipalities have adjusted their parking policy. However, no research has been done into the objectives of the municipalities and whether they are adopting the CROW standards. Therefore, this thesis analyses the interests, goals and experiences of relevant stakeholder groups.

1.2. Societal Relevance

The expected growth of the Dutch population between 2015 and 2030 is almost 950,000 people. Almost three quarters will take place in Amsterdam, Rotterdam, The Hague, and Utrecht (CBS, 2016). In addition, there is a move toward large cities. So space becomes scarcer in the larger municipalities. Parking standards can be a major role in solving the scarcity problem. However, municipalities do not know how residents travel behaviour will look like in the future and certainly not the next generation (Plugge, 2018).

In 2018, February the 'City Deal about electrical carsharing in urban area development' was signed. In seven cities in the Netherlands, at least two innovative housing projects will be delivered over the next three years. The projects shall deliver a total of 200 shared electric cars and more than 5,000 houses. The introduction of shared cars means that less parking spaces are needed (Rijksoverheid, 2018). However, no investigation has been conducted into whether the purchase of parking spaces and the availability of shared cars offers a solution.

This study provides new insights into carsharing usage and car ownership in residential development by providing dedicated carsharing and a low minimum parking requirement. The findings shall make an essential contribution to the field of new construction buildings. The study offers some critical insights for municipalities, and how they can promote carsharing in the right way with parking requirements for residential development.

1.3. Research Objective

Based on the scientific gaps, this research focuses on the determination of the effect of combining the two opportunities, an introduction of a low minimum parking requirement and offering carsharing. Further, this research investigates what the change of car ownership and the use of carsharing of residents is in existing buildings with this combination.

The research goal is to determine the effect of combining the two opportunities, a reduction of the minimum parking requirement and providing carsharing on the change of car ownership and the use of carsharing of residents (See Figure 1.2).

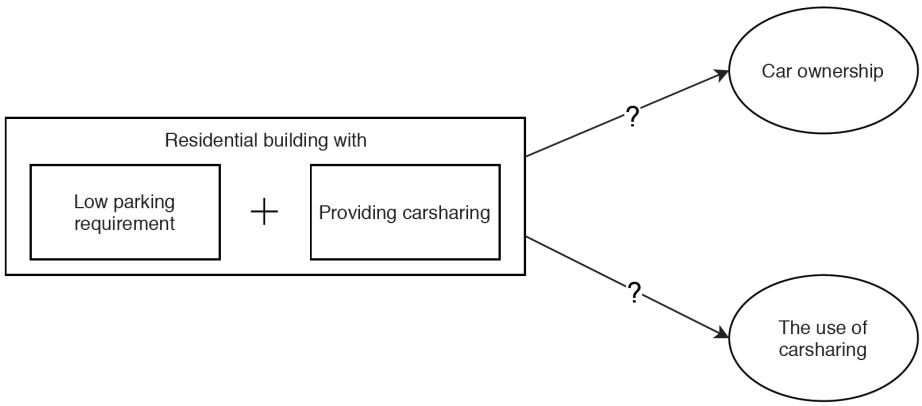


Figure 1.2: Visualisation of the effects investigated

For this study, the main research question is as follows:

What is the effect of a low minimum parking requirement in combination with dedicated carsharing at a residential building on car ownership and the use of carsharing of households?

1.4. Research Approach

To give a substantive answer to the main research question, a combination of qualitative and quantitative methods are used. First, a literature review is conducted to identify scientific gaps. Besides, the literature review indicated factors that may influence car ownership and use of carsharing. The literature review aimed to research the effects. The factors that influence the dependent variables according to the literature are placed in a theoretically conceptual model. The conceptual model visually represents the cause-effect relationships theoretically. Also, the conceptual model is used to make a simplified conceptual model to quantify the relationships with the collected data, because not all factors can be measured in this study. Second, to test the conceptual model, insights from practices are gained. Desk research is used to identify projects in current practice. Four residential buildings were chosen for interviews to gain more insights. The projects were chosen, because they were all situated in different cities, had different developers and different carsharing providers. Interviews were held with municipalities, developers and carsharing organisations. The interviews gave more insight into the goals and experiences of the stakeholders with the low parking requirement in combination with dedicated carsharing. Thirdly, to analyse the conceptual model, data of the projects was needed. To see differences in households with and without a low parking requirement and dedicated carsharing, data was collected for both groups. Six control cases (without the combination) were located in the same area as the two selected cases (with the combination). A data collection of the built environment was performed using a Geographical Information System and desk research. Socio-demographic characteristics of households have been collected through a survey. In this survey, questions about the households' car ownership and use of carsharing before and after the residential move were asked. Lastly, the outcomes of the survey, combined with the collected built environment data, were statistically analysed. Chapter 2 can be consulted for more information about the methods.

1.5. Scope

This research is focusing on providing carsharing and car ownership. However, this is a vast subject. Therefore, an overview of the scope of this thesis is made.

This research aims to explore the potential of carsharing at residential buildings with a low parking requirement in reducing car ownership and in the use of carsharing and how this is affected by its attributes. We explore the potential of carsharing use in the trips made, and in the car ownership before and after moving on the household level. We explore the relationship between the household's characteristics and using carsharing, and household's characteristics and reducing car ownership. This includes built environment factors of the households. Effects on the environment are excluded from this research.

The selected residential buildings are in the Netherlands in a very strong urban neighbourhood, in Utrecht and Rotterdam. The selected cases provide carsharing with a dedicated parking space on their property and

consists of a service provider (B2C). The case studies exist for at least three months so people might have changed their travel behaviour within this time (Bamberg, 2006). Besides, a control case close to the case study is selected.

The survey data is collected in April 2019. The surveys are not conducted among distinct people; the surveys were sent to all houses within the selected cases, so all characters of people could be included. For data that is used to describe the cases, such as built environment characteristics, it is tried to use the most updated data so, that the data is related to the survey data that is collected.

1.6. Report Outline

In Figure 1.3, the different phases and chapters can be seen. The report is structured into five chapters. In Chapter 2, the methods that are used for this study are explained. Chapter 3 provides an extensive overview of the literature and discuss factors that influence the use of carsharing and car ownership. Besides, it presents a conceptual model based on the theory, interrelations between factors will be identified. Chapter 4 reports the results of this research. Lastly, Chapter 5 contains discussions, conclusions and recommendations for practice and further research.

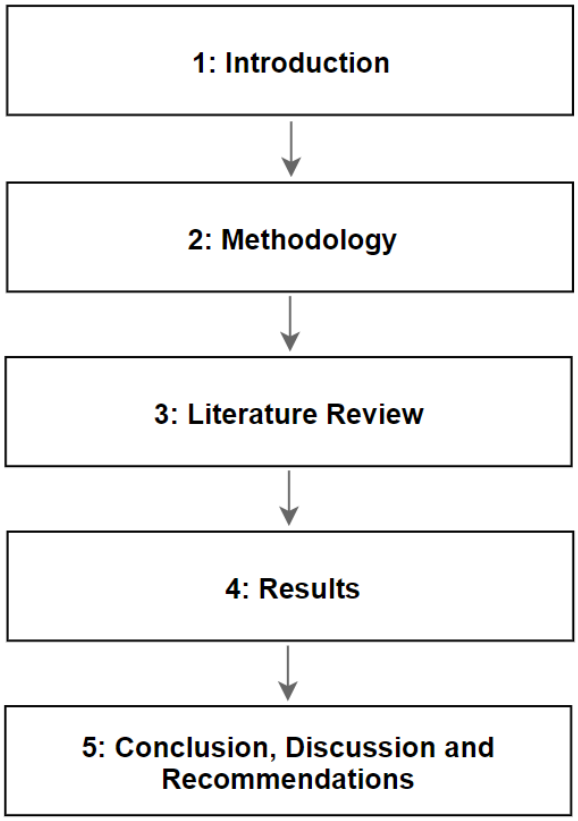


Figure 1.3: Research flow diagram

2

Methodology

This Chapter commences with an explanation of the research approach of this study. First, Section 2.1 gives an overview of the different methods used in this study. Second, Section 2.2 provide a more detailed explanation of the data collection methods. Third, the data analysis method is described in Section 2.3.

2.1. Research Approach

In this research, quantitative and qualitative research was conducted to answer the question of what the effect of a low minimum parking requirement in combination with carsharing have on car ownership and the use of carsharing of residents. An overview of the different methods used can be seen in Figure 2.1. In which subsection the method is explained is shown in Figure 2.1, each research tasks is presented in a box and described separately.

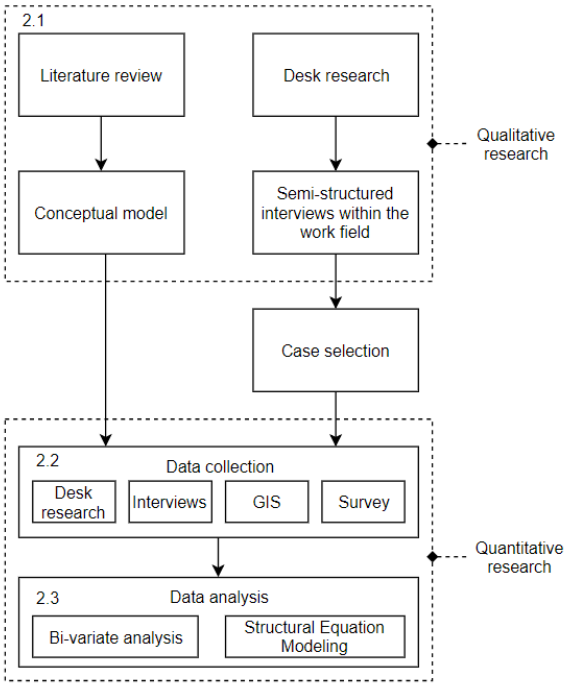


Figure 2.1: Methodology

2.1.1. Literature review

A literature review is performed for three reasons (Hart, 1998). First, to get familiar with carsharing and parking requirement, besides to conclude which research needs to be filled because according to the literature there is known little or nothing. Second, to find the factors that influence carsharing and car ownership. With this information, a conceptual model is made of the different effects that are found. Third, the literature review is performed to assess existing literature about the effects of carsharing and parking requirement on car ownership and the use of carsharing. The literature is used to have preliminary knowledge for the interviews within the work field. So, the theory is used to conduct the interview guidance.

The literature is found through online databases. The citations and metrics of controlled databases (Scopus, Science Direct) can be unreliable. Therefore, uncontrolled databases such as Google Scholar is used. More research is available on the latter, compared to the controlled databases (Halevi et al., 2017). To find literature on the databases, the main keywords that are used are 'carsharing', 'dedicated carsharing', 'parking requirement', 'car ownership', 'parking standards', and 'residential development'. The 'and' and 'not' operators were used in the search, and these two restrict the result of a search. The 'or' operator is also used and increases the results. Besides, the snowball technique is used for searching literature. This means that it follows the references from bibliographies from found sources (Ridley, 2012). In addition, literature was found by viewing at the work of specific researchers. An overview of research can be found at their profile page on Scholar with the number of citations. For example, the work of Donald Shoup is analysed, who is a research professor of urban planning and who has done a lot of research into parking.

2.1.2. Conceptual model

Literature review shows the factors that influence carsharing and car ownership. In addition, literature that indicates that relationships between factors are identified. These combined form the basis of the conceptual model. The conceptual model is the visual representation of the expected cause-effect relationship. The model shows which relationships are expected between variables and how they relate to each other. The dependent variables in this research are carsharing and car ownership, since we want to know how these changed due to parking requirement and offering car sharing. The conceptual is presented in Chapter 3, together with its underlying hypotheses. A simplified conceptual model could be used to quantify the relationships with the collected data.

2.1.3. Desk research

To test the conceptual model, first case studies with dedicated carsharing and low parking requirement at residential buildings in the Netherlands were searched. Desk research is used to find these buildings. Second, data regarding cases are collected through desk research. Desk research, as a method of data collection, is explained in Section 2.2.

2.1.4. Semi-structured interviews within the work field

Among the found buildings in the desk research, interviews were held with founders of carsharing organisations, policy advisers of municipalities concerning parking and (sustainable) mobility, and project developers. The interviews were semi-structured. The interviews were used as qualitative research, focuses on their goals and experiences. Additionally, to find more possible case studies and to validate the data from the cases that came out the desk research.

For all residential buildings with a shared car that were found during desk research, some more specific information was asked. For example, since when the building existed, and what the parking supply was. Based on this, four remaining apartments were selected for further investigation. For each case, I have spoken with three organisations, namely carsharing provider, project developer, and municipality. A list of the 12 participants of the names, organisation, and position are presented in Appendix D. A summary of all transcripts was made, and all participants were asked to verify the document, all reviews can be found in Appendix G. The advantage of an interview is that it is possible to keep asking questions so that more underlying ideas of parties could be found. A disadvantage is that there is a lower validity. Analysing the interviews is conducted by tagging sections of text with specific topics. In this way, the various responses of the participants can be compared by filtering on a specific topic (Baarda, 2014). The performed analysis are presented in Appendix H.

2.1.5. Case selection

For this research, it was needed to choose cases because this research is about a specific target group. Namely, people who live in a building with carsharing and have a particular parking policy. As previously discussed, specific buildings have been selected. Here, a more detailed explanation of the case selection is explained. Because cases during the interview were not always suitable, and because the interviewees came up with better examples, the case selection for the quantitative part took place. First, residential buildings with dedicated carsharing should be found in the Netherlands. At the moment, many of these innovative projects are under construction and do not yet exist. Seven buildings containing dedicated carsharing were identified. The case studies are selected based on the following criteria:

- The building has a lower parking requirement than 1.
- The project has shared cars on their property.
- All residents that live in the building are not allowed to get an on-street parking permit from the municipality.
- The buildings are located in one of the major cities in the Netherlands, in the inner centre.
- The houses of the project must be occupied for at least three months.
- The buildings do not consist of student accommodation only.

It is decided to select as many cases as possible so that the differences between cases can be analysed. For example, the neighbourhood in which a case is located can affect car ownership. The survey design is discussed in more detail in Section 2.2. After discussions within the work field, it turned out that two cases had socially sensitive issues. One because the shared car was never actually used, and they did not want this information became public. Another project did not want their residents to be inconvenienced with a survey. They preferred to do their research and did not want to cooperate. Therefore these two cases could not be included in this study. Based on the criteria above, four cases were selected to use for further analysis. Also, for every building, a control site was identified. To compare the cases with a low parking requirement and carsharing, control cases were needed since there are no known effects of cases without these additions. Moreover, as described in the literature review, the local context influences the effects. Control cases are chosen close to the selected, so the collected data have the same built environment factors. In total, eight cases are analysed. The control sites are chosen based on the following criteria:

- All residents that live in the building are not allowed to get an on-street parking permit from the municipality.
- The buildings are located in the same defined area of the municipality as the main site, with this the parking policies are the same.

It was initially decided that the control case should also have a low parking standard as a criterion. However, it turned out that these cases did not (yet) exist, or could not be found. Besides, residents of a project were nevertheless able to obtain a parking permit. The characteristics of the cases are explained in Chapter 4. In Table 2.1, an overview of the projects included in this research is presented. The cases that did not meet the criteria are indicated with 'diff'.

Table 2.1: Overview of control and main sites

City	Building	Selection	Housing
Rotterdam	Het Timmerhuis	Diff	84
Rotterdam	De Hofdame	Control	231
Utrecht	Museo	Main	58
Utrecht	Hollandse Toren	Control	36
Utrecht	Neudeflat	Diff	88
Utrecht	Vredenburgplein	Control	36
Utrecht	Oudenoord	Main	70
Utrecht	Korenschoofstraat	Control	158

The population analysed in this study, is described in Section 2.2. The chosen sites have some similarities and

differences, which makes the analysis more difficult. There are differences in the number of parking spaces, in the number of sharing cars, and in the policy rules. At all sites, it expected that people's behaviour (in car ownership and carsharing use) influenced by the built environment factors and the residential location, which make the sites suitable for research.

2.2. Data Collection

To analyse the conceptual model constructed and its underlying hypotheses, data is needed. To collect the data of the factors described in the conceptual model several methods are used. The factors included in the conceptual model were found during the literature review and presented in Table 2.2. Desk research was used to collect built environment data. There are different sources applied for desk research. Statistical data from Statistics Netherlands (CBS) is used for information about the general population in the cities (KpVV CROW, 2017a;b;c;d;e). Public information is used to find information about the parking requirements for the different cities. Reports and GIS (Geographical Information System) help to find more information about the housing unit characteristics, neighbourhood characteristics, and local land use density. Which source used for which factors is presented in Table 2.2. The disadvantage of desk research is that not always all data is available that is needed. Also, the data that is collected may be unreliable. Furthermore, it may be unclear how certain data, results and conclusions reached. Therefore, conclusions must be drawn tentatively from these sources. Besides the built environment factors, the data of socio-demographic and the dependent variables must be collected. The latter is collected by surveying the residents. Hereafter, the survey design is widely explained. First, general information about the survey is given. Second, the number of respondents that are needed is determined. Third, the presentation of the survey is explained. Last, an explanation of the pilot survey is held.

2.2.1. Survey with residents

Based on the conceptual model and the literature, the survey was drawn up. Many factors can determine residents' choices in car ownership and use of carsharing. Therefore, it was decided to collect the data of factors throughout a survey. In this way, the data can be linked to specific sites. Factors not derived from desk research or interviews are included in the survey. An overview of the factors that are determined by the survey is presented in Table 2.2. The survey consists of 25 closed-ended questions and five open questions. Studies (Burchell & Marsh, 1992; Memarian et al., 2012) have shown that the number of respondents decreases as the number of questions increases. Therefore, it was decided to make as many closed-ended questions as possible, so that it is easier and quicker for the respondent to complete the survey. A wider explanation of the survey design can be found in Section 2.2. An advantage of surveys is that predetermined options can be chosen, and the results can be analysed well. A disadvantage is that the answer options of respondents are limited and therefore in this research, there may be missing information.

2.2.2. Determining number of respondents

A method to determine the desired number of respondents is needed. Therefore, it must be known what the population is that will be described in research. Therefore, first, it is explained which population is investigated in this study. Second, a calculation of the desired sample size is presented.

Since this study focuses on people living in residential buildings with a low parking requirement and shared cars, the population are residents that live in these apartments in the Netherlands. Besides, the buildings chosen for this analysis are unique. The rent is between €1000 and €2600 exclusive per month. With the information of a research 'ability to pay' in the rental sector, that is based on gross household income (Eskinasi et al., 2017); it can be concluded that people with a high income are most likely living in these apartments. However, student accommodation with low parking requirement and carsharing were found during this study. Student accommodations have a different target group and do therefore not belong to the population in this study.

Initially thought four cases in the Netherlands met the criteria described in Section 2.1.5. However, concluded during this research, only two residential buildings met the criteria of a low parking requirement and a carsharing service in the Netherlands. However, as described earlier, many of the buildings described are under construction. People that are going to live in these buildings, and people that want to live in these kinds of buildings are also seen as the population. It is hard to determine the population for this research. As mentioned before, it is for practical reasons not doable to acquire large data sets (n>385) for multiple locations separately. Within the described population, two areas are selected. For the number of households

Table 2.2: Overview of factors included in the research with the data collection method

Category	Factor	Method
Socio-demographic	Age	Survey
	Gender	Survey
	Income	Survey
	Household type	Survey
	Employment status	Survey
	Educational level	Survey
	Drivers' license	Survey
Car ownership	Car ownership	Survey
Change of car ownership & Use of carsharing	Change of car ownership	Survey
	Reason to dispose the car	Survey
	Car ownership before relocation	Survey
	Car ownership of lease cars before relocation	Survey
	Car ownership after relocation	Survey
	Car ownership of lease cars after	Survey
	Frequency of use of carsharing before relocation	Survey
	Frequency of use of carsharing after relocation	Survey
	Membership of carsharing organisation before relocation	Survey
	Membership of carsharing organisation after relocation	Survey
Residential (re)location	Surface of current home	Survey
	Reason of relocation	Survey
	Location of last home	Survey
	Location of current home	Survey
	Policy parking of last home	Survey
	Policy parking of current home	Desk r. & interview
	Number of parking spaces	Desk r. & interview
	Parking costs at building	Desk r. & interview
	Number of shared cars at building	Desk r. & interview
	Number of housing	Desk r. & interview
	Parking requirement	Desk r. & interview
Built Environment	Population density	GIS
	Distance to hospital	GIS
	Distance to ...	GIS
	Residential land use density	GIS
	Retail and hospitality land use density	GIS
	Business land use density	GIS
	Shared cars at building [#/housing unit]	GIS
	Shared cars MyWheels	GIS
	Shared cars Greenwheels [#]	GIS
	Shared cars around Witkar [#]	GIS
	Total shared cars [#/hectare]	GIS

according to the two cases, a calculation has been made for the required sample size, which can be found in Appendix I.4. A minimum of 32 respondents is needed to describe the selected cases, it is unknown how many respondents are needed for the control cases.

Furthermore, with multiple regression analysis authors advise to include at least 10 to 20 times as many respondents as there are variables (Inc, 2018). Norm, as mentioned earlier, must be taken into account when determining the number of factors and remembered when concluding.

2.2.3. Presentation of survey

As mentioned before, the questionnaire should not be too long (Burchell & Marsh, 1992; Memarian et al., 2012). For this, it is chosen only to ask the most relevant questions and limit the number of open items. Demographic questions are asked at the end of the questionnaire because it appears that there is a higher chance that people complete the survey. All questions are presented as simple as possible so that everyone should understand the survey. Items are automatically skipped when not applicable. The questions in the survey are based on examples seen in research.

It is chosen to do an online survey, so that is easy for the respondent to answer. The tool to send the questionnaire and process the responses is 'Collector'. During the interviews within the work field, it was asked whether collaboration for this research was possible to see whether there was a possibility to sent out the survey among the residents. For privacy reasons, it was not possible. Since there were no e-mail addresses available of the respondents, it has been chosen to put a note in the mailbox with an URL-link and a QR code. The survey flyer was sent to 761 units; an overview of the survey sites is presented in Table 2.1. A part of the sample could not be reached, because the entrance to the letterbox could only be reached with a key. The questionnaire can be found in Appendix F. After a week, the survey was also placed on the Residents' Facebook groups. So that people received a reminder and were also approached differently. This way of approaching could cause more people to complete the survey.

2.2.4. Pilot survey

As a preparation, the survey is tested among friends and colleagues of the author. In this way, the questions can be tried out, and potential practical issues addressed (Othman et al., 2018). Twelve respondents test the survey. The pilot survey gave an insight into how long it took to complete it, and whether all the questions were interpreted correctly and clear for the pilots. With the feedback, some items were adjusted. Lastly, the committee of this research has given final advice. After the pilots, the answers were removed from the data set. For the final presentation of the survey, see Appendix F.

2.3. Data Analysis

To analyse the effects described in the conceptual model, data analysis is performed. In this Section, the methodology for analysing the collected data is discussed. First, in Section 2.3.1 it is defined why Structural Equation Modeling is applied. Second, it is explained why statistical analysis is needed in Section 2.3.2. Lastly, an explanation of Structural Equation Modeling will be held in Section 2.3.3, the criteria that must be met and how the model fit can be measured.

2.3.1. Suitable for study

To answer the research question Structural Equation Modeling (SEM) is used. SEM is a method that is guided by the use of a conceptual model. The main advantages of SEM are that it

- can distinguish between total, direct and indirect effects in modelling or intermediary variables
- is capable of incorporating non-observed variables with multiple indicators
- can include correction for measurement errors in all observed variables

Since the model presented in Chapter 3 showed that there are multiple factors with relationships with other factors, the choice for SEM was made. In the conceptual model, two dependent variables are described by several independent variables. However, with using regression analysis, the effect of one independent variable through another independent variable on a dependent variable cannot be measured. Besides, the independent variable can have a mutual effect on the dependent variable that also cannot be measured with regression analysis. See Figure 2.2. In SEM, in addition to the direct influence of factors, these final direct influence of factors is also taken into account. This fact is beneficial in order to answer the research question and has better insights into the complexity of the conceptual model. Factor analysis is applied in parallel with the use of SEM. Confirmatory Factor Analysis is a part of SEM where entire concepts can be determined

based on the factors discussed. Therefore, these two analyses will be explained hereafter. AMOS and SPSS software programs were used for the application of SEM and factor analysis, respectively.

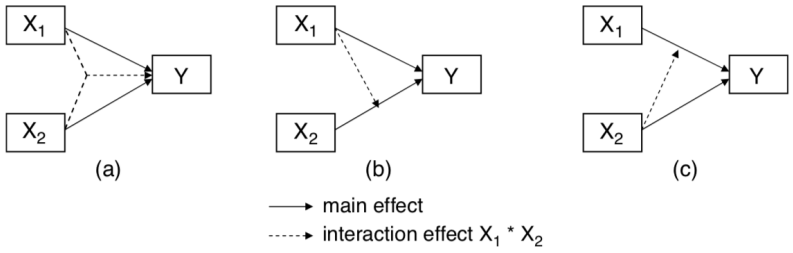


Figure 2.2: Interaction effect and its meaning (Van Acker et al., 2007)

2.3.2. Statistical Analysis

First, descriptive and basic statistical analysis is performed. This is needed to know what kind of data is collected. Second, to decide which data will be included in the final model. Tests are performed to see whether there is a relation between the variables. Furthermore, some data have to be re-categorised and reversed. To find relations between the variables bi-variate analysis was performed. Different correlation tests can be performed, which test will be used is dependent on the measurement scale. The difference between tests is explained in Appendix K. In Appendix J, the collected data and their measurement levels are shown.

2.3.3. Structural Equation Model

A Structural Equation Model consists of a measurement model and a structural model. For both, properties must be fulfilled before the results of the effects can be considered trustworthy. An example of an SEM model can be seen in Figure 2.3.

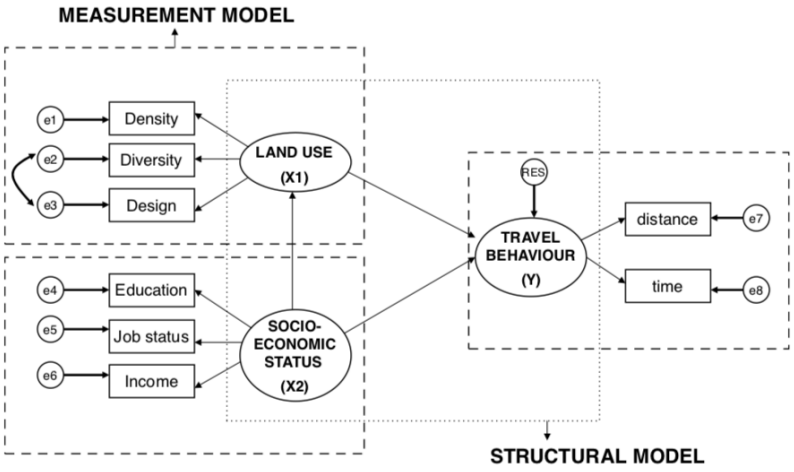


Figure 2.3: An example of a SEM with latent variable (Van Acker et al., 2007)

Factor analysis is used to analyse the measurement model. The factors described in the conceptual model cannot be described directly. Therefore, each factor is determined based on multiple indicators. Describing the factor is done by applying factor analysis with using the software package SPSS. Within the factor analysis, it is examined whether indicators deliver a significant amount. The conditions for factor analysis are described in detail in Appendix L. In Table 2.3 the criteria for factor analysis are represented. The factor analysis can be used exploratory or confirmative. In this study, the conceptual model is based on the literature review. For this, a Confirmative Factor Analysis (CFA) is performed to see whether the observed variables correctly measure the latent variable (Hair et al., 2014). In Figure 2.4 the construction of a factor model is shown. In this example, three measured indicators (X) describe the latent variable. An error (e) term shows

the unique variance of an indicator, which is unobserved. As can be seen, the factor model of Figure 2.4 is one of the measurement models in Figure 2.3.

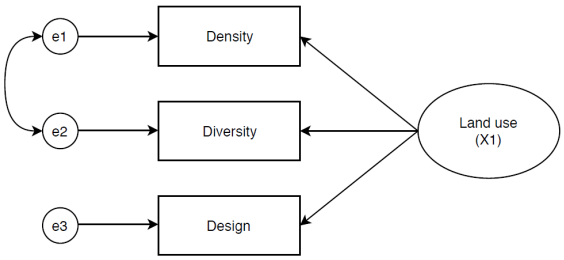


Figure 2.4: Factor model

Table 2.3: Criteria for factor analysis (Hair et al., 2014)

Indicator	**Threshold**
Measure of Sampling Adequacy	≥ 0.50
Bartlett's Test of Sphericity	< 0.05
Communalities	> 0.25
Factor loadings	> 0.50
Cronbach's Alpha	> 0.70

The constructs must fulfil the properties of normality, unidimensionality, convergence validity, reliability and discriminant validity. The constructed CFA will be analysed in the software package AMOS. In Table 2.4 can be seen how these properties can be established. Unidimensionality refers to if the constructs only load on one factor. Convergence validity indicates whether the variables within the construct correlate well with each other, and the factor is explained well by the observed variables. Discriminant variables indicate that the variables within the construct correlate more strongly with each other than outside (Hair et al., 2014).

To estimate the model parameters of the CFA, the maximum likelihood function is used. This function is mostly used in SEM, and therefore chosen. However, this function requires a normal multivariate distribution of variables. To determine the model fit of the CFA, the thresholds of Table 2.5 are used.

Table 2.4: Criteria for validity and reliability with threshold (Hair et al., 2014)

Criteria	**Indicator**	**Threshold**
Normality	Kurtosis	<-2, >2
Unidimensionality	KMO	>0.5
Convergence validity	Average Variance Extracted (AVE)	> 0.5
Reliability	Composite Reliability (CR)	< 0.7
Discriminant validity	Maximum Shared Variance & Average Variance Extracted	MSV < AVE

The conceptual model will conduct for the structural model. The structural model, combined with the measurement model an SEM model can be constructed in AMOS. In AMOS, it is possible to analyse all the effects of the measured variables. However, the model can be highly complex. Sum scores can be used to make the model less complex. With factor scores, each score can differ in their weights. However, the generalisation of the results may be more challenging (Hair et al., 2014). Before the results of an SEM model can be interpreted, the model fit has to be determined. The criteria and the thresholds were presented in Table 2.4. When understanding the criteria, it will be better to compare models. Therefore, the different criteria are explained hereafter.

Model fit

First, the model fit is assessed with the Chi-square (χ^2) and the p-value of the model itself. The χ^2 is calculated by the following formula (Molin, 2018):

Table 2.5: Properties with threshold (Hair et al., 2014)

Indicator	**Threshold**
χ^2	As low as possible
p-value	> 0.05
df	-
χ^2/df	<2
CFI	>0.9
RMSEA	<0.1
PClose	>0.05
PCFI	>0.8

$$\chi^2 = (N-1)|(S-\sum(\delta))|$$

Where:

χ^2	=	Chi-squared distribution based on degrees of freedom
N	=	Number of cases
S	=	Observed covariance matrix
$\sum(\delta)$	=	The observed covaraince matrix from a model

This null hypothesis is that the model fits the data when model p > .05. A low χ indicate that the model fit is higher. However, it must be noted that a lower number of cases (N) increase the model fit. Because this test is very dependent on the sample size, other indicators are also used to determine the model fit (Lance & Vandenberg, 2009; Schermelleh-Engel et al., 2003). Moreover, the model fit is also related to the number of variables included in the model. For these reasons, the thresholds must only be seen as a guideline (Hu & Bentler, 1999).

- χ^2/df: Chi-square value assessed by the
- CFI compares the χ^2 of the model with the chi^2 of the null model, it is taking the sample size into account.
- RMSEA (Root mean squared error of approximation) determines the model fit to the populations' covariance matrix, therefore it is penalising the complexity of the model.
- PClose determines the probability that the model is close to fitting, the p-value is testing the null hypothesis that RMSEA is no greater than 0.05.
- PCFI is the result of applying the parsimony adjustment to the CFI.

Besides the indicators of Table 2.5, modification indices can be used to improve the model fit. These indices indicate whether there are possible relationships between two variables. It is used in this study that MI greater than four would significantly improve the model fit. However, only relationships should be added that are theoretical or theoretically logical (Hermida, 2015).

3

Literature Review

This Chapter presents a review of the literature that addresses the effects of carsharing and parking requirement. First, in Section 3.1, an introduction to carsharing is provided and in Section 3.2 to parking requirements. Then, in Section 3.3 literature of carsharing in combination with parking requirements is presented. The purpose of these three sections is to identify the scientific gaps. The scientific gaps are described at the end of each section. Section 3.4 presents factors that influence car ownership, besides Section 3.5 presents factors that influence carsharing. Then, in Section 3.6 the relationships between the factors found in the previous sections are discussed. Lastly, a conceptual model for this research is conducted and discussed in Section 3.7.

3.1. An Introduction to Carsharing

As the aim of this study is to research the effects of carsharing and parking requirements on travel behaviour. It is important first to investigate the existing knowledge about carsharing and parking requirements. In this literature review, both scientific as grey literature is used. It must be taken into account that grey literature has a lower status. Although, the grey literature provides valuable information for the Dutch cases.

3.1.1. Existing knowledge about carsharing

Several studies have looked at the impact of carsharing, Shaheen & Cohen (2012) categorised the impacts as *environmental, land use, social effects, and transportation*. Research indicates that when people switch to shared cars, they will drive fewer kilometres (Nijland & van Meerkerk, 2017). Fewer car kilometres has a positive effect on *environmental and transportation impacts*. Although, in the research respondents who indicated that they had experienced a major life event during the period of car sharing were initially not included in the analysis of Nijland & van Meerkerk (2017). After all, such events are often a reason to reconsider the mobility behaviour. Excluding respondents that experienced a major life event also resulted in the number of respondents falling from 363 to 165. Therefore there is no certainty about the causality. Furthermore, in the research of Nijland & van Meerkerk (2017), there were no control groups used.

Besides the effect of carsharing on the kilometres driven, research is done to find the effect on car ownership. According to Momo (2009), a shared car replaces four to eight private cars, which is a total of 36 to 84 square meters in space. With this information, there is a rough estimation made of a total savings of 120,000 square meters in the Netherlands. Although, studies in the U.S. and Canada found that 6 to 23 cars were replaced by carsharing. Moreover, other European studies found a number between 4 and 10 (Lane, 2005). Shaheen & Cohen (2007) concluded that location-specific variations may result in different impacts. Research has shown that on average 92% of the time a private car is parked (MacArthur et al., 2015). Therefore, when more people use shared cars, and the number of private cars will decrease, less number of parking places will be needed. However, it is unknown how many private cars will be replaced by providing one shared car in the Netherlands.

Researchers have inconsistent outcomes about the impacts of carsharing. Contrary to what is stated above (Nijland & van Meerkerk, 2017), Brockmeyer & Weigele (2014) concluded that car use might increase. The research in Berlin found that free-floating shared cars are at the expense of walking, cycling, and public transport (Brockmeyer & Weigele, 2014). This will mean that it might harm *environmental and transportation*

impacts. The research of Brockmeyer & Weigele (2014) also showed that shared cars are almost as inefficient and occupy nearly as much space as cars in private ownership. The free-floating shared cars run around 62 minutes per day and therefore take up a parking space for almost 23 hours a day. A private vehicle is used in the city for 30 to 45 minutes.

Besides the environmental, transportation and land use effects, there are also *social effects*. An earlier study (Vasconcelos et al., 2017) had as a goal to understand if carsharing systems have a positive net annual profit for society as a whole. Vasconcelos et al. (2017) compared two different carsharing systems to analyse the financial and environmental costs and benefits with the use of a CBA (cost-benefit analysis). The city of Lisbon was used as a case study, and the two different systems were a one-way carsharing station-based system with and without vehicle relocation. Only diesel vehicles promised an annual net profit for operators and only positive environmental impacts could be reached by electric carsharing systems.

Besides the researches of Lane (2005); Momo (2009); Shaheen & Cohen (2012), some more recent researchers have reported that carsharing reduce car ownership, also in comparison with the general reduction of car ownership of non-members (Cervero et al., 2007; Firnkorn & Müller, 2011; Giesel & Nobis, 2016; Klincevicius et al., 2014; Le Vine & Polad, 2017; Martin et al., 2010). The results of these studies, however, differ considerably and are difficult to compare with each other because they have been carried out in different cities and countries and under different circumstances. For an overview, see Table 3.1. In the research of Le Vine & Polad (2017) no information about the home addresses of the survey respondents were included, so built environment characteristics are not included in the study. Which is a limitation. None of these studies include transport factors, socio-demographic factors, built environment factors, and housing location factors altogether. With the idea that more members will get rid of private cars, the impact of car sharing will be higher in the future, especially on travel behaviour and mode choice according to Cervero (2003).

Table 3.1: Literature review; the effect of carsharing on car ownership

Author, year	**Method**	**Data**	**Objective**	**Conclusion / result**
Cervero (2003) Cervero et al. (2007)	Best-fitting multiple regression model	San Fransisco, California in 2001, 2003 and 2005	Examines the longer-term impacts of carshare program on travel demand and car ownership	Membership was associated with reduced car ownership
Firnkorn & Müller (2011)	A forecast based on a quantitative survey	Ulm, Germany in 2009	Discussion of the environmental effects of a free-floating car-sharing system	Free-floating fleets could reduce car ownership in cities
Giesel & Nobis (2016)	Descriptive analyses and two binary logistic regressions	Berlin, Germany in 2015	Examines to what extent free-floating carsharing leads to a reduction of car ownership compared to station-based	Station-based and free-floating carsharing leads to a reduction of private cars but to different degrees
Klincevicius et al. (2014)	Multiple regression models	Montreal, Quebec, Canada in 2008	A first assessment of the reduction of car ownership in an area served by station-based carsharing service	Carsharing may have an influence on the number of cars per household
Le Vine & Polad (2017)	Descriptive statistics and binary logistic regression	London, England in 2015	Establish the early-stage impact of free-floating carsharing on private car ownership	Users indicated that they decided not to buy a car, disposed a car or will sell a private car.
Martin et al. (2010)	A before-and-after analytical design	North American in 2008	Impact of carsharing on household vehicle holdings	Carsharing members reduce their vehicle holding, despite that 60% of all households joining carsharing are carless

3.1.2. Motivation for carsharing

In previous research, the characteristics of car sharers are indicated (Jorritsma et al., 2015). When comparing the car sharers with the total population, the 18- till 49-years-olds make a relatively large use. Besides, car sharers are mostly young singles and households with young children. Two-thirds of the carsharing users have at least completed higher education (HBO or WO degree). Last, most car sharers live in the very strongly urban areas, more than 40 percent. Compared with the total population, 15 percent is living in very strongly urban areas. These findings relate to Dutch users, research in other European and North American countries also find most car sharers are concentrated in urban areas (Burkhardt & Millard-Ball, 2006; Cervero, 2003; Shaheen & Rodier, 2015).

The trip purpose according to the research of TNS NIPO (2014) is mainly to visit friends and family. Other objects that frequently mentioned are shopping, transporting heavy items, recreational motifs, and business trips. Burkhardt & Millard-Ball (2006) concluded the same, most carsharing trips had as a purpose recreation, social tours, other shopping, and grocery shopping. Dieten (2015) identified that the preferences for carsharing systems are the lowest possible running cost (0.3 euro per kilometer) and a limited walking distance to

the car (maximum 5 minutes). For every purpose of the trip, it is preferred not to return the vehicle to a specific place. Also, a reserved parking space is essential for people, and people would rather take an electric car (Dieten, 2015).

3.1.3. Conclusion: existing knowledge about carsharing

To conclude, the literature found has shown that carsharing may influence the number of cars per household. However, the outcomes differ. Moreover, in the research of Martin et al. (2010) 60% of the households joining carsharing are carless. It could, therefore, be that people without a car are more attracted to a residential building with a shared car. However, this study only researches people with membership. In addition, it appears that members are often highly educated, live in highly urban areas, are young singles or are households with young children. It has not been investigated whether car ownership is lower among this group. That is why this thesis looks at both households with a membership, and households without. So that it can be viewed whether there is a difference between these two groups in car ownership. In addition, it appeared that most studies only analysed direct relationships, while it is known that several factors influence travel behaviour. The parking requirement is not included in previous studies. Therefore, it is interesting to know which factors influence car ownership, to see what the real effect of shared cars is on car ownership.

3.2. An Introduction to Parking Requirements

As the aim of this study is to research the effects of carsharing and parking requirements on car ownership and carsharing use. In addition to the introduction of carsharing, literature of parking regulations is gained. In this section, the parking regulations in general, the parking requirements and the effects of parking requirements are discussed.

3.2.1. Parking regulations

According to Gragera & Albalate (2016), parking regulation is seen as an excellent option to encourage the modal shift to tackle congestion and pollution in metropolitan areas. Research carried out by Liao et al. (2018) indicated that 40% might be willing to use carsharing and replace some of their private car trips. Even 20% are likely to renew their private car when carsharing systems become available. With this information, Liao et al. (2018) said that parking spaces and fees could affect the use of carsharing. In the research, they said that there is a doubt about the increase in using shared cars. They stated that, only when parking regulations and vehicles will be more expensive, people will change to shared cars. However, this is an expectation and not researched in this study.

Previous studies (Dieten, 2015; Liao et al., 2018) have shown that people prefer a carsharing system that includes reserved parking spaces for carsharing users. As it is easier to recognize the car and the parking space is always available. However, studies about the relationship between carsharing and parking are scarce (Millard-Ball et al., 2006; Shaheen et al., 2010). Research carried out by Millard-Ball et al. (2006) indicated that a more comprehensive policy framework is needed for carsharing to discourage car ownership and use, for the maximum impacts to be realised.

An earlier study (Shaheen & Cohen, 2007) already expected that carsharing becomes integrated with urban transport and land use strategies, with the support of parking policies. In the research a global overview with carsharing parking policies is conducted, 40% of the responding nations of their survey appeared to have access to dedicated carsharing parking zones. Experts of different countries indicated that supportive parking policies are an essential opportunity for carsharing (Shaheen & Cohen, 2007); however, in this study, the effect of the various parking policies is not researched. Although many studies concluded that parking regulations would affect carsharing, there is no research about this relation to the best of the author's knowledge.

3.2.2. Objectives of parking requirements

In a research (Mingardo et al., 2015) four main objectives of parking policies are distinguished:

1. To contribute to better accessibility and mobility of the urban area.
2. To contribute to a better quality of life in the city (mainly a better air quality and quality of the living environment).
3. To support the local economy.
4. To raise municipal revenue.

A widely used parking policy is the parking requirement, local authorities using these standards as a min-

imum or a maximum. The minimum parking requirement is used to provide enough parking spaces. The maximum parking requirement is used to restrict the number of motorists, mostly in central areas (Mingardo et al., 2015). A common problem of urban planners is that the maximum observed parking demand will be used to determine the minimum parking requirement (Shoup, 2017). In the Dutch Parking and environmental law is established that; "municipalities can use the parking numbers of CROW (platform for transport) as a guideline for the determination of the parking need without further justification" (van Bommel & Guner, 2011). Those parking numbers are based on developments in car ownership and car use.

Donald Shoup is a research professor of urban planning and did a lot of research about off-street parking. Shoup (1997) did survey in different cities in Southern California between 1975 and 1993 about the parking requirements. He concluded that 98 percent of the cities required more parking spaces than the estimated demand. Beside in another research of Shoup (1994) is revealed that as a result of the minimum parking requirement the cost of housing rises. According to the developers, the requirement made previous densities impossible without building underground garages. The cost of development increased in this way. Building a parking space can cost for a developer around 20,000 euro (above ground) and 40,000 euro (underground). On the rent per month, it can undoubtedly cost 100 euro (Provincie Zuid-Holland, 2017). To make the project feasible, developers reduce urban density by building fewer houses. Instead, there would be more land for parking spaces.

Shoup (1999) mentioned in a research that no one knows where minimum parking requirements come from. In that research (Shoup, 1999), Shoup gives the advice to prevent parking spillover, namely: cities could price on-street parking rather than require off-street parking. The market can price parking spaces fairly and efficiently, instead of using the minimum parking requirement.

In research of BPD (2018) an inventory of parking requirement of Dutch municipalities are shown. It gives insights per district whether they make a distinction in their parking requirements for zones, living area, housing-type (land-based or stacked) and type of ownership (purchase or rent). What is remarkable is that not all municipalities make a distinction between these factors in their parking standards, and especially household size, income and degree of urbanity influence car ownership. Finally, in the research, they introduce a new way of looking at parking demand, where the average car ownership is taken as the starting point.

As already mentioned, parking requirements can increase affordability (Shoup, 1997). But according to Litman (2016) also increase economic efficiency and equity. In a parking requirement guide of CROW (2018), an overview of the possibilities that municipalities have to arrange parking spaces properly at buildings, now and in the future is given. Herein are, for example, the reasons to decrease or increase the parking requirement are summarised.

Policy consideration to decrease the parking requirement are (CROW, 2018):

- Preventing empty real estate
- Quality of public space
- Sustainability
- Parking costs, enforcement
- Affordable housing
- Stimulate walking, cycling and public transport
- Expectations of self-driving cars
- Better use of existing parking capacity

Policy consideration to increase the parking requirement are (CROW, 2018):

- Preventing parking overload
- Quality of public space
- 'Business climate'
- Hospitality visitors
- Reduce 'search traffic'
- Car accessibility
- Complaints residents and entrepreneurs
- Parking revenues

3.2.3. Conclusion: existing knowledge about parking requirements

To conclude, parking requirements are set up according to grey literature to achieve different goals, but the effects of the parking requirement are not all proved by scientific literature. In the Netherlands the parking requirements drawn up by CROW can be used as a guideline without further justification. However, research by (Shoup, 1994) has shown that 98% of California cities build too many parking spaces. A study by BPD looked at how parking standards in the Netherlands, are determined in the municipality (BPD, 2018). They concluded that various factors should be taken into account because they indicate that the difference in car ownership has changed (for example, a difference in the size of homes). After the research of BPD, municipalities adjusted their parking policies. However, no research has been conducted into the goals of the municipalities,

and whether they adopt the standards of CROW. Therefore, in this thesis, the interests, goals and experiences of relevant stakeholder groups will be analysed.

3.2.4. The effects of parking requirements

Now the goals of parking requirements are clear, an insight into the different measured effects according to research will be given. Several studies (Christiansen et al., 2017a;b; Groote et al., 2016; Guo, 2013) have looked at the impact of parking supply on car ownership (Table 3.2). Guo (2013) used a nested logit model and showed that the parking supply could determine the decision of household car ownership with the use of a case study in New York. He also concluded that a maximum off-street parking requirement could reduce the car dependency of people. For example, if it can reduce the residential parking supply. A maximum off-street parking standard could significantly reduce car dependency and mitigate the associated externalities, such as congestion and GHG emissions. However, parking requirements should also include on-street parking and driveways. The findings indicated that households use garages and driveway even for other purposes than car storage.

Table 3.2: Literature review; effect of parking requirements

Author, year	Method	Data	Objective	Conclusion / result
Christiansen et al. (2017a)	Multivariate analysis	Norwegian 2013	Investigate how parking requirements for households and home parking availability influence car ownership and car-use	Positive relationship between parking availability and car ownership.
Christiansen et al. (2017b)	Regression	Norwegian 2013, 2014	Analyse the impact of parking availability at home and at destination on car use	Limited access to parking at home also affects car use.
Groote et al. (2016)	A boundary-discontinuity design	Amsterdam 2004 - 2007	Estimate the welfare implications of these residential parking subsidies through changes in car ownership	Waiting lists for parking permits reduce household car ownership.
Guo (2013)	Nested logit model	New York 1998 & 2010 [1]	Investigate the impact of residential parking supply on private car ownership	Parking supply can significantly determine household car ownership decisions

In research about the impact of parking availability on car use, other characteristics were also analysed (Christiansen et al., 2017a). When public transport is poor and/, or the household income of people is increasing, they will be using their car more. Furthermore, the use of a vehicle decreases with a higher density of the built environment, and when the destination is closer to the city centre. The circumstances not having own dedicated parking space and the walking distance to parking reduced the chance of choosing the car. With the results of this research, the maximum parking standards are seen as an important policy implication to reduce car-use on journeys to work.

Results of Groote et al. (2016) indicated that waiting lists for parking permits reduce household car ownership. Each extra year of waiting for a parking permit reduces car ownership by two percentage points in Amsterdam. Amsterdam is the largest city in the Netherlands, and the cars per capita for the population older than 18 years is 0.37 in contrast with the average of the Netherlands which is 0.6. People may get used to having not a car, and therefore use different modes. An extremely low parking requirement can lead to the same result.

Another research of Christiansen et al. (2017b) also analysed the relationship between parking facilities and travel behaviour. The findings of this research rely on data from major cities, where public transport is relatively good. Remarkable is that car ownership is probably not associated with the number of trip frequencies. Non-car owners make the same amount of trips. Furthermore, the distance from home to the parking location has no impact on the number of trips. Although, the distance is associated with more walking and public transport trips. So, a low number of parking spaces do not have to increase adverse welfare effects.

3.2.5. Conclusion: the effects of parking requirements

To conclude, several studies (Christiansen et al., 2017a;b; Groote et al., 2016; Guo, 2013) have looked at the impact of parking supply on car ownership and found all that parking supply can determine household car ownership decisions. Moreover, other factors were also included in the research and found as important. However, the relations were only analysed by multivariate and regression analysis. Which means that only direct relations are considered, and indirect relations have not been analysed. Although many studies (Liao et al., 2018; Millard-Ball et al., 2006; Shaheen & Cohen, 2007) concluded that parking regulations would affect carsharing, there is no research about this relation to the best of the author's knowledge. However, it has been shown that the number of trips a person makes does not depend on the parking facilities (Christiansen et al.,

[1] Car ownership rate was collected in 1998 but parking supply was recorded in 2010

2017a). It is therefore unknown whether people use a shared car instead of their cars. Therefore, this research will investigate the direct and indirect relationships between parking spaces and car ownership.

3.3. Carsharing in Combination with Parking Requirements

Currently, more and more municipalities of urban areas in the Netherlands want to change their parking requirements for future residential areas. Especially, municipalities want to offer an exception to the building of the number of parking spaces for homes with a shared car. The majority of studies actually indicate the carsharing effect on car ownership, besides studies conclude the effect of parking requirement on car ownership. This section compares these two effects in the literature. The only research, to the author's knowledge, of implementing a reduction in the parking requirements for a residential building that provides dedicated carsharing was conducted in 2013 (Engel-Yan & Passmore, 2013). A study for the City of Toronto, Canada, was performed to develop a regression model of vehicle ownership and suggests that a presence of dedicated carsharing vehicles is associated with reduced vehicle ownership and parking demand. However, further work is required to define this relationship for the local context because of cultural differences. Furthermore, parking policies can differ in every municipality in the Netherlands. Besides that, this research is five years old, and because of the new developments around carsharing, this article is probably not comparable for cases in the Netherlands. Furthermore, in the research of Engel-Yan & Passmore (2013), the focus lied on vehicle ownership and parking demand, and this compared between residential buildings with and without dedicated carshare vehicles. In this thesis, a comparison between before and after a residential move to a building with dedicated carshare vehicles will be made. A better investigation of changes in travel behaviour can be made in this way. A broader look about the changes will be analysed in this research.

3.4. Factors Influencing Car Ownership

The dependent variables in this study are the change of car ownership and the use of carsharing; this could be seen in Figure 1.2. For this, different factors that may influence the change of car ownership will be identified with the use of literature in this Section. In the next Section, the same will be performed for the dependent variable 'the use of carsharing'. In Section 3.1, 3.2 and 3.3 already some factors that influence car ownership are mentioned. In this Section underlying relations between factors are discussed. Veterník & Gogola (2017) made an overview of the main factors that affect travel behaviour in general. Based on this work, a first insight into the factors that influence car ownership and car sharing use are found in the literature. A more specific classification is used for this study; the factors are categorised in Socio-demographic characteristics, Residential (re)location and Built Environment.

3.4.1. Socio-demographic factors

Travel behaviour may be influenced by personal differences; people differ in their desire and plan (Bamberg, 2006). Car ownership influences the travel behaviour of people. With owning a car, people can travel longer distances compared to modes as public transport, walking, and biking. As might be expected, car ownership has a strong relationship with the modal choice. Although, other socio-economic variables also influence car ownership. Transport research in the Netherlands suggests that socio-demographic characteristics (such as gender, age, household type, and employment status) have high importance. Only the most relevant social demographic factors will be described, in Table 3.3 the variables that will be mentioned here can be seen.

Table 3.3: Socio-demographic characteristics

Socio-demographic characteristics	Age
	Gender
	Income
	Household type
	Employment status
	Educational level
	Drivers' license

Age

It is known from the literature that age has an influence on car ownership (Dargay, 2002; Oakil et al., 2016;

Potoglou & Kanaroglou, 2008). Age also influence the family building process, research showed that this influences the car ownership (Manting, 2014). Although, most research is about car ownership in general, and not about disposing of a private car. In study of Kockelman & Kalmanje (2005) it was found that the willingness to change current driving behaviour decreased with age.

Gender
Several studies have concluded that there are differences in travel behaviour between men and women. Although, this is not always directly influenced by gender, but also due to different social roles (Gordon et al., 1989; Schwanen et al., 2001). Still, more women take care of the children, which will lead to different travel patterns (Turner & Niemeier, 1997). In other words, the difference in travel behaviour between women and men depends on the trip purpose. Besides, for a male, it is important when buying a car that they can impress others (Moutinho & Goode, 1995). Besides, where males are more likely not to change their driving behaviour, gender has a significant effect (Dogerom et al., 2018). In general, a woman is less likely to own a car, because they often have a lower income and are more likely to have no job (Toasin Oakil et al., 2018). Lastly, males and females have different attitudes toward cars (Oakil et al., 2016).

Income
According to researches, household income influences travel behaviour, when the household income is higher the probability of walking and cycling for trip purposes is lower. For example, car ownership is higher under high-income groups (Van Acker & Witlox, 2010). In research of Kockelman & Kalmanje (2005) it was found that the willingness to change current driving behaviour decreased with income.

Household type
The size of the household can describe household type, the number of adults in a household, and the number of children in a household. A household without children may use less the car to work (Dieleman et al., 2002). It is a common finding that car ownership is lower among singles than a household with children. However, this may be explained by a lower income and, or the employment status (Potoglou & Kanaroglou, 2008). Although, research shows that households with young children increase the number of cars. This might be explained because children have to be taken away to school and sports activities (Nolan, 2010). Furthermore, research of Oakil et al. (2016) found that increasing urbanization could reduce car ownership among young people in the future.

Employment status
Employment status or working status can be defined by having a job or not. Besides, student and retired can be taken along in research. Since there might be differences in employment status and car ownership. In research of Toasin Oakil et al. (2018) and Potoglou & Kanaroglou (2008), it was found that people with a job more often have a car than jobless persons. According to literature employment status often goes together with household income. Furthermore, there may be a relationship between a higher income with a larger household (Dogerom et al., 2018).

Educational level
It is likely that travel behaviour differs under high and low educated people. According to literature high educated people are more likely to move over long distances. Besides, people with a higher educational level may have a higher income. With a higher income, it is more likely due to financial reasons to buy a private car. Educational level has an indirect effect on car ownership. The attitude towards vehicle ownership changed by the level of education, due to the environmental issues (Flamm, 2009).

Drivers' license
Studies have revealed that the number of people with a driver's license in a household influences car ownership at household level (Ben-Akiva & Lerman, 1974; Ryan & HAN, 1999; Whelan, 2007).

3.4.2. Residential (re)location

Residential location choice can be separated in the location choice and in the intention to move. The location choice depends on many aspects. For example, people choose a location based on the location of their job and where friends live. Besides, people chose a location based on the neighbourhood and travel be-

haviour preferences. In a comprehensive analysis of built environment characteristics on residential household choice and car ownership levels, one of the findings was that built environment factors affect residential choice decisions (Bhat & Guo, 2007). The built environment factors are described in the following subsection. In research of Kim et al. (2005), it is found that transport-related factors, such as costs and distance, are associated with an increase in the probability of moving. Also, built environment factors will describe these factors. So personal preferences are essential for choosing the location. Besides, socio-demographic factors will influence the location. For example, the home choice depends on someone's income and household size. Socio-demographic factors are explained in the previous subsection. The residential location choice is very complex. In this section, the factors that influence the move itself and the characteristics of a residential building will be described. In addition, residential relocation may be described by self-selection, self-selection is very complex and will therefore be explained separately in Section 3.6.1.

Table 3.4: Residential (re)location factors

Residential (re)location factors	Life events
	Housing unit characteristics
	Socio-demographic characteristics
	Built Environment of the residential location

Life events

People have travel habits, in this way the travel behaviour is very stable. One of the few things that can change travel behaviour is a life event (Clark et al., 2016; Lanzendorf, 2003; Scheiner & Holz-Rau, 2007). Life events can be a residential move, other life events that mostly influence travel behaviour are, e.g. employment status changes and changes in household structure (Clark et al., 2016; Martin & Shaheen, 2011). It is self-evident that life events co-occur. In the research of Clark et al. (2014) three types of mediating factors (a statistical variable that explains the relationship between two other variables) are founded that influence the travel behaviour. Figure 3.1 shows a conceptual model. The first mediating factor is personal history; for example, the experience that people have with the use of travel modes. Secondly, the intrinsic motivations, for example, the desire to save money or improve health. The third factor is facilitating conditions that can be public transport availability. In the research of Ihrke (2014) four collapsed categories are used for reasons for a move. In Table B.1 in Appendix B can be seen which reasons are covered by family-related, job-related, housing-related and other reasons.

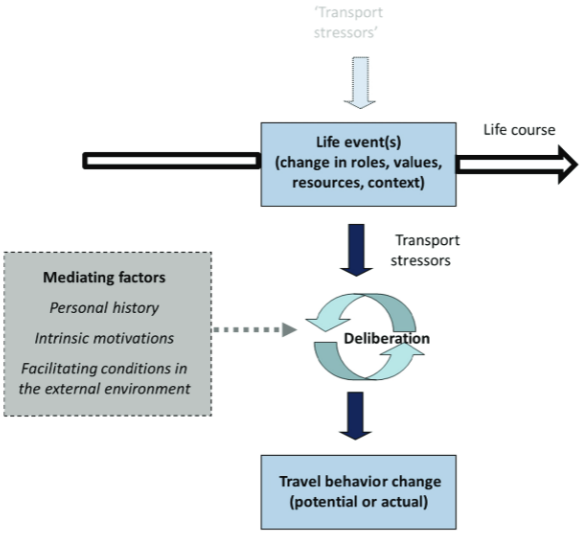


Figure 3.1: Conceptual model explaining turning points in travel behaviour (Clark et al., 2014)

Concerning car ownership, the study of Toasin et al. (2014) analyses the change of car ownership by household (life) events. A strong relationship between household events and change in car ownership is suggested in the study. In particular, the (future) events childbirth, job change and residential relocation change (in-

crease or decrease) the car ownership. These changes can be explained in the factors household type, employment status, and income.

Housing unit characteristics
The housing unit is an indicator for the choice of a location, and a housing unit can be described by type, size and standard (Scheiner & Kasper, 2003). Housing characteristics may be related with a specific lifestyle, which may result in that housing type and social-demographic factors are related. For example, the income of a household can affect the price of a house, and if people are renting or buying a house. Besides, the price of a house is often related to the surface of a house. Possibly, parking spaces can also be seen as a housing unit characteristic, since a parking space can be offered specifically for a unit. Besides, the prices of the parking spaces can also differ. However, there are no relations found in the literature between these housing unit characteristics and car ownership.

3.4.3. Built environment factors

The built environment is seen as one of the main factors that influence travel behaviour according to Veterník & Gogola (2017). In the literature built environment and travel behaviour is a wide researched relation. Suggested in several studies, built environment is correlated with car ownership (Cao & Cao, 2014; Cao et al., 2007; Potoglou & Kanaroglou, 2008; Zegras, 2010). As mentioned in the previous subsection, built environment affect residential choice decisions. Built environment also affect car ownership decisions; thereby it was concluded that policy decisions in the built environment for both decisions have to be analysed (Bhat & Guo, 2007). Although, household demographics had a greater effect on car ownership according to the research, the following built environment factors are analysed, Table 3.5.

Table 3.5: Built Environment factors

Built Environment factors	Population density
	Neighbourhood characteristics
	Number of parking spaces
	Availability of carsharing
	Policy parking

Population density
The population density can define the level of urbanisation. People might select themselves in neighbourhoods with their preferred travel mode. Self selection will be wider explored in Section 3.6.1. Studies also found, independent of self-selection influences, significant relations between the built environment and travel behaviour (Cao et al., 2009; Ewing & Cervero, 2010; Naess, 2014). More specific about car ownership, high population density at the residential location is correlated with low car ownership (Chen et al., 2008).

Neighbourhood characteristics
There are many aspects at the neighbourhood level of the built environment, for example, the accessibility to facilities, the presence, and connectivity of roads and paths, the land-use mix, the density of a street network, etc. Here, the most important in relation to car ownership will be described. In the study of Ding & Cao (2019) significant variables of built environment selection in existing car ownership studies were summarised. This study showed that, residential density and employment density are seen as the most important for analysing car ownership and use. Besides, areas can be divided into suburban and urban residential neighbourhoods, the neighbourhood characteristics between these two are mostly different. Population characteristics differ in these areas and influence travel behaviour. Other differences in these two areas are the number of schools, shops, services, bars, and restaurants (De Vos et al., 2018). The distance to the city centre from residence is essential for understanding travel behaviour in different urban contexts. A higher distance increases the odds for driving (Christiansen et al., 2017a). To conclude, neighbourhood can be measured in many ways, moreover various studies found a significant effect of the neighbourhood level on car ownership (Cao & Cao, 2014; Potoglou & Kanaroglou, 2008). Table 3.10 summarises the significant variables and their relationship to car ownership. Besides the neighbourhood characteristics of residential location, the neighbourhood characteristics of working location may also have an effect on car ownership. The level of neighbourhood-scale may also have different relations than for example regional level.

Number of parking spaces
One of the facilities near home that is associated with transportation are parking spaces, other facilities are walking and cycling trails, stores, and sports fields (de Vries et al., 2010). Furthermore, there are different parking types, and they also behave differently. Parking can, for example, differ in the location (on-street or garage), the price of the parking space, the number of parking spaces, the distance to parking space. Guo (2013) showed that parking supply could significantly determine household car ownership. Besides, Christiansen et al. (2017a;b); Groote et al. (2016) concluded also that there is a positive relationship between the availability and car ownership.
Note: there are different forms of parking spaces, for example on-street parking and parking on private property. In this study, parking spaces on private property are seen as a housing unit characteristic and parking on-street as a built environment factor.

Availability of carsharing
As mentioned in Section 3.1, researchers have reported that carsharing reduce car ownership (Cervero et al., 2007; Firnkorn & Müller, 2011; Giesel & Nobis, 2016; Klincevicius et al., 2014; Lane, 2005; Le Vine & Polad, 2017; Martin et al., 2010; Momo, 2009; Shaheen & Cohen, 2012). Although, the results differ considerably. In these studies, the change in car ownership is mostly analysed after people joining carsharing or becoming a member. Besides, the availability of carsharing can be measured in many ways. For example, if carsharing exists or not, if the car is available during a day or how many cars are provided per housing unit are options.

Policy parking
Christiansen et al. (2017a) shows that the effect of parking requirements decreases when the distance to a city center is larger. As mentioned before, several studies showed that the parking supply could determine the household car ownership (Guo, 2013). Although, not all policymakers believe that regulations will influence car ownership. It is stated that parking supply can determine the car ownership decision, according to a study in New York. The parking supply even outperforms household income and demographic characteristics (Guo, 2013).

3.4.4. Conclusion: factors influencing car ownership
To conclude, the aforementioned socio-demographic characteristics all appear to influence travel behaviour. It also appears that the factors are often interdependent. For example, having a job has an impact on income, and therefore on having a car, which affects travel behaviour. The literature review shows that age, income, household type, employment status, education level are all related to each other and influence car ownership. In addition, the residential (re)location is also related to socio-demographic factors. Besides, personal preferences for the housing unit characteristics and the built environment play a role in choosing the location. Moreover, residential (re)location often happens simultaneously with other life events, such as changes in household structure. The event residential relocation can increase or decrease the car owner of a household (Toasin et al., 2014). Lastly, the built environment is seen as one of the main factors that influence travel behaviour. Although, household demographics had a greater effect on car ownership according to Bhat & Guo (2007). This literature study has shown that many factors influence car ownership, moreover, they are also often correlating and there are many indirect relationships. Therefore it would be useful to know how the relationships between the factors relate according to the literature.

3.5. Factors Influencing the Use of Carsharing
In the previous Section, the factors that influenced car ownership are discussed. In this Section, the factors that will influence the use of carsharing will be described in the same way. The same categories as in the previous Section will be used. A more general introduction of the categories and the influence on travel behaviour can be read in the previous subsection.

3.5.1. Socio-demographic characteristics
Distinct socio-demographic characteristics are mentioned in the literature to show personal differences, in Table 3.7 an overview of the different socio-demographics that are used by carsharing researchers is shown. In most researches, the members of carsharing services were not representative of the population in the specific area. Research carried out by Cervero (2003) indicated that it was due to the early adopters, the participants were called political greens. These findings can be interesting for this research. Here, the findings of the

socio-demographics will be explained.

Table 3.6: Socio-demographic characteristics

Socio-demographic characteristics	Age
	Gender
	Income
	Car ownership
	Household type
	Employment status
	Educational level
	Drivers' license
	Membership

Age
Research of Prillwitz & Barr (2011) defined clusters according to daily travel characteristics, 'persistent car users' are mostly middle-aged and in contrast 'consistent green travellers' are mostly young professionals. The 'consistent green travellers' walk and cycle more. Concerning carsharing, members are mostly between 25 and 35, according to Millard-Ball et al. (2006). In Table 3.7 an summary of used socio-demographic characteristics is presented, it can be seen that most studies included age in their research. Several studies have found that the 18- till 30-years old's make relatively extensive use of carsharing (Efthymiou et al., 2013; Jorritsma et al., 2015). The mean age in the study of (Cervero et al., 2007) was 39.6 years and in another research more than half of the surveyed members were in their 30s (Cervero, 2003). A specific age group, over 40 years, increased the probability of using a shared vehicle according to Cervero (2003). The age group differ in the mentioned studies, however all indicate that the average age is below 40.

Gender
In the research of Kawgan-Kagan (2015), early adopters for gender preferences were researched. Female and male car sharers have significant differences in age, income and employment status. Furthermore, it seems like women have a preference for one type of car instead of trying different models. Gender is mostly included in the research about carsharing (Table 3.3). Le Vine & Polad (2017) said that customers tend to be male. In the research of Chatterjee et al. (2013) there is also stated that more users are male, while in the research of Cervero (2003) 62% of the surveyed members were women. The focus of the studies mentioned was not specifically on gender differences.

Income
Regarding carsharing, members with a relatively high income increased the probability of using a shared car (Cervero, 2003; Cervero et al., 2007). The findings of Jorritsma et al. (2015) also concluded that most carsharing users have a higher income. While other studies found that more low to middle incomes reserve carsharing (Costain et al., 2012).

Car ownership
Car ownership is the most frequently tested variable for carsharing studies because researches want to know if carsharing leads to the reduction in car ownership. Several studies (Cervero, 2003; Lane, 2005; Liao et al., 2018; Martin & Shaheen, 2011; Steininger et al., 1996) have explored the factors that influence car ownership, especially by offering carsharing. People who sold their car were mostly women of a lower-income household (Klincevicius et al., 2014). Moreover, car ownership was found more significant than income, educational level and age. The fewer private cars available in a member's household, the more likely he or she used a shared vehicle (Cervero, 2003). However, the factors that may influence car ownership with the use of carsharing must not be forgotten. These are, e.g. the amount of car usage and the perceived need to use a car, the availability of residential parking, and negative beliefs about car use (financial cost, maintenance requirements, hassle, and environmental impact) (Chatterjee et al., 2013). More factors that may influence car ownership, were analysed in the previous section.

Household type
The influence of household type on carsharing has not been described extensively in the literature. A study

found that most carsharing members were young singles or households with young children (Jorritsma et al., 2015). The research of Cervero (2003) also found that more than a third lived alone, and almost 25% lived with other non-related adults.

Employment status
Studies on the influence of employment status on travel behaviour are scarce. Employment status is related to the variables income and educational level, therefore they may give the same findings (Van Acker & Witlox, 2010). In the research of Liao et al. (2018) employment status was included, they found that a typical carsharing user is employed.

Educational level
Educational level is related to travel behaviour, the higher the level of education the higher the commuting distances by car and public transport (Schwanen et al., 2001). The relation of education level on carsharing has not been described extensively in the literature. The literature that says something about the educational level concluded most carsharing users have higher education (Cervero, 2003; Jorritsma et al., 2015; Liao et al., 2018). Although, Jorritsma et al. (2015) found nearly two-thirds of the users of B2C-carsharing have completed higher professional education or university education, compared with almost 50 percent of peer-to-peer users.

Drivers' license
As only people with a drivers' license can be a member of carsharing services, it is self-evident that drivers' license influences the use of carsharing. In studies, it must be included that this factor will limit the comparability of the general population (Becker et al., 2017).

Membership
The same applies for the factor membership as for the factor drivers' license; it is self-evident that being a member influences the use of carsharing. However, it is not necessary for every provider to have a subscription.

Table 3.7: Summary of used socio-demographic characteristics in carsharing studies

	Gender	Age	Income	Car ownership	Household type	Employment status	Educational level	Drivers' license
Carsharing								
Cervero (2003)	x		x	x				
Cervero et al. (2007)	x	x	x					
Firnkorn & Müller (2011)	x	x	x	x				
Klincevicius et al. (2014)	x	x						
Lane (2005)		x	x	x	x			
Le Vine & Polad (2017)	x	x	x	x	x			
Liao et al. (2018)	x	x	x	x	x	x	x	
Martin & Shaheen (2011)	x	x	x				x	
Martin et al. (2010)	x	x	x	x	x			
Steininger et al. (1996)		x			x		x	
Parking requirement								
Christiansen et al. (2017b)	x	x	x	x	x		x	x
Christiansen et al. (2017a)	x	x	x				x	
Groote et al. (2016)		x	x	x	x			
Guo (2013)			x	x	x			x

3.5.2. Residential (re)location

Several studies have looked at the changes in travel behaviour as a consequence of residential relocation. Vice versa, people might choose a residential location based on their car ownership. For example, people that own a car might choose a location with good accessibilities for vehicles. On the other hand, households without a car might choose a housing location with good public transport (Scheiner & Kasper, 2003). So, relocation and housing location choice may influence travel behaviour. As described in the previous section, the residential (re)location factors that are included in this literature study are life events, housing unit characteristics, socio-demographic characteristics and built environment of the residential location. The latter two are described in the previous and next subsections. In addition, residential relocation may be described by self-selection, self-selection is very complex and will therefore be explained separately in Section 3.6.1.

Table 3.8: Residential (re)location factors

Residential (re)location factors	Life events
	Housing unit characteristics
	Socio-demographic characteristics
	Built Environment of the residential location

Life events

There are no significant relations found between life events and carsharing use according to the authors' knowledge. Furthermore, it is hard to explain if people use carsharing because of a life event or because of other reasons. Although, it is known from the literature that a life event, such as moving, often influence travel behaviour patterns (Clark et al., 2016; Lanzendorf, 2003; Scheiner & Holz-Rau, 2007).

Housing unit characteristics

In the research of Engel-Yan & Passmore (2013), building characteristics were included when analysing carsharing and car ownership at the building scale. Factors that were included: parking spaces per unit, number of bedrooms per unit, the assessed value per unit, the assessed value per square meter of gross floor area and gross floor area per unit. Only the assessed value per unit was included in the regression model; however, in this study income was not included. While income and value per unit strongly correlate according to other studies. Other literature that describes the relationship between housing unit characteristics and carsharing was not found.

3.5.3. Built Environment

As mentioned in Section 3.1 a widely used factor in the literature with regard to carsharing is the level of urbanisation. Most carsharing members live in high-density areas and using public transit frequently (Burkhardt & Millard-Ball, 2006; Cervero, 2003; Shaheen & Rodier, 2015). A factor that is used for measuring built environment is the land use mix, Millard-Ball (2005) concluded that land use mix affects the success of carsharing. In the research of Kang et al. (2016), research about finding factors that influence carsharing usage, the land use was measured by the ratio of total floor area for residential use, commercial use, business use and educational use in the district. Furthermore, the research uses for built environment factors the population density. So, built environment can be described in measured in many ways. The built environment factors that are discussed below and included in this literature study are population density, neighbourhood characteristics, number of parking spaces, availability of carsharing and policy parking.

Table 3.9: Built Environment factors

Built Environment factors	Population density
	Neighbourhood characteristics
	Number of parking spaces
	Availability of carsharing
	Policy parking

Population density

Kang et al. (2016) found that in an areas with higher proportion of young residents in their 20s and 30s the

demand of carsharing is higher. The ideal location of carsharing services is in neighbourhoods with a high residential density (Millard-Ball, 2005). Since the number of possible carsharing users will increase when the population density increases. However, the influence of population density on the use of carsharing is not extensively researched.

Neighbourhood characteristics
Carsharing demand is high in an area where a higher proportion of building floor area is used for business, according to Kang et al. (2016). Most car sharers live in the very strongly urban areas, more than 40 percent. Compared with the total population, 15 percent is living in the very strongly urban areas (Jorritsma et al., 2015). These findings relate to Dutch users, research in other European and North American countries also find that most car sharers are concentrated in urban areas (Burkhardt & Millard-Ball, 2006; Cervero, 2003; Shaheen & Rodier, 2015). As might be expected, high land-use density will lead to shorter average distances to destinations, which means people will need less motorised transport. Furthermore, Christiansen et al. (2017a) reported that these effects could be increased with parking requirements.

Number of parking spaces
In the qualitative study of Chatterjee et al. (2013), it was concluded the availability of residential parking influence the choice of being a member of a carsharing organisation. In the work of Engel-Yan & Passmore (2013), the effect of using carsharing on parking demand was researched. This relationship was therefore investigated in the other direction. The investigation showed that the demand for parking spaces went down and a lower parking requirement is therefore appropriate when offering a shared car. The indirect effect might explain this through the factor car ownership. Because when the use of carsharing increase, car ownership may decrease, which will reduce the demand for parking places.

Availability of carsharing
De Lorimier & El-Geneidy (2010) concluded that a high availability of carsharing is a positive factor for users; a low availability leads to member frustrations. People that become a member of a carsharing organisation, want to be able to use a car whenever they want. So this might mean that the size of the fleet can affect the use of carsharing. Furthermore, the availability of carsharing can be defined in different ways. Of course, the presence of carsharing has its influence on the use.

Policy parking
In the previous section, it is already stated that parking supply can determine car ownership. Policy parking is a broad concept, parking policy that support carsharing is growing (Shaheen et al., 2010). However, this study focuses on the reduction of minimum parking requirements. The only study that has analysed dedicated carshare vehicles within a residential development, concluded that carsharing is associated with reduced vehicle ownership. With this information, it was stated that carsharing supports the minimum parking requirements. However, carsharing depends on location, and details of the parking requirement are very important (Engel-Yan & Passmore, 2013). Besides, indirect effects such as car ownership and the number of parking spaces must be considered.

3.5.4. Conclusion: factors influence the use of carsharing

To conclude, studies on the influence of socio-demographic characteristics on carsharing are scarce. However, it is known from the literature that travel behaviour is dependent on socio-demographics. Moreover, during the literature review, it became clear what kind of persons the typical members are. Namely, the typical member is young, their household type is single or exists of households with young children. Besides, members are mostly highly educated, employed and have a high income.

During the literature review, it became clear that relocation and housing location choice might influence travel behaviour. However, there are no studies found that investigate the relationship between life events or housing units and carsharing use according to the authors' knowledge. In addition, self-selection may describe residential relocation and must therefore not be forgotten.

All the literature found indicates that the use of shared cars is higher in densely populated areas and the very strongly urban areas. The use of carsharing could mean a reduction in the number of parking spaces required, but the relationship has not been investigated the other way around. The relationships were investigated directly and not examined whether this can be explained away by car ownership. Therefore it would be useful to know how the relationships between the factors relate according to the literature.

3.6. Existing Conceptualisations of Travel Behaviour

In the previous sections, factors that influence car ownership and use of carsharing are analysed. It is found that many of the same factors influence these two. Although, it is not always clear in what way the relationship is, and if an indirect effect explains the relationship. This section aims to investigate how the relationships between the socio-demographic characteristics, the built environment and travel behaviour according to the literature are interrelated. First, an explanation of how self-selection can take place can be read in subsection 3.6.1. Then some models that are found in the literature that show the relationships between the built environment, socio-demographic characteristics and travel behaviour are presented in subsection 3.6.2. Next, a reflection of the relationships founds and how these can be used in this study will be discussed in subsection 3.6.3.

3.6.1. Introduction to residential self-selection

Previous studies have found a significant relationship between the built environment (BE) and travel behaviour (TB). However, this significant relation does not mean that there is a causality. Residential self-selection may disturb the association between BE and TB. An association is not necessary for a causal relation. A causal relation in scientific research requires four kinds of evidence. First, the relationship must be a statistically significant relationship (association). Second, the relationship cannot be attributed to another variable (non-spuriousness). Third, the cause precedes the effect (time precedence). Last, a logical explanation is needed as to why the claimed cause would produce the observed effect (causal mechanism) (Cao et al., 2009).

For example, a resident who lives close to a train station is more likely to use the train. However, the question arises, is this relation from the built environment to travel behaviour a true impact? Or is the effect spurious, and do people have a preference for both factors (TB and BE)? The causal relationship could also be in the other direction (from TB to BE), for example, the resident prefers public transport and therefore may choose to live in a neighbourhood close to a train station.

In Appendix B, Figure B.3 shows the plausible relationships among attitudes, BE and TB, found by (Cao et al., 2009). Since in this study BE and TB factors are included, understanding self-selection is vital for this research. Moreover, ignoring self-selection can lead to an overestimation of the impact of variables involved in models for location choice and travel behaviour (van Wee, 2009). Since relocation is a self-chosen result, this change can also come along with other variables that are not included in the model.

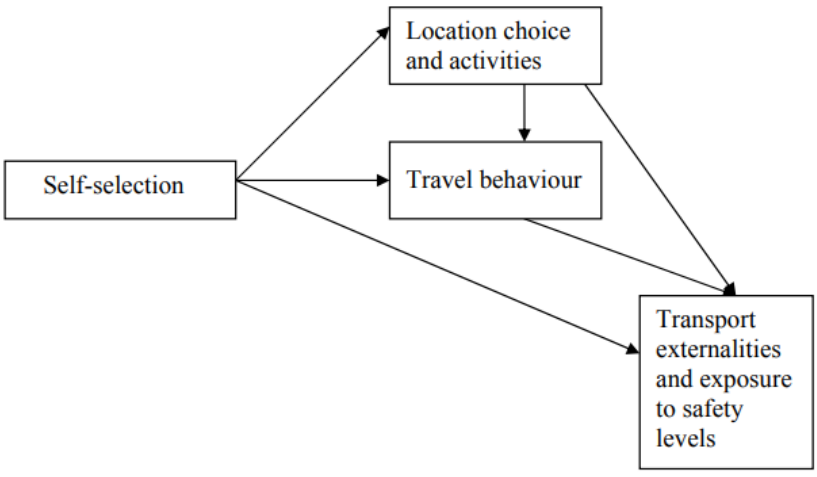


Figure 3.2: The direct and indirect impacts of self-selection (van Wee, 2009)

To visualise self-selection, in the research of van Wee (2009), an overview of the options for people to self-select them are shown in a Figure, see Figure 3.2. It shows that self-selection has a direct effect on travel behaviour and an indirect effect via location choice and activities. Also, self-selection has a direct effect on transport externalities, but also multiple indirect effects on transport externalities and exposure to safety levels. Besides, van Wee (2009) noted that some effects also could be two-directional.
The options people have in terms of self-selection according to van Wee (2009) include :

1. Locations and activities:

- Residential location
- Work location, employment characteristics and job type
- Destination choice for non-work trips

2. Travel modes, travel behavior and driving behavior:
    - Use of cars, public transport, bicycle
    - Number of trips
    - Trip distances and trip travel times
    - Car ownership level (no, one, two, more than two cars)
    - Car-type choice (e.g. SUV, sedan, station car, convertible)
    - Engine and fuel choice
    - Other trip characteristics
    - Driving behavior (style of driving, e.g. aggressively, quite)
    - Driving under the influence of alcohol and/or drugs
    - Driving in bad weather conditions
3. Exposure to safety levels and impact of externalities:
    - Noise
    - Air pollution
    - Risk
    - Safety
    - Congestion

As can be seen, many of the mentioned factors in the previous two sections are options that self-selection include. This study focuses on car ownership and residential location. As presented in Figure 3.2, self-selection has a direct and indirect effect on travel behaviour, an immediate effect on location choice and a direct and an indirect effect on transport externalities. So, it must be noted that travel behaviour and travel modes are strongly related. Furthermore, it is not possible to include all the choices and preferences of the respondents in this research. It can be concluded that it is essential to account for self-selection, "the tendency of people to choose locations based on their abilities, needs, and preferences" (Litman & Steele, 2018).

It would be not surprising if a direct effect of self-selection may occur in this research. Moreover, it would be good to know for municipalities, carsharing providers and developers what the real effects are. It would be helpful for policymakers. Besides, for developers and carsharing organisation, it would be relevant to know what kind of people moves to buildings that include less parking spaces and provide carsharing.

For example, people that do not have a car can choose for a house without parking spaces. When knowing this, land use can be better utilised in this way. As a result of this, there is more space for green spaces or children playgrounds. However, it will be challenging to separate the effects of self-selection, moving and travel behaviour.

3.6.2. Existing Conceptualisations of travel behaviour

To investigate the relationships between socio-demographic characteristics, built environment and residential relocation, theories has been analysed. Literature has constructed several models. Here, some of the models that are found in the literature will be presented. More theoretical models can be found in Appendix B.

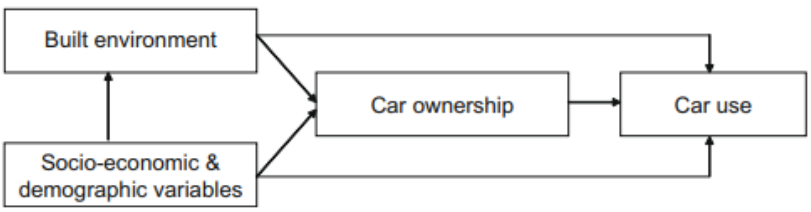


Figure 3.3: Conceptual model describing the relationships between the built environment and travel behaviour through intermediary nature of car ownership (Van Acker & Witlox, 2010)

The research of Van Acker & Witlox (2010) was describing the factor of car use. In their research, three different models describing the relationships between the built environment and travel behaviour were tested.

In Appendix B, the three different models can be found. Van Acker & Witlox (2010) confirms the intermediary nature of car ownership with the use of Structural Equation Modeling (Figure 3.3).

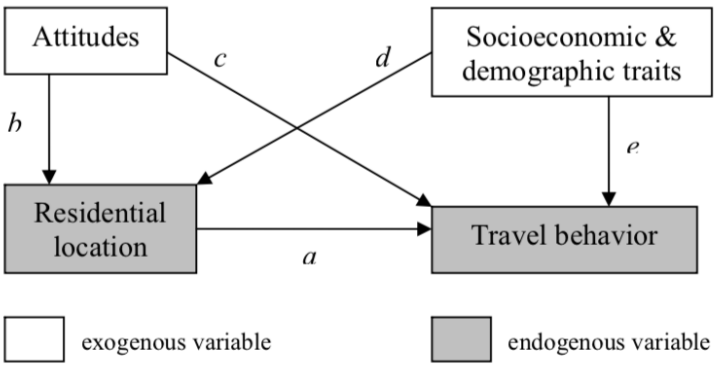


Figure 3.4: A Simple Recursive Structural Equations Model of Residential Location and Travel Behaviour (Cao et al., 2009)

However, for this study, it is needed to understand the residential location. A simple structure of Cao et al. (2009) shows that there is a relation between residential location and travel behaviour (Figure 3.4). Moreover, the residential location can be affected by attitudes and socio-economic demographics. The same applies to the factor travel behaviour. However, this simple model did not include built environment factors.

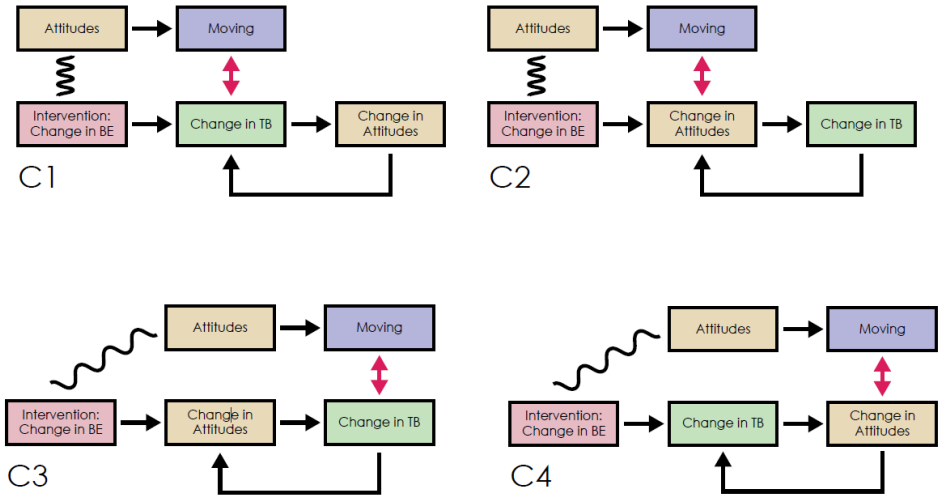


Figure 3.5: Conceptualization of the relationship between the built environment, travel behaviour, and attitudes for movers in quasi- and natural experimental studies (attitudes influence the choice to move, but new environment does not result in changes in TB or changes in attitudes) (Heinen et al., 2018)

In another study, the relationships between the built environment, travel behaviour, and attitudes, focusing on residential self-selection were analysed (Heinen et al., 2018). The aim of their paper to extend existing conceptualisations. As a result, extended conceptualisations were presented (Figure B.4). However, it was concluded that there is no single perfect conceptualisation that applies to everyone. In Figure 3.5, four options of the conceptualisations are presented. In these constructs, attitudes influence the choice to move, but a new environment does not result in changes in TB or changes in attitudes. As can be seen, different relationships are constructed. These constructs have no issues with that the potential residential self-selection may result in a residential self-selection bias. The other models, presented in the Appendix, may result in a residential self-selection bias. The examples named with the letter C do not have this issue, because the move

does not result in a change in travel behaviour due to assumptions underlying the structures (Heinen et al., 2018).

3.6.3. Reflections on existing conceptualisations

In the previous sections, factors that influence car ownership and use of carsharing are analysed. It is found that many of the same factors influence these two. Besides, it is analysed in what way the relationships possible are, and an indirect effect can explain the relationships. In this section, a reflection of the relationships found and how these can be used in this study will be discussed.

Conceptual model theoretically

As mentioned, the relationships between socio-demographic, residential relocation, built environment and the dependent variables 'change of car ownership' and 'use of carsharing' can be described in many ways. The factors that influence the two dependent factors, according to the literature, are placed in a conceptual model. Figure 3.6 visualises the outcome, the model is made with different theories and models. The conceptual model is mainly based on the conceptual model that is described by Heinen et al. (2018). Besides, the conceptual model that confirms the intermediary nature of car ownership is used as a basis here (Figure 3.3). In their study, they used as a dependent variable 'car use'. However, this model is also mentioned to describe the dependent variable travel behaviour in general. Therefore, it is assumed that the same factors describe the dependent variable, use of carsharing. All relationships that are shown in Figure 3.3 will be used in the conceptual model. However, some relationships are described through another factor. The factors that are not included in the model of Van Acker & Witlox (2010) are: residential relocation, attitude and change of attitude. These factors are found as important to explain travel behaviour (Cao et al., 2009; Heinen et al., 2018).

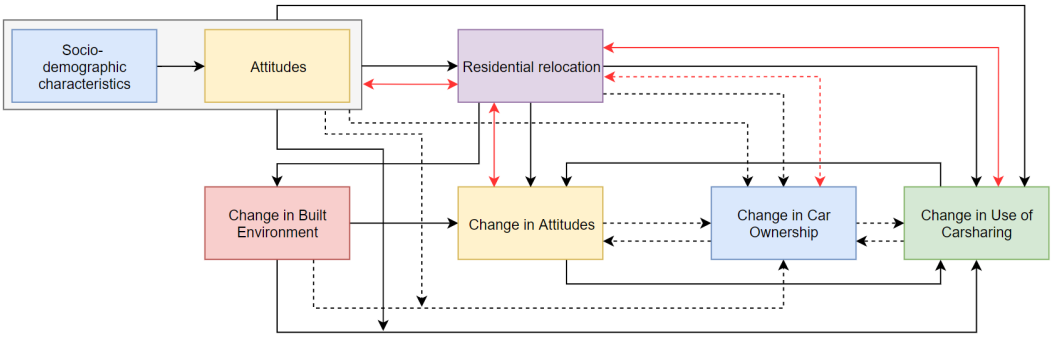


Figure 3.6: A Conceptual Model describing the relationships between socio-demographic and change in use of carsharing through intermediary factors (a black single-headed arrow represent causation, the red double-headed arrow represents correlation)

Figure 3.6 shows the conceptual model that describes the relationships between socio demographic characteristics and change in travel behaviour through intermediary factors theoretically. The factors are categorised in five clusters that all have (in)direct influence on the dependent variables 'change of car ownership' and 'change of use of carsharing'. The five factors are; Socio-demographic characteristics, Attitudes, Change in Built environment, Residential relocation and Change in attitudes. A black single-headed arrow represents causation. The red double-headed arrow represents correlation. The blue factors Socio-Demographic characteristics and Change in Car Ownership are not included in the models of Heinen et al. (2018). Therefore, the dotted lines represent new constructed relationships in comparison to the theory of Heinen et al. (2018). Attitudes are not only depending on socio-demographic characteristics. Moreover, people have attitudes (and preferences) for a residential location and also for travel behaviour or having a car. Here, we limit attitudes to those relating specifically to transport, which are of direct relevance to the residential self-selection. All relationships between the factors are explained separately in the following section.

Conceptual model for analysing

As shown in the conceptual model and mentioned before in the literature review, some effects could also be two-directional. Since SEM does not allow feedback loops, and SEM must be built with the use of a con-

ceptual model based on theory, another conceptual model is constructed. For this, the correlating and the feedback loops that are presented in Figure 3.6 are replaced by a relation in one direction. The relations are based on relationships found in the literature (Heinen et al., 2018). Besides, due to a lack of time, not all data can be collected for all variables shown in Figure 3.6. Therefore, attitudes and change in attitudes are not included in this study. However, attitudes are described as intermediary factors. When excluding these factors, relationships are shown directly in Figure 3.7. It must be kept in mind that examining these relationships in this way can be stronger and misleading.

To causal theory, hypotheses are a central principle. A low parking requirement and the availability of carsharing can be seen as a Built Environment factor. However, in this study, it will be used as a grouping variable. With the use of a grouping variable, the data set is split. The conceptual model will be tested for the two groups separately (Byrne & Stewart, 2006). Residents with carsharing and low parking requirement, and residents without (control group). In this way, a comparison can be made between the two groups. The two hypotheses that can be answered with this model are described here. The first hypothesis is "The relationship Socio-Demographic characteristics and Change of Car Ownership is stronger for residents living in a residential building with carsharing and low parking requirement." The second hypothesis is "The relationship Socio-Demographic Characteristics and Use of Carsharing is stronger for residents living in a residential building with carsharing and low parking requirement." In Figure 3.7 relationships are presented with the letters A till J. Since the relationship that will be answered with the hypotheses are direct and indirect effects. The total effects will be analysed for answering the hypothesis. The possible direct and indirect effects on the change of carsharing use are A, B+C, E+G, B+D+F+G, B+D+H, B+J+G.

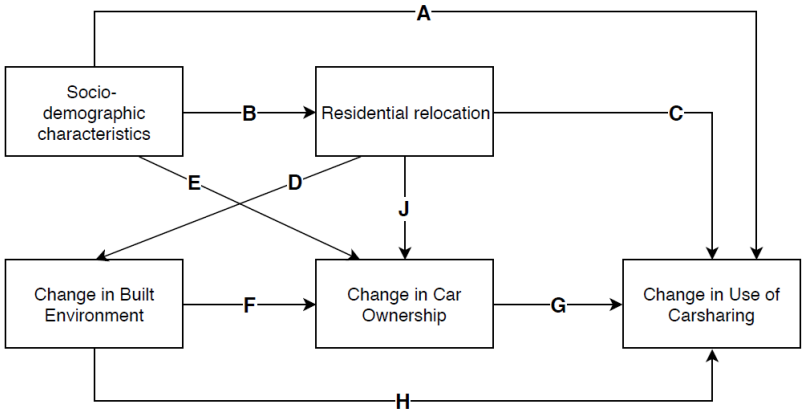


Figure 3.7: A Simplified Conceptual Model describing the relationships between socio-demographic and change in use of carsharing through intermediary factors

3.7. Conclusion

The first goal of the literature review was to identify the scientific gaps; the conclusion can be found in Section 1.1. The second goal was to identify the factors that influence residents' use of carsharing & change of car ownership according to literature. It is found that many of the same factors influence these two. Although, it is not always clear in what way the relationship is, and if an indirect effect explains the relationship. Furthermore, the relationships are not all found significant.

In Table 3.10, an overview of the factors that were analysed and their impact on car ownership and the use of carsharing can be found. In the first column, the category is written down, in the second column the specific factor. The impact is indicated with Yes, No, Increase or Decrease. Yes means that there is a relationship, but it is not known in which way. No, will indicates that there is no clear relationship found. The most important factors for car ownership seen in the literature are household income and demographic factors. In the subsection hereafter, a conceptual model is presented that describe the relationships between the factors.

The purpose of this research is to determine the effect of a low minimum parking requirement in combination with dedicated carsharing at a residential building on car ownership and the use of carsharing of households. However, the literature reviewed that more factors influence car ownership and use of carshar-

Table 3.10: Summary of factors and their effect on car ownership (CA) and on use of carsharing (UC) known from the literature

Category	Factor	Effect CO	Effect UC
Social Demographic	Age	Yes	Yes
	Gender	Yes	Yes
	Income	Increase	Yes
	Car ownership	-	Decrease
	Household type	Yes	Yes
	Employment status	Yes	Yes
	Educational level	Yes	Yes
	Drivers' license	Yes	No
	Membership	-	No
Residential (re)location	Life events	Yes	No
	Housing unit characteristics	No	No
Built environment	Residential density	Decrease	No
Neighbourhood	Employment density	Decrease	-
Neighbourhood	Urbanisation level	Decrease	-
Neighbourhood	Distance to facilities	Decrease	-
Neighbourhood	Connectivity of roads and paths	Decrease	-
Neighbourhood	Land-use mix	Decrease	-
Neighbourhood	Transit accessibility	Decrease	-
	Number of parking spaces	Increase	Decrease
	Availability of carsharing	Decrease	Increase

ing, the three dimensions that are mentioned most are socio-demographic characteristics, residential relocation and built environment. The relationships between these dimensions and the dependent variables 'change of car ownership' and 'use of carsharing' can be described in many ways. Figure 3.8 shows the conceptual model that describes the relationships between socio demographic characteristics and change in carsharing use through intermediary factors theoretically, the model is made with different theories and models (Cao et al., 2009; Heinen et al., 2018; Van Acker & Witlox, 2010). The factors are categorised in five clusters that all have (in)direct influence on the dependent variables 'change of car ownership' and 'change of use of carsharing'. The five factors are; Socio-demographic characteristics, Attitudes, Change in Built environment, Residential relocation and Change in attitudes. The relationships in the conceptual model will be explained below. Numbers represent the relationships, and the factors are shown in bold in the text.

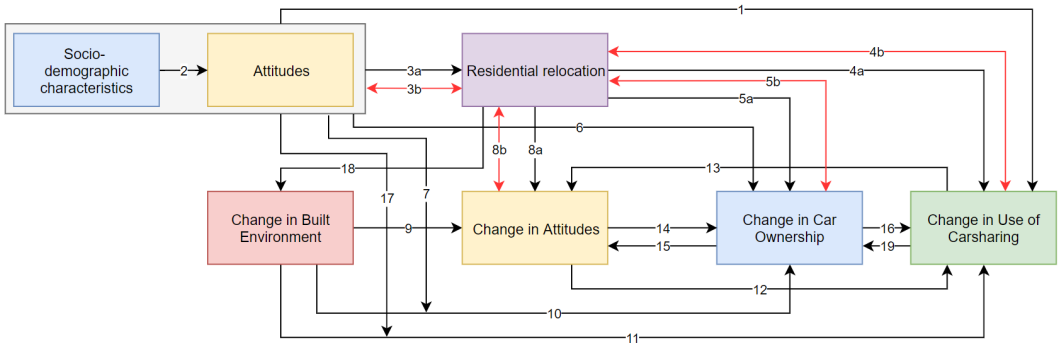


Figure 3.8: A Conceptual Model describing the relationships between socio-demographic and change in use of carsharing through intermediary factors (a black single-headed arrow represent causation, the red double-headed arrow represents correlation)

Studies about the influence of **socio-demographic characteristics** on **carsharing** are scarce. To construct a conceptual model based on theory, theories about travel behaviour are used. Travel behaviour is the study how people use transport, for example, carsharing use, theories about the change of travel behaviour are widely researched and are therefore used here to describe the dependent factor **use of carsharing**. It is known

from the literature that travel behaviour is dependent on **socio-demographics** [1]. The typical carsharing member is young, their household type is single or exists of households with young children. Besides, members are mostly highly educated, employed and have a high income. It appears that **socio-demographic characteristics** are often interdependent. For example, having a job has an impact on income, and therefore on having a car, which affects travel behaviour. The literature review shows that age, income, household type, employment status, and education level are all related to each other and influence **car ownership** [6]. In addition, the **residential (re)location** is also related with **socio-demographic factors** [3b]. Personnel preferences and **attitudes** for housing unit characteristics and **built environment** play a role with choosing the **residential location** [3a]. **Attitudes** are psychological constructs, mental and emotional. **Attitudes** are independent, however **attitudes** can depend on **socio-demographic characteristics** [2]. **Attitudes** and **socio-demographic** influence the same factors, and are therefore represented in one box in this conceptual model. **Residential relocation** often happens simultaneously with other life events. Attitudes can also vary over time, in the conceptual model, a factor **change in attitudes** is therefore included. The change in attitudes can depend on the residential relocation [8a, 8b], on the change in car ownership [15], and the change in the use of carsharing [13]. By all means, the **residential relocation** might increase or decrease the **car ownership** of a household (Toasin et al., 2014) [5a]. Besides, this relation might correlate [5b]. The same applies to the relations between residential relocation and change in the use of carsharing [4a, 4b].

A **residential relocation** will cause a **change in the built environment** [18]. Several studies (Burkhardt & Millard-Ball, 2006; Cervero, 2003; Jorritsma et al., 2015; Shaheen & Rodier, 2015) indicated that the **use of shared cars** is higher in densely populated areas and in the very strongly urban areas. Previous studies found a significant relation **between built environment** and travel behaviour [11]. Self-selection may disturb this association, self selection is "the tendency of people to choose locations based on their abilities, needs and preferences" (Litman & Steele, 2018). In the conceptual model, several indirect relations between **change in built environment** and **change in use of carsharing** are indicated. These indirect relationships ensure that self-selection is included in the model. Heinen et al. (2018) concluded that there is no single perfect conceptualisation that applies for everyone, therefore all options are included in this conceptual model. For example, **attitudes** can have an influence on the relationship self between **built environment** an **use of carsharing** [17]. Another example is the **change in attitudes** that indirect influence **built environment** and **use of carsharing** [9, 12, 14, 16]. The same applies for **change in built environment** and **change in car ownership** [7, 10, 9, 14].

4

Results

In this Chapter, the results are discussed. First, in Section 4.1, the results of the semi-structured interviews are discussed. Second, the collected data of the study areas will be described in Section 4.2. Thereafter, the descriptive of the survey data will be presented in Section 4.3. Finally, the statistical analysis of the data is presented in Section 4.4.

4.1. Results: stakeholders interests, goals, and experiences

In this section, we study the interests, (intended) effects and experiences of the most relevant stakeholders (municipalities (M1, M2, M3, M4), developers (D1, D2, D3) and carsharing providers (C1, C2, C3)) about parking requirement and carsharing. The analysis is based on a series of twelve semi-structured interviews; a list of the participants can be found in Appendix D. First, we examined the interests of the stakeholders. This will help to find conflicting interest when present. The goals are examined to find what the influence is of carsharing and parking requirements according to the stakeholders. Second, the experiences will be presented. Since offering shared cars in combination with a low parking requirement is a new concept, many experiences will be gained that will be relevant for the future. This may help in advising municipalities and developers on parking policies in combination with carsharing. Then, the factors that influence the use of carsharing are discussed. Last, a conclusion of the analysis of the interviews is given. All developers mention not all reasons, an overview of which statements have been made by which participants can be found in Appendix H. Since this information comes from personal conversations, it might be that these reasons presented are not complete for an organisation. Also, this list may be incomplete or found to be incorrect by others. An overview of the findings can be found in Table 4.1.

4.1.1. Interests and goals

First of all, developers participate primarily to learn, and the stakeholder groups have yet measured no effects. The developers, carsharing providers and municipalities, aims to use the space better, provide mobility, and reduce car ownership. No potential conflicts in the interests and goals between stakeholders are identified. First, providing mobility is the most important goal (D1, D3, D4, M1, M3). In addition, many goals of the stakeholders relate to the environment (C1, D1, D4, M3). No new or conflicting goals have been identified based on the narratives in comparison to the goals known from the literature review.

4.1.2. Experiences

The experiences concerning the use of shared cars vary. Two organisations experienced a low use (C1, D1), and two experienced a high use (C2, D4). The low use of carsharing may be the result of that shared cars are new for most users, and electric cars as well (C1, D4, M1). It is therefore often a threshold that is difficult to cross, as people tend to stick to their habits. It is difficult to break that habit, according to the experiences of various parties (C1, D2). It is necessary to motivate people to use shared cars (C1, D2). For example, through marketing, discounts, or showing that it is advantageous with a calculation tool (C1). In addition to experiences with carsharing, the experiences concerning the use of parking spaces vary. Many parking spaces seem to be empty that belong to residential buildings (D3, D4, M1). However, there are also examples showing that the garage is full (M1, M2). Two different municipalities have indicated that residents were

not aware of the number of parking spaces (M1, M2). The communication is not always clear to residents. After complaints from residents, municipalities have made exceptions and still have given residents a parking permit for on the street (M1, M2). Developers have also noticed that offering no parking spaces is not an option; there are always people who want a parking space (D2). As a result of the high parking prices, some residents rent a parking space somewhere else (D2).

4.1.3. Factors influencing the use of carsharing

Based on the narratives, all factors that emerged during the literature study that could influence the use of carsharing and car ownership are identified. According to the literature, the typical user is 'young', the residents of the buildings analysed are also 'young' (C1, D1, D4). The focus group is on mid-tenants (D1), but based on the narratives sharing car users could be anyone (C3, D2, D4). The theories of the stakeholder groups about users are somewhat divided, and the target group on which the stakeholders focus is not entirely clear. The municipality of Rotterdam believes that there could be a specific target group that does not need parking spaces (M2). The strategies about the built environment vary. Although most organisation expect that carsharing work best in the big cities (C1, D3, D4, M1, M3, M4), however, it must additionally be taken into account that cities also differ among each other. Amsterdam has different mobility systems, residents and capital (M1). Carsharing providers and a developer, on the other hand, expect that carsharing can work very well in cities on the outskirts (C1, C2, D2), although the focus will then be primarily on families who dispose of their second, third or fourth car (D2). Many preferences (attitudes) mentioned by users; these will not be discussed here. However, these can be read in Appendix H. Finally, the following problem is often mentioned. Carsharing users want certainty about the availability of shared cars. Therefore the number of shared cars must increase. Nevertheless, it is not profitable to have many cars that are not used. Besides, most of the organisations are startups and cannot manage the scale increase economically (C1). Though, the expectation is that an increase in scale will contribute to a growth in sharing car use (C1, C2, M1).

4.1.4. Conclusion

The goal of the interviews was to provide insights into the effects of carsharing and parking requirements according to developers and municipalities. To see what they want to achieve with it, and to see if it has worked the way they wanted. Based, on the narratives no potential conflicts in the interests and goals between stakeholders are identified. The experiences concerning the use of shared cars, the use of parking spaces and strategies about the built environment vary. An overview of the interests, goals and experiences of developers, municipalities and carsharing providers with providing low parking requirement and carsharing services are presented in Table 4.1.

Table 4.1: Overview of stakeholders interests, goals, and experiences regarding to carsharing and parking requirements

	Interests	**Goals**	**Experiences**
Carsharing providers	Market expansion	Reduce the number of cars, better use of space and better air quality	The carsharing concepts are used less than expected, only in one case they are used more than expected. People find sharing cars and electric cars exciting, people are used to their private cars. People have a habit that is hard to break. People must be motivated to use shared cars (for marketing, discount, calculation tools, etc.). People have preferences for a car that is nearby or in the building, and the service level needs to be high.
Developers	Optimal use of space, market expansion	Provide a service, provide mobility, economically, to increase liveability, environmental, to have less congestion, to go along with the latest development, to build less parking spaces, lower CO2 emissions	People can have a preference for a petrol car or an electric car. People find sharing cars and electric cars exciting. Parking spaces have never been sold all, however people still want parking spaces. Besides, people park their car somewhere else or sell their car. The carsharing concepts are used less than expected and are not (yet) profitable, but other cases conclude that the shared cars are used very well. People have a habit that is hard to break. It is not possible to have more green.
Municipalities	Improve the quality of city with reduce carbon emissions, improve air quality, optimal use of land use	Carsharing is used to reduce car ownership. The discount is an incentive for car sharing in new area developments. Reduce development costs and create more flexibility for developers.	People find sharing cars and electric cars exciting. There are many parking spaces empty and there are garages occupied. Communication about parking spaces not always clear for residents, exceptions have been made and people have nevertheless received a permit.

4.2. Study Area

Table 4.2 gives an overview of the projects that are included for the quantitative analysis, in Appendix I general descriptions of the cases and more characteristics of the projects can be found. The parking requirements presented are not the requirements given in advance by the municipality, but the final parking requirement. They are calculated by dividing the number of parking spaces by the number of houses. In some of the cases, households can get a parking permit — causes in that the number of parking spaces on their property, does not state the parking offer correctly. For example, the number of parking spaces for 'Neudeflat' is three. However, people can get a parking permit for one car on-street. Therefore, for this case, the parking requirement is set to one. So, it is possible that these parking requirements are not right. Despite, it will give an idea of the differences between the cases. In Table 4.2, the control cases are shown with their characteristics. As can be seen in the table, it appears that the selected case study 'Neudeflat' has zero shared car. During the desk research, it was found that there was one shared car; however, during the survey, it appeared that this was not the case. Several residents indicated that there was no shared car, but that the shared car was promised. Afterwards, discussions were held with various residents of the Neudeflat, to confirm this information. Besides, it became clear that not all cases were excluded for a parking permit on-street.

Table 4.2: Overview of case studies. Data from (Bewust nieuwbouw, 2017; BMW Group, 2017; 2018; Jelyta, 2015; VastgoedBerichten, 2017)

City	**Building**	**# Shared car**	**# Housing**	**Since**	**Parking req. [p-spaces/unit]**
Utrecht	Oudenoord	3	70	May 2017	0.64
Utrecht	Museo	2	58	June 2018	0.34
Rotterdam	Het Timmerhuis[1]	2	84	Dec. 2015	2
Rotterdam	De Hofdame	-	231	-	1.5
Utrecht	Zijdebalen	-	148	-	1
Utrecht	Hollandse Toren	-	65	-	1
Utrecht	Neudeflat	0	88	2016	1
Utrecht	Vredenburgplein	-	35	-	1

In Chapter 3, the built environment factors that will be analysed for the cases are determined. Since the respondents live at different locations and the built environment differs per case, all built environment factors are collected. An overview of all characteristics of the case studies can be found in Table 4.3. Besides, for every respondent, the built environment factors that belong to their previous residential location are collected. These factors are not shown in this table. However, it is used to calculate the difference in built environment factors between the current and past home.

[1] the parking requirement is not low, but there is a very high rent for these parking spaces

Table 4.3: Overview of built environment factors of the case studies (CBS Open data StatLine, 2018a;b;c; pdok, 2019; Ritjeweg, 2019)

	Oudenoord	Zijdebalenl	Museo	Hollandse Toren	Vredenburgplein	Neudeflat	Het Timmerhuis	De Hofdame
Population density								
Population density [residents/km2]	5145	5145	5725	5167	5167	5725	6284	6284
Built environment factors								
Distance to hospital	2.8	2.8	1.5	2.9	2.9	2.4	0.7	0.7
Hospitals within 5 km [#]	2.4	2.4	3.1	2.5	2.5	2.9	7.8	7.8
Distance to big supermarket	0.2	0.2	0.3	0.5	0.5	0.2	0.3	0.3
Big supermarkets within 1 km [#]	7.8	7.8	6.8	5.1	5.1	12.1	7.6	7.6
Distance to daily shops	0.2	0.2	0.2	0.4	0.4	0.2	0.2	0.2
Daily shops within 1 km [#]	38.8	38.8	41.1	40.9	40.9	60.5	72.2	72.2
Distance to department store	0.8	0.8	1	1.1	1.1	0.5	0.7	0.7
Department stores within 5 km [#]	8	8	8.1	8	8	8.6	11.1	11.1
Distance to cafe	0.3	0.3	0.1	0.4	0.4	0.1	0.2	0.2
Cafes within 1 km [#]	27.9	27.9	30.6	18	18	60.4	36.2	36.2
Distance to restaurant	0.2	0.2	0.1	0.2	0.2	0.1	0.1	0.1
Restaurants within 1 km [#]	85.4	85.4	125.1	84.7	84.7	213.3	109.2	109.2
Distance to hotel	0.7	0.7	0.4	0.5	0.5	0.2	0.3	0.3
Number of hotels within 5 km [#]	25.7	25.7	27.4	26.6	26.6	25.3	55.3	55.3
Distance to train station	1.6	1.6	0.9	1.1	1.1	1.9	0.7	0.7
Distance to important transfer train station	1.6	1.6	2.8	1.2	1.2	2.1	1.8	1.8
Population density	5145	5145	5725	5167	5167	5725	6284	6284
Local land use density								
Retail trade and catering (ha)	10%	10%	14%	15%	15%	68%	32%	32%
Business park (ha)	10%	10%	0%	36%	36%	0%	20%	20%
Total built (ha)	84%	84%	91%	65%	65%	100%	64%	64%
Availability of carsharing								
Shared cars at building [#/housing unit]	3	0	2	0	0	0	2	0
Shared cars MyWheels [#]	3	3	1	3	3	1	3	3
Shared cars Greenwheels [#]	7	7	4	6	6	5	13	13
Shared cars around Witkar [#]	2	2	0	2	2	0	3	3
Total shared cars [#/hectare]	0.39	0.39	0.23	0.10	0.10	0.24	0.11	0.11
Policy parking								
Parking permit (yes = 1, no = 2)	2	2	2	2	2	1	2	2
Housing unit characteristics								
Zone according to parking policy	A2/B1	A2/B2	A1	A1	A1	A1	N/A	N/A
Parking spaces [#]	45	158	20	36	36	3	168	346.5
Parking price [€/month]	100	Incl.	90.65	200	200	28.57	220	20
Parking price [€/month] on-street	12.56	12.56	28.57	28.57	28.57	28.57	9.6	9.6
Parking requirement	0.64	1	0.34	1	1	1	1.4	1.5
Number of housing	70	158	58	36	36	88	84	231
Number of shared cars at building	3	0	2	0	0	0	2	0

4.3. Descriptive Results of the Sample

Here, an evaluation is described of the data that is collected. More than 10% of the 700 households have filled in the survey. In total, 92 people started with the survey, and 86 people have completed it. The population was defined in Chapter 2. In Chapter 2, it was explained that data is collected with the use of different sources. Before it is possible to use this data, it was needed to define new variables. In Appendix I.1, it is explained how data is transformed into new variables. In order to be able to interpret the data correctly, data preparation is needed, the description can be consulted in Appendix I.1.

Table 4.4: Number of respondents per case study

Case study	Number of respondents	Percentage of sample	Percentage of building
Utrecht, Oudenoord	14	16%	20%
Utrecht, Museo	4	5%	7%
Rotterdam, Het Timmerhuis	12	14%	14%
Rotterdam, De Hofdame	12	14%	5%
Utrecht, Zijdebalen	29	34%	18%
Utrecht, Hollandse Toren	1	1%	3%
Utrecht, Neudeflat	9	10%	10%
Utrecht, Vredenburgplein	5	6%	14%

In Table 4.4, the number of respondents per residential building is shown. A line in the Table distinguishes the buildings, the upper are buildings with a low parking standard and car sharing and everything below the line without. As became apparent during the research, two selected cases did not meet the low parking standard or appeared to have no shared car. Therefore, these two cases (Het Timmerhuis & Neudeflat) are also used as control cases. However, this causes problems, since only two cases are left, and the number of respondents that live in a building with a low parking requirement and a carsharing service is 18 (Oudenoord & Museo). Therefore, the survey cannot be seen as a sample for the described population. Besides, the number of respondents per case varies a lot. The number of respondents of Hollandse Toren is 1. It is self-evident that one person cannot be representative of all residents of the building. Therefore, specific factors of a case study, such as the parking price or the parking requirement rate, cannot be included in the further analysis. Though, the cases do differ in this respect. However, for example, the neighbourhood characteristics of the residents are included. Otherwise important factors are missing. Hence, it has to be taken into account that it is still hard to compare the different locations because for every building the sample size is small.

Table 4.5 shows the sample characteristics. As expected, the income level and educational level of this sample size are both higher than in the Dutch population (Table I.1 in the Appendix). Most people in the sample are quite young and working. Also, most respondents consist of a household without children. However, in the selected cases, the average age is much younger. Further, there are no notable differences between the selected cases and control cases, according to Table 4.5. In the literature review was revealed that the educational level of most carsharing users was high (Cervero, 2003; Jorritsma et al., 2015; Liao et al., 2018). Besides, the income was in most studies relatively high of carsharing users. Moreover, the typical carsharing user is young, employed, and their household type is single or exists of households with young children (Cervero, 2003; Jorritsma et al., 2015; Liao et al., 2018). The characteristics of the typical users therefore correspond to the respondents of the control as well as the selected cases, and may therefore also use sharing cars earlier.

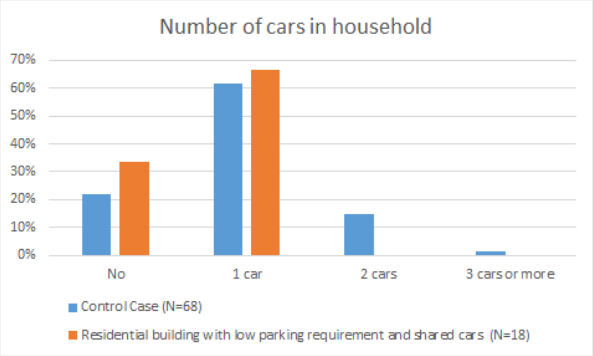
Table 4.5: Characteristics of respondents - - Comparison between selected and control cases

Variable	**Level**	**Percentage Control Cases N=68**	**Percentage Cases N=18**
Gender	Male	54%	50%
	Female	41%	50%
Age	<25 years	4%	6%
	26 - 34 years	37%	83%
	35 - 54 years	21%	11%
	55 - 64 years	32%	0%
	>65 years	6%	0%
	Average	42	29
Monthly net household income	<€1500	3%	0%
	€1500-€3000	12%	0%
	€3000-€4500	19%	33%
	€4500-€6000	29%	39%
	>€6000	25%	22%
	Did not wish to answer	12%	6%
Employment	Student	15%	11%
	Working	85%	89%
Household type	Single person household	25%	6%
	Single person with children	1%	0%
	Living together with children	9%	6%
	Living together without children	62%	89%
	Others	3%	0%
Education level	LBO, MAVO, VMBO	3%	0%
	HAVO/VWO	6%	0%
	HBO	28%	28%
	WO	63%	72%
Driver license	Yes	100%	100%
	No	0%	0%
Car ownership	0 cars	22%	33%
	1 car	62 %	67 %
	2 cars	15%	0%
	3 cars or more	1%	0%

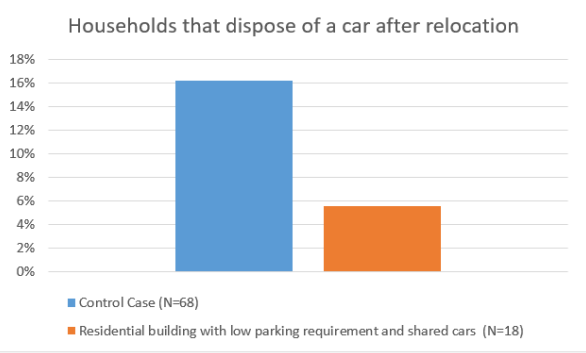
Figure 4.1 to Figure 4.5 represent the data that is gathered from the survey with some bar charts. Figure 4.3 shows that households with a low parking requirement and shared cars (orange) have fewer cars than households without a low parking requirement and shared cars (blue). However, more households of the control cases (blue) disposed of their car after the relocation. The most common answer to the question of why people dispose of their car is: because people do not need a car at the new location, because they are using PT, bike or foot. Besides, some people said that the parking space was too expensive. Only one person said that there was no space, and therefore did not have a car anymore, this relates to the parking requirement. No one has filled in as reason: because of using the shared car. For more details, see Table 4.7. With Figure 4.2, it can be concluded that more households in the selected cases have a membership of a carsharing service. Also, it became clear that more respondents of the selected cases in comparison to the site cases became a member after the relocation. Figure 4.3a shows the use of carsharing for households with membership only. It can be seen that there are three households of the selected cases that (almost) never use the shared car. Besides, one household uses it 6-11 days per year, and one household four days per week or more. Figure 4.4a present the difference in use before and after the relocation. It shows people started to use more carsharing and people that use carsharing less than before, in both types of cases. More accessors (households who do not have a car and join carsharing) in percentage are found in the selected case (Figure 4.4b), it can be a result because carsharing is provided at households residential building. However, this result might also be since it is not always possible to park a car at these buildings. Characteristics of the accessors are represented in Table 4.6. In cases with a low parking requirement (orange), more households did not have a car before or after relocation (Figure 4.5a). So, it might be that buildings without parking spaces attract

households without cars or wishes to have a car. Lastly, there are four shedders (a household who give up a car and join carsharing) among all the respondents (Figure 4.5b). These respondent are living in the control cases. Table 4.7 the shedders (participants 23, 33, 74 and 75) are described by their characteristics.

To conclude, it looks like a small effect on car ownership can be seen. However, there are no notable differences in the use of carsharing. These effects are not significant, this will be more elaborated in the next section. Moreover, it must be noted that the sample size is minimal.

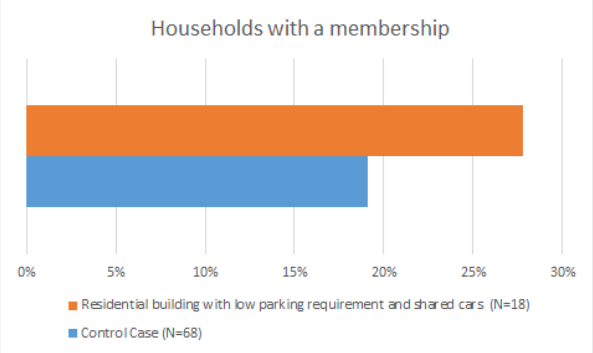


(a) Number of cars in household

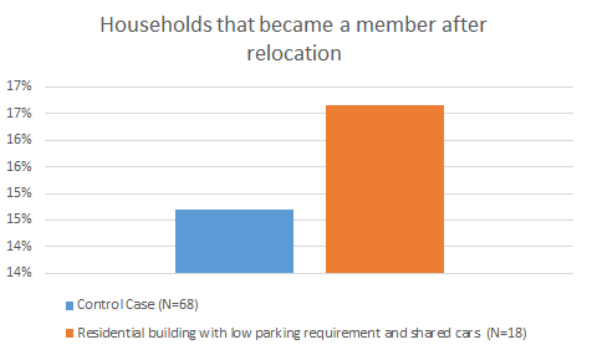


(b) Households that dispose a car after relocation

Figure 4.1: Car ownership - Comparison between selected and control cases



(a) Households with a membership

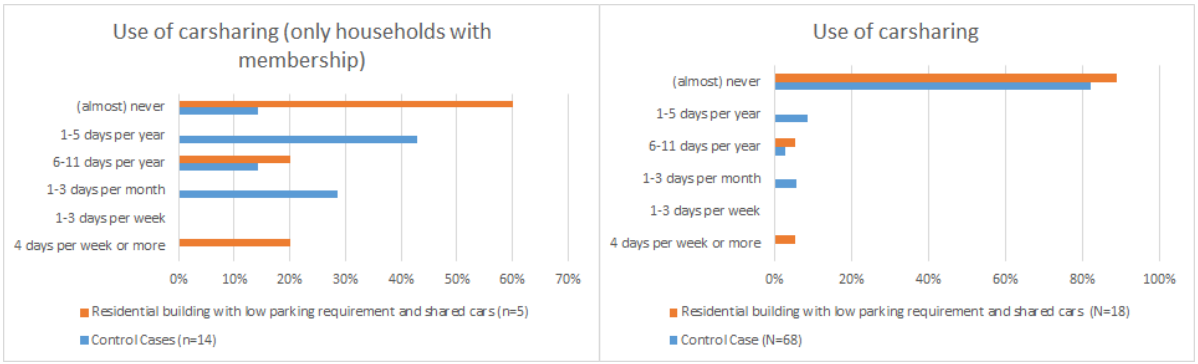


(b) Households that became a member after relocation

Figure 4.2: Membership of carsharing - Comparison between selected and control cases I

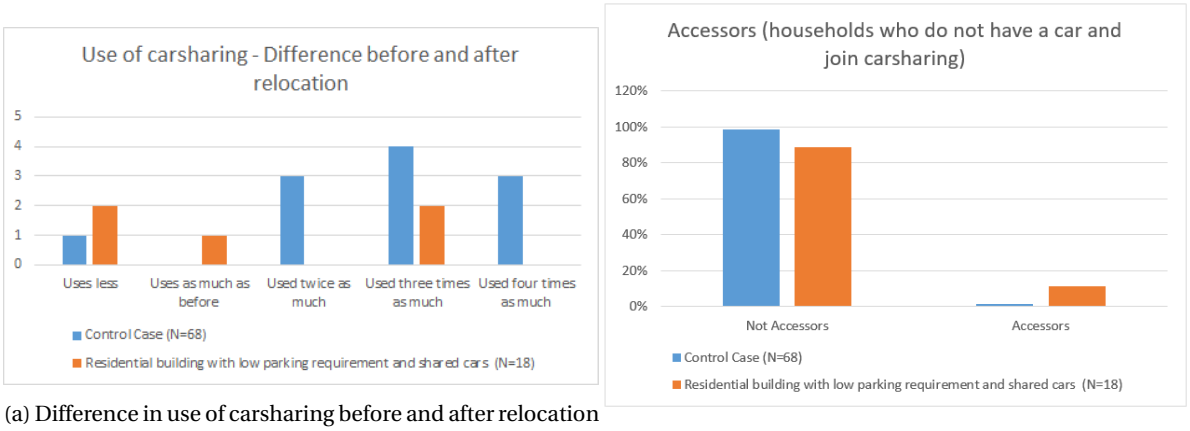
Table 4.6: Characteristics of accessors

Participant	Building	Age	Employment	Household	Carsharing provider	Use of Carsharing	Car ownership
3	Zijdebalen, Utrecht	26	Working	Living together / married without children living at home	GreenWheels	6-11 days per year	0
43	Museo, Utrecht	31	Working	Living together / married without children living at home	We Drive Solar	6-11 days per year	0
57	Oudenoord, Utrecht	27	Working	Living together / married without children living at home	Snapp en MyWheels	(Almost) never	0



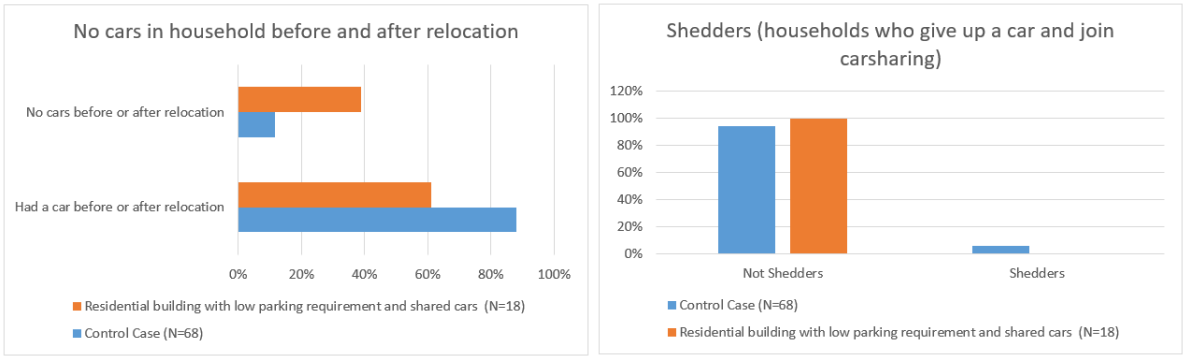
(a) Use of carsharing (only households with membership) (b) Use of carsharing

Figure 4.3: Use of carsharing - Comparison between selected and control cases II



(a) Difference in use of carsharing before and after relocation (b) Accessors

Figure 4.4: Use of carsharing - Comparison between selected and control cases III



(a) Households with no cars before or after relocation (b) Shedders

Figure 4.5: Use of carsharing - Comparison between selected and control cases

Table 4.7: Characteristics of households that dispose of car

Participant	Building	Age	Employment	Household	Old or new member	Motivation to dipose car	Car ownership
11	Zijdebalen, Utrecht	62	Working	Living together / married without children living at home	No member before or after relocation	I can now do my daily journeys by public transport	Had 2 cars before relocation, now 1
16	Vredenburgplein, Utrecht	47	Working	Living together / married with children living at home	No member before or after relocation	I find the parking place too expensive at this location. I can now do my daily journeys by public transport I can now do my daily. journeys on foot or by bike For financial reasons.	Had 1 cars before relocation, now zero
23	Vredenburgplein, Utrecht	54	Working	Living together / married without children living at home	New member of Greenwheels	I no longer need a car at this location. I find the parking place too expensive at this location. I can now do my daily journeys by public transport.	Had 1 cars before relocation, now zero
33	Neudeflat, Utrecht	32	Working	Living together / married without children living at home	New member of Snapcar	I no longer need a car at this location. I have no parking space at this location. I can now do my daily journeys by public transport. I can now do my daily journeys on foot or by bike.	Had 1 cars before relocation, now zero
40	Het Timmerhuis, Rotterdam	33	Working	Living together / married without children living at home	No member before or after relocation	I find the parking place too expensive at this location.	Had 1 cars before relocation, now zero
45	Vredenburgplein, Utrecht	41	Working	Single without children living at home	No member before or after relocation	I no longer need a car at this location. I find the parking place too expensive at this location. I can now do my daily journeys by public transport. I can now do my daily journeys on foot or by bike.	Had 1 cars before relocation, now zero
47	De Hofdame, Rotterdam	68	Rretired	Single without children living at home	No member before or after relocation	I no longer need a car at this location. I find the parking place too expensive at this location	Had 1 cars before relocation, now zero
74	Zijdebalen, Utrecht	49	Working	Single without children living at home	New member of Greenwheels	I no longer need a car at this location. I can now do my daily journeys by public transport. I can now do my daily journeys on foot or by bike.	Had 1 cars before relocation, now zero
75	Het Timmerhuis, Rotterdam	50	Working	Living together / married without children living at home	New member of Juuve	I find the parking place too expensive at this location. I can now do my daily journeys on foot or by bike.	Had 2 cars before relocation, now 1
26	Zijdebalen, Utrecht	38	Working	Living together / married with children living at home	No member before or after relocation	*Has entered the question incorrectly*	Had 2 cars before relocation, now 1
39	De Hofdame, Rotterdam	64	Retired	Living together / married without children living at home	No member before or after relocation	*Has entered the question incorrectly*	Had 2 cars before relocation, now 1
61	Oudenoord, Utrecht	24	Student	Living together / married without children living at home	No member before or after relocation	*Has entered the question incorrectly*	Had 2 cars before relocation, now 1

4.4. Results of Statistical Analysis

In this section, the results of the analysis, as described in Section 2.3 are presented. First, the bi-variate results are shown and discussed. Second, a reflection on the structural equation model is given. Last, a conclusion of the quantitative analysis is drawn.

4.4.1. Bi-variate analysis results

First, the relations between the dependent and the independent variables will tested, to analyse the associations in the data set. Variables used in the analysis include characteristics of the built environment, personal and household characteristics and aspects of car ownership and use of carsharing. The last two are the dependent variables that will be described in this research. As can be seen in Table 4.3, *built environment characteristics* only refer to density and accessibility, other variables that describe the built environment could not be included due to a lack of suitable data. Moreover, some data as parking price cannot be used when describing only one person. Besides, *household and personal characteristics* are collected, presented in Table 4.5. The choice for *residential location* were collected using the survey. However, it turned out that the data that was found could not be included in the analysis. In the survey, it was asked whether the household consciously opted for a home with shared cars. Three respondents confirmed this, and everyone else indicated that that was not the reason. The households who confirmed this question, all live in the apartment where no shared car has placed. Therefore, this answer might have been written down for emotional reasons. Thus the location choice factor will not be included further in this study. The dependent variables analysed are described as follows:

- Joined membership after relocation (0 = no, 1 = yes)
- Dispose of a car after relocation (0 = no, 1 = yes)
- Membership of the carsharing organisation (0 = no, 1 = yes)
- Frequency of use of carsharing (1 = "(almost) never", 2 = "1-5 days a year", 3 = "6-11 days a year", 4 = "1-3 days a month", 5 = "1-3 days a week", 6 = "4 days a week or more")
- Number of cars in the household (0 = no cars, 1 = 1 car, 2 = 2 cars, 3 = 3 cars or more)

Correlations between dependent and independent variables

Only the most harmonious relations are analysed in the bi-variate analysis. All case studies are located in the centre of a big city. Therefore the built environment data is very similar. So it is decided to choose the variables that differ the most from each other. Besides, the literature shows that the distance to a train station can be critical for travel behaviour analysis. So, this factor is included in further analysis. The factors that are used further in the analysis are chosen here based on the correlations. The complete analyses can be found in Appendix K. The correlations are first tested with the Kendall's Tau test, the values show the distribution-free measure of correlation, this test is suitable for data that is measured on an ordinal scale (Kendall, 1938). This test is recommended for a small sample size. The values of the tests can be compared with each other in Figure 4.6. However, because the measurement levels of the variables differ, different tests must be performed to see if the associations are significant. In Appendix K the Mann-Whitney z-scores, Pearson correlation and Phi value are explained and the significance of the correlations are presented in Table K.1 for the socio-demographic characteristics and Table K.2 for the built environment factors. It became clear that the correlation between household type and the number of cars is not significant according to the Pearson test. Besides, the association between distance train and joined membership is not significant according to the Mann Whitney u test. Significant associations are presented boldly in the table.

However, most relations are not significant; here the correlations between the variables will be discussed that are shown in Figure 4.6. Gender cannot be evaluated in this research because the household use and ownership describe the dependent variables. The age has a positive significant association with dispose of the car. Besides, age has a positive association with the number of cars in this sample. Values of age in relation to membership and use of carsharing are minimal. The income has a positive influence on the number of cars, and the income has a positive influence on the membership of carsharing. Both relations were also found during the literature review. However, the frequency of the use has a negative (minimal) correlation. The household type that is indicated from a small to a large household has a positive influence on the number of cars. This was also stated in the literature review. Besides, the relation with the use of carsharing is negative. It was indicated in the literature review that especially singles and young households used carsharing. These relationships appear to be the same in this sample. The educational level harms the number of cars,

according to the literature review, this was not expected. However, this could be the result of the educational level distribution being non-normal in the sample. Though, the educational level has a positive association on membership, although the association is small and a negative relation with the frequency of use of car-sharing. Lastly, five built environment factors are shown in the Figure. The distance to a train station and the distance to big supermarkets have a negative relation with the membership, and with the number of cars. However, the number of shops, the population density, and the number of restaurants have a positive relation with memberships (above 0.205) and the number of cars. The different values could be a result of the built environment factors distribution being non-normal in the sample.

		Joined Membership	Dispose Car	Membership	Frequency	Number of Cars
Gender	value	0.092	-0.011	0.13	0.066	0.008
	Sig	0.395	0.919	0.23	0.532	0.939
Age	value	0.003	**0.209**	-0.024	0.004	0.039
	Sig	0.971	**0.021**	0.795	0.963	0.653
Income	value	0.03	0.013	0.113	-0.03	0.123
	Sig	0.76	0.896	0.259	0.759	0.2
Employment	value	0.076	-0.128	0.125	0.092	-0.034
	Sig	0.482	0.237	0.25	0.383	0.744
Household type	value	-0.148	0.012	-0.005	-0.028	0.235
	Sig	0.159	0.909	0.959	0.787	0.02
Educational level	value	0.093	-0.129	0.021	-0.014	-0.052
	Sig	0.38	0.223	0.839	0.895	0.61
Distance train	value	-0.206	-0.098	-0.159	-0.093	-0.138
	Sig	0.042	0.334	0.115	0.344	0.154
Number shops	value	**0.205**	0.084	0.116	0.063	0.081
	Sig	**0.043**	0.406	0.25	0.52	0.406
Population density	value	**0.215**	0.082	0.125	0.067	0.083
	Sig	**0.034**	0.421	0.218	0.495	0.397
Number restaurants	value	0.164	-0.098	0.093	0.026	0.068
	Sig	0.105	0.334	0.357	0.791	0.485
Number big supermarkets	value	**-0.211**	-0.158	-0.152	-0.093	-0.049
	Sig	**0.037**	0.119	0.132	0.344	0.617

Figure 4.6: Correlations between dependent and independent variables (Values based on Kendall's Tau test, red means a negative value, green a positive value)

It must be taken into account that bi-variate analyses do not always show the pure effect. However, only one socio-demographic variable is correlating significantly. Age has a significant positive relation on disposing of the car. The effects of the socio-demographic variables are as expected, the literature described the same relationships.

Correlations between dependent variables and distinction case groups

The differences between the dependent variables and the distinction of the two case groups (households with a low parking requirement and carsharing, and households without) is tested. However, all associations are not significant (Table 4.8). In Appendix, in Table K.3 the z- and Phi-scores are presented). Correlated variables are included in further analysis. Although, it can already be concluded that not enough variables are correlating significantly to make the simplified conceptual model which is presented in Chapter 3.

Table 4.8: Correlations between dependent variables and distinction case groups (Kendalls' tau)

	Joined membership	Dispose car	Membership	Frequency	Number of Cars
Value	-0.022	-0.125	0.087	-0.058	-0.174
Sig	0.837	0.250	0.425	0.586	0.095

Insignificant correlations

Insignificance might be since the sample size is minimal. However, this might also be explained by data that is not normally distributed. As can be seen in Table 4.3, the built environment factors do not differ much from each other. Insignificance can also be explained by that the data do not describe the factors specific enough. Although, in this analysis, the data was not yet adjusted to scales. So, the data was here more specific

than in further study. Only, it must be noted that the built environment data is on the neighbourhood level. To conclude, there are only six different levels in the built environment characteristics. From this, it can be carefully concluded that data of the built environmental factors, car ownership and socio-demographic factors did describe the data specific enough. Furthermore, more precise data was not available. Therefore, probably due to the small sample size together with the fact that people's answers and the built environment factors are often the same, there are limited significant correlations found.

4.4.2. Reflection on the Structural Equation Model

With the use of SEM, the indirect effects can be measured as well. For the interpretation of the relations in the models, it is important to realise that it is not possible to quantitatively determine the direction of the relations within an SEM model. The direction of the relations must be determined with the use of literature.

It has been attempted to create a Structural Equation Model based on the conceptual model with latent variables, so that equations could represent the use of carsharing and the change of car ownership. With the use of a sum score (equations), one variable can present the total score of the indicators, instead of using three single indicators. It is better to use latent factors with indicators in research. However, as mentioned before, it is preferable to include 20 cases per variable, but 10 is also accepted in further analysis. In this study, the sample size is 86, the maximum variables that can be used in the model are therefore 8.6. So, the original model must be simplified in order to be able to interpret a reliable model.

Besides, the criteria of normality, unidimensionality, convergence validity, reliability and discriminant validity must be fulfilled before the constructs can be considered trustworthy. However, it became apparent during the factor analysis that the socio-demographic indicators did not describe the latent variable reliable. The same problems occur for the latent factor 'built environment'. This can be due to the limited information of the constructs. However, the constructs were used; otherwise, importation information would be missing. A broader explanation of the factor analysis can be found in Appendix M.1. Besides, other constructs were also considered. For example, the difference in built environment factors before and after relocation was constructed. However, all constructs did not perform reliably.

The initial conceptual model results in an SEM model with a bad model fit. To make any statements on the significance and weights of the relations, it is essential to have a good model fit. Many reasons can cause a bad model fit. The main problem of the model fit in this research was the PCFI. PCFI indicates the model parsimony adjustment, which means that insignificant paths should be deleted. All models that were built continued to display a wrong PCFI. All model had insignificant paths. In the bi-variate analysis, it also was shown that significant relations were scarce.

Therefore, the relations cannot be seen as a result of the population described. However, this model can be used for further travel behaviour research. Because this technique can show interesting relations, however, the relations in this model cannot conclude effects or confirm hypotheses. Adjusted conceptual models were made, to test relationships with an SEM. However, the adjusted conceptual model is less well supported by the literature. The main findings of these Structural Equation Model are presented in Appendix M.2.

When the sample size would be larger, it might be possible to perform a group analysis. Two groups can be made, people that live in a residential building with the combination of shared cars and low parking standards and without. In this way, multi-group effects can be measured. So, differences can be seen between groups. However, for each group, the sample sizes must be at least 50 and preferably 100. Moreover, when the sample sizes are larger, more variables can be included in the final model since the criteria of variables depend on the number of respondents.

4.4.3. Conclusion

The goal of conducting the quantitative analysis was to find how car ownership and use of carsharing of 'households with a low parking requirement and carsharing' and 'households without a low parking requirement and carsharing' change after the relocation.

With the descriptive statistics, small differences between the two groups about car ownership can be seen. A higher percentage of the households in the selected cases did not have a car before they moved and they had fewer cars compared to the control cases. However, a higher percentage of the households dispose of their car in the control cases. In relation to carsharing, a higher percentage of the households in the selected cases have a membership. However, a big part of these members does seldom use shared cars. Further, there are no notable differences in the use of carsharing. These effects are not significant. Moreover, it must be

noted that the sample size is minimal. The correlations between the dependent variables and the distinction of the two groups (households with a low parking requirement and carsharing, and households without) do not show any significant associations. However, this sample shows some small differences. It must be noted that these effects are only the direct effects, it was intended to make a structural equation model to analyse the pure effect. Despite the model fit was overall good, it did not succeed to test the hypotheses with the use of multi-group analysis. This is devoted to the sample size, as described above.

5

Conclusions, Discussion and Recommendations

The objective of this final chapter is to conclude and discuss the research. Offering shared cars to residential buildings is on the rise, especially in combination with a low parking standard. This research focuses on the effect of offering shared cars in combination with a low parking requirement. The main findings of the research are substantiated in Section 5.1, this will answer the main research question. The conclusion is discussed in Section 5.2. Next, the limitations of this research are discussed in Section 5.3. Finally, recommendations for further research and practice are presented in Section 5.4.

5.1. Conclusions

The objective of this research is to determine the effect of combining the two opportunities, a reduction of the minimum parking requirement and offering carsharing, on car ownership and the use of carsharing of households. The effect is determined in two ways, qualitatively and quantitative. This section concludes this research by answering the following main research question:

What is the effect of a low minimum parking requirement in combination with dedicated carsharing at a residential building on car ownership and the use of carsharing of households?

Although a large body of literature exists on the impact of carsharing on car ownership, conclusions are not decisive. Results differ depending on the data used, and the data differs in countries, year and variables. The same applies to studies that indicate the impact of parking supply on car ownership. The literature review revealed that four main dimensions influence car ownership and the use of carsharing: socio-demographic dimension, residential (re)location dimension, attitudes and built environment dimension. With the aid of the literature a conceptual model has been made to show the relationships of these dimensions.

Mainly the socio-demographic dimension is researched well. However, the built environment and residential (re)location dimension in relation to carsharing remains scarce. Moreover, only one research was found by the author that includes parking requirement and carsharing. Also, this study did not include the built environment and residential (re)location factors. The created conceptual model shows that many other factors can describe the use of carsharing and change in car ownership in many ways. So in addition to parking requirements and offering shared cars, more factors must be taken into account. It is therefore not straightforward to measure the effects of parking requirements and offering car sharing on car ownership and carsharing use.

The research revealed that the stakeholder groups have not yet measured the effects. Also, it is shown that stakeholder groups do not draw firm conclusions about the possible effects. Since the cases that were investigated has not been around for long, the long-term effects may be different. To conclude, we have shown that most stakeholders expect that carsharing and a low parking requirement will decrease car ownership. Besides, stakeholders indicated that the change in car ownership depends on many other factors. Factors that are mentioned are characteristics of residents, the location of the residential building and the availability of the shared cars. The same applies to the effect of providing carsharing in combination with a low parking

requirement on the use of carsharing. The factors mentioned by stakeholder groups are the same factors as mentioned in the literature and included in the conceptual model. No conflicts were found in the intended goals of the stakeholders. All want to reduce the number of cars, better use of public space and are focused on sustainable mobility. However, experiences differ in the use of carsharing and the use of parking spaces. Two organisations experienced low use, and two experienced a high use. In addition to experiences with carsharing, the experiences concerning the use of parking spaces vary (which indicates the factor car ownership). Many parking spaces seem to be empty that belong to residential buildings. However, there are also examples showing that the garage is full. So the effect on the use of shared cars and car ownership is therefore not (yet) visible according to the stakeholders.

No significant differences were found between the two study samples. However, the results of the descriptive statistics of the collected data of the cases show small differences between the two groups (households that live in buildings with a low parking requirement and carsharing, and buildings without) in relation with car ownership. A higher percentage of the households in the selected cases did not have a car before they moved, and they had fewer cars compared to the control cases. However, a higher percentage of households dispose of their car in control cases. Although, none of the respondents indicated that they had disposed of the car because they were using a shared car, and only one household indicated that they had no parking space and therefore had disposed of the car. However, four households did give up their car and join carsharing. In relation to carsharing, a higher percentage of the households in the selected cases have a membership. However, a big part of these members does rarely use shared cars. In the sample, three accessors (households that had no car and joined carsharing) were present. However, it is not known how their travel behaviour used to be. Based on these results, it appears that people without a car may live in a residential building with a low parking standard. Offering shared cars will probably not decrease car ownership, households mainly have other reasons to dispose of their car.

To conclude, this research has shown that different factors influence car ownership and use of carsharing. Because of this, the relation between 'a low minimum parking requirement and offering carsharing' and the use of carsharing and car ownership, needs to be investigated indirectly. However, the factors that will have the most influence are socio-demographic factors, attitudes, residential relocation and the built environment. The effect of a low minimum parking requirement in combination with dedicated carsharing at a residential building on car ownership and use of carsharing appears in this sample as follow. The number of cars per households in a building with a low parking standard is lower. However, it often appears that people did not have a car beforehand. The residential buildings will therefore mainly attract people who did not already have a car. A low parking standard has no visible influence on the disposal of a car, when households dispose of their car this is not because they use a shared car. Moreover, offering a shared car does not have an evident influence on its use. However, no significant differences were found between the two groups. Besides, the use of the shared car and the car ownership of households may be explained by other factors.

5.2. Discussion

The results of this research are merely based on the selected cases. This means that the results are based on the features of these specific case. By using the selected cases, it means that the results are based on the insights gained from studying only these. Besides, the cases differ in several ways that are not included in the analysis. For example, the number of shared cars and parking policies. Therefore, the results can be different when using other cases. Moreover, the results of the data analysis are dependent on more factors that could be included in the study. Therefore, the use of shared cars or car ownership could also depend on factors other than those included in the study. Furthermore, the results are based on the residents who live there, while other people could give different results.

As discussed, the conceptual model shows that there are many indirect effects, therefore a Structural Equation Model would fit very well this study. However, the sample size was too small to build a Structural Equation Model. At the start of this study, the author could not have known that the number of respondents could not be achieved. It was thought that more cases met the selection requirements, two of the cases appeared to have no shared car or no low parking standard and could therefore not be included. Due to the small sample size, no significant differences could be found between the two groups, while these are probably there.

Which time is best to ex-post surveys is not clear, because it is not known how long it will take before people make a change in car ownership or car sharing. For this, it could be that if the survey were held later, this would lead to different results. The cases also differ in how long they have existed, which means that the

case is not analysed after the same length of time. Also, the moment of relocation may also differ from people, on which the change in travel behaviour may depend.

5.3. Limitations

The content of this research is to determine the effect of a low parking requirement in combination with carsharing on the change of car ownership and the use of carsharing by several important decisions and the use of applied research methods. The objective of this section is to reflect on the implications of these choices. Before mentioned limitations of research methods were discussed in Chapter 2.

5.3.1. Limitations cases

First, it was challenging to find cases that met the set requirements. It appeared that it is hard to find information about the parking requirement of buildings. Buildings with a lower parking requirement than 1 (not student accommodation) are very scarce, although a lot will be built soon. As all cases were located in Rotterdam or Utrecht, different cities could not be compared with each other. Furthermore, it influenced the small difference in built environment factors. Second, cases were found that proved to be irrelevant during the investigation, due to incorrect information. Cases have also been dropped because developers did not want their residential building examined. Third, it was initially decided that control cases should also have a low parking requirement. So a comparison could be made between a low parking requirement with and without shared cars. However, it turned out that cases with a low parking requirement could not be found or (yet) exist. Therefore, not all control cases have a low parking requirement. Fourth, the chosen sites have some similarities and differences, parking policies differ in every city in the Netherlands and even for specific residential buildings. It is not feasible to include all factors of different cases. To conclude, the limitations have led to a small number of cases. When a more extensive data set was gathered, it would have been possible to estimate a model. In addition, cases were included that later did not meet all requirements, which has led to less useful comparisons.

5.3.2. Limitations interviews

This study is limited to the Dutch stakeholders, while many findings may also apply to other countries. However, the relationship for the local context can differ because of cultural differences. Moreover, only interviews with municipalities in Amsterdam, Rotterdam and Utrecht were held. Policies and interests may differ between municipalities. Within municipalities, different departments exist, and these may have different interests that are not divided into this research. Also, local context differs within a country. Also, it must be noted that interviewees might have an interest which impacts their objectivity. The results may be different when other organisations or people were interviewed. More relations and motivations of people that may be important for this research to join carsharing or dispose of a car can be found by conducting more in-depth interviews with residents. Moreover, it was challenging to find the right people for interviews with the proper parties, and this took much time. It was also difficult to find residents who were willing to have an interview conducted. Due to privacy reasons, it is more difficult nowadays to get in touch with residents.

5.3.3. Limitations of the survey as a data collection method and execution

A practical limitation of this survey is that it was hard to execute the survey. None of the parties involved could or did want to help in setting up the survey among residents, which resulted in that the respondents could only be reached by visiting the respondents at their residential building. The author posted notes in peoples mailbox by hand, which is very time intensive. Besides, the author posts a message on Facebook with the same note. Due to lack of time, people have not been approached personally again. Not all cases could be reached by Facebook, which reduces that people were approached as random as possible.

5.3.4. Limitations of survey design

The survey would also be written in English, so foreigners and people that do not understand Dutch, could also complete the survey. Another limitation is that not all questions have been asked in the form of households; some questions have only been asked by the person who completed it, such as age, education, gender. It would be better if all the information were available from the entire household. In the survey only asked what the location of the previous home was for the respondent and not for the entire household, but people within one household can come from different homes. This leads to various changes in the built environment factors.

5.3.5. Limitations of built environment factors

The collected data of neighbourhood factors include many different variables. Furthermore, the data was very detailed and continuous. However, the data of the built environment was limited and could be measured more specific. The availability of shared cars can be measured in different ways, binary (exist or not), or distance to the closest shared car, the degree of availability of shared cars. Besides, the parking requirement could be measured better. First, there is uncertainty about the correctness of the parking standards, and it is also difficult to include the number of parking spaces when people can also obtain a permit. For this, it was needed to make assumptions. However, this data was not collected or available. Including more continuous data of the built environment will improve the exploration of the relations.

5.3.6. Limitations of Structural Equation Modelling

A discussion of the SEM models build in this research is described in Section 4.4.2. An underlying assumption for SEM is that the relationships should be significant to increase the model fit and describe the weights of the relations. However, this could not be met in this research. Underlying assumptions as the normality distribution of all variables were not fulfilled (Hooper et al., 2008). This research includes nonnormally distributed variables. Furthermore, the endogenous variable car ownership was categorical. For this, an alternative estimation, weighted least square parameter (WLSMV) should be used instead. WLSMV does not require large sample sizes. The sample size was a problem in this research. However, the use of WLSMV will still require more respondents than used in this research to be able to measure relationships (Yuan & Bentler, 2000). Ideally, the conceptual model would include all found factors and described the parking requirement factors and the number of sharing cars both with a ratio variable. Besides, the sample size needs to be extended. However, with the limited time and budget available, it was not possible to obtain a larger sample size. More research is required to prove the causalities statistically.

5.4. Recommendations

Finally, based on the conclusion, discussion and limitations, recommendations for future research and practice are given in this section.

5.4.1. Recommendations for research

This study provides a starting point for having insights into the effects of residential buildings with a low parking requirement and carsharing on the use of carsharing and car ownership. There is more research needed for the interrelationships between the specific variables. More locations must be analysed, so differences between built environment factors and policies can be determined. Besides, more respondents must be collected. A structural equation model can be made when having a larger sample, in which significant direct and indirect relationships can be found. In this way, it can be proved whether the low parking standard in combination with shared cars at a residential building influences car ownership and use of carsharing.

The results of this study are based on only a small number of residents, therefore it cannot be determined based on this study whether, and how, to adopt a reduction in the parking requirements for residential buildings with access to carsharing services. For example, the case study in which the organisation that indicated that shared cars were used a lot, had few respondents. Therefore it could be that carsharing use is much higher than shown in this study. Moreover, why these differences exist between these two examples has not been investigated, and could provide essential insights.

5.4.2. Recommendations for practice

To decrease car ownership and increase the use of carsharing, some recommendations for practice can be considered for developers and municipalities.

According to the literature, the typical carsharing users are between 25 and 35. The household type is defined as living alone or a household with young children. Besides, users are employed and high educated. For this, developers should focus primarily on homes where this target group lives when offering sharing cars to residential buildings.

During the interviews with the various parties, it emerged that not all residents with a low parking standard were aware of the number of parking spaces and that they could not obtain a parking permit on the street. It is important that developers communicate this clear to their residents when selling the houses. In addition, it turned out that some cases municipalities have given a parking permit to residents that were excluded. However, this may result in that the parking policies become even more unclear to residents. In this

way, residents can remain hopeful that they can get a parking permit. It is better if municipalities do not make exceptions. Moreover, it has also been shown in this study that when residents do want a car and do not have a parking space, they will look for a different solution of their own. In this way, the goal can be achieved that fewer cars will be in the city centre, and other empty parking spaces will be filled.

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Appendices

A

Paper

An extra requirement to obtain the Master of Science in Transport, Infrastructure and Logistics degree, a scientific paper is written.

The effect of a low minimum parking requirement in combination with carsharing on the use of carsharing and car ownership

C.E. van den Berg, Dr. J.A. Annema, Dr. ir. G. Correia and Prof. dr. G.P. van Wee

***Abstract*—In this paper, we study the effect of a low parking requirement in combination with dedicated carsharing at a residential building on car ownership and use of carsharing. This paper aims to develop a conceptual model to describe these effects. Comparable to customary theories in transport geography, this conceptual model includes socio-demographic factors, attitudes, residential relocation and the built environment. Besides, the interests, goals and experiences of stakeholders that include these combinations are analysed. The analysis is based on a series of 12 semi-structured interviews with carsharing providers, municipalities and developers in the Netherlands. Using two examples of residential buildings that include a low parking requirement and carsharing, this article examines to what extent parking requirement and offering carsharing leads to a reduction of car ownership and use of carsharing compared to control cases. Based on online surveys (n=18/68) carried out, descriptive analyses and binary analysis were performed.**

The findings show that the stakeholders have the same goals. However, they have different experiences regarding car use and car ownership. The effects on car ownership and use of carsharing may also be influenced by other factors that are described in the conceptual model. Lastly, the findings of the differences between the selected and the control cases, show that it often appears that households in the selected cases did not have a car beforehand. Moreover, offering a shared car does not have a clear influence on its use. However, the use of the shared car and the ownership of the shared car may be explained by other factors. Moreover, the differences are not statistically significant.

***Keywords*—Carsharing, Parking Requirement,Car Ownership, Residential Development**

I. Introduction

The population in the Netherlands continues to grow, especially the number of residents in larger municipalities continues to increase (Kooiman, de Jong, Huisman, van Duin, & Stoeldraijer, 2016). As a result, the number of cars in cities is growing, which causes more traffic jams and air pollution. Due to population growth, municipalities also have to deal with urban densification and transformation. At the same time, the public space is under pressure. Besides, municipalities want more green areas and playgrounds for children. Parked cars now occupy this space (van den Eerenbeemt, 2018). For these reasons, among others, municipalities therefore want to reduce car ownership.

In February, 2018 the 'City Deal[1] about electrical carsharing[2] in urban area development' was signed. This agreement stated that in seven cities in the Netherlands, have to deliver at least two innovative housing projects over the next three years. These projects shall deliver a total of 200 shared electric cars and more than 5,000 houses. . This may result in need of less parking spaces (Rijksoverheid, 2018).

One of the possible solutions to decrease the number of private cars is to change parking regulations, especially a reduction of the minimum parking requirements[3] for buildings is mentioned (Gragera & Albalate, 2016). In addition, carsharing is often seen as a solution to decrease the number of private cars. One of the ways to reduce parking requirements is through carsharing. Rotterdam, Amsterdam and Utrecht have included an exemption in the parking requirements; when developers offering shared cars for a minimum of 10 years, the parking requirement is expected to be reduced by 20% (Gemeente Rotterdam, 2018). However, it has not been researched what impact parking requirements in combination with providing carsharing have on car ownership.

This study provides new insights into carsharing usage and car ownership in residential developments by providing dedicated carsharing [4] and a low minimum parking requirement.

This paper is structured as follows. First, the research problem is explained in section II. Second, in section III the methodology is outlined which describes how the results of

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[1]The City Deal 'electric sharing mobility in urban area development' is the starting point for a 3-year program, in which 2 ministries, the province of South Holland, the 7 cities and large private parties will gain experience together in sharing electric cars in combination with solar energy generated by homes. In each city at least 2 building projects will participate in the coming 3 years.

[2]'Carsharing' refers to a model where cars can be rented for shorter periods of time, there are different forms of carsharing, for example, Peer-to-Peer (SnappCar) or B2C (GreenWheels).

[3]A parking requirement is the minimum number of parking spaces that should be realised for a particular function of a building that is set by the municipality: such as a home, office or facility.

[4]Dedicated carsharing refers to shared cars that must be parked back at the dedicated space.

this research are obtained. In section IV, the results of this study are discussed. The last section, section V, provides the concluding remarks.

II. Research Problem

Many researchers (Liao, Molin, Timmermans, & van Wee, 2018; Millard-Ball, Murray, & ter Schure, 2006; S. Shaheen & Cohen, 2007) expect that there will be a relationship between the number of parking spaces and carsharing use, but this has not been investigated. Therefore this study analyses this effect. In addition, many studies look at the effects of carsharing on car ownership or at the effect of parking requirements on car ownership. However, what now appears is that in many cities carsharing will be provided in areas with a low number of parking spaces. For these specific cases, it is necessary to study the effects together on car ownership. The only research, to the author's knowledge that combines carsharing and parking supply in its research, is Engel-Yan and Passmore (2013).

However, travel behaviour and cities are both very complex systems. Travel behaviour may be the result of indirect effects, and the dependent variables (car ownership and use of carsharing) may be the interdependencies. Several studies (Christiansen, Engebretsen, Fearnley, & Usterud Hanssen, 2017; Christiansen, Fearnley, Hanssen, & Skollerud, 2017; Groote, Ommeren, & Koster, 2016; Guo, 2013) have concluded that there is a relationship between the number of parking spaces and car ownership. As well, several studies (Cervero, Golub, & Nee, 2007; Firnkorn & Müller, 2011; Giesel & Nobis, 2016; Klincevicius, Morency, & Trépanier, 2014; Lane, 2005; Le Vine & Polad, 2017; Martin, Shaheen, & Lidicker, 2010; Momo, 2009; S. A. Shaheen & Cohen, 2012) concluded that there is a relationship between carsharing use and car ownership. These studies show that carsharing members reduce their vehicle holding. Although no scientific research has investigated the direct and indirect impact of residential buildings with low parking requirements in combination with providing carsharing on car ownership and use of carsharing, which seems to be a promising development according to several parties.

Given the challenges of the cities, the fact that carsharing is seen as a solution in urban development and the lack of insight into the combination of providing carsharing and a low parking requirement: The research goal is to determine the effect of combining the two opportunities, a reduction of the minimum parking requirement and providing carsharing on the change of car ownership and the use of carsharing of residents (See Figure 1).

For this study, the main research question is as follows:

What is the effect of a low minimum parking requirement in combination with dedicated carsharing at a residential building on car ownership and the use of carsharing of households?

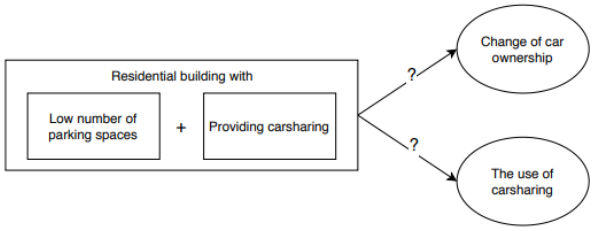

Fig. 1: Visualisation of the effects to be investigated

III. Research Approach

For this study, a combination of qualitative and quantitative methods are used to give a substantive answer to the main research question.

First, a literature review is conducted to identify scientific gaps. Besides, the literature review indicated factors that may influence car ownership and use of carsharing. The literature review aimed to research the effects. The factors that influence the dependent variables according to the literature are placed in a theoretically conceptual model. The conceptual model (Figure 2) visually represents the cause-effect relationships theoretically. Also, the conceptual model is used to make a simplified conceptual model to quantify the relationships with the collected data, because not all factors can be measured in this study.

Second, to test the conceptual model, insights from practices are gained. Desk research is used to identify projects in current practice. Four residential buildings were chosen for interviews to gain more insights. The projects were chosen, because they were all situated in different cities, had different developers and different carsharing providers. Interviews were held with municipalities, developers and carsharing organisations. The interviews gave insight into the goals and experiences of the stakeholders with the low parking requirement in combination with dedicated carsharing.

Thirdly, to analyse the conceptual model, data of the projects was needed. To see differences in households with and without a low parking requirement and dedicated carsharing, data was collected for both groups. Six control cases (without the combination) were located in the same area as the two selected cases (with the combination). A data collection of the built environment was performed using a Geographical Information System and desk research. Socio-demographic characteristics of households have been collected through a survey. In this survey, questions about the households' car ownership and use of carsharing before and after the residential move were asked.

Lastly, the outcomes of the survey, combined with the collected built environment data, were statistically analysed.

IV. Main findings

The purpose of this research is to determine the effect of a low minimum parking requirement in combination with dedicated carsharing at a residential building on car ownership and the use of carsharing of households. The main findings of factors that influence car ownership and use of carsharing will be discussed with the use of the conceptual model. In addition, the main findings of the stakeholders are described. Last, the main findings concerning the conceptual model based on the study sample are given.

The literature reviewed that more factors influence car ownership and use of carsharing. The four dimensions that are mentioned most are socio-demographic characteristics, residential relocation, attitudes and built environment. The relationships between these dimensions and the dependent variables 'change of car ownership' and 'use of carsharing' can be described in many ways. Figure 2 shows the created conceptual model that describes the relationships between socio-demographic characteristics and change in the use of carsharing through intermediary factors theoretically, the model was established with different theories and models (Cao, Mokhtarian, & Handy, 2009; Heinen, Wee, Panter, Mackett, & Ogilvie, 2018a; Van Acker & Witlox, 2010). The relationships in the conceptual model will be explained below. Numbers represent the relationships, and the factors are shown in bold in the text.

Studies about the influence of **socio-demographic characteristics** on **carsharing** are scarce. To make a conceptual model based on theory, theories about travel behaviour is used. Travel behaviour is the study how people use transport, for example, carsharing use, theories about the change of travel behaviour are widely researched and are therefore used here to describe the dependent factor **use of carsharing**. It is known from the literature that travel behaviour is dependent on **socio-demographics** [1]. The typical carsharing member is young; their household type is single or exists of households with young children. Besides, members are mostly highly educated, employed and have a high income. It appears that **socio-demographic characteristics** are often interdependent. For example, having a job has an impact on income, and therefore on having a car, which affects travel behaviour. The literature review shows that age, income, household type, employment status, and education level are all related to each other and influence **car ownership** [6]. In addition, the **residential (re)location** is also related with **socio-demographic factors** [3b]. Personnel preferences and **attitudes** for housing unit characteristics and **built environment** play a role with choosing the **residential location** [3a]. **Attitudes** are psychological constructs, mental and emotional. **Attitudes** are independent, however **attitudes** can depend on **socio-demographic characteristics** [2]. **Attitudes** and **socio-demographic** influence the same factors, and are therefore represented in one box in this conceptual model. **Residential relocation** often happens simultaneously with other life events [5]. Attitudes can also vary over time, in the conceptual model, a factor **change in attitudes** is therefore included. The change in attitudes can depend on the residential relocation [8a, 8b], on the change in car ownership [15], and the change in the use of carsharing [13]. By all means, the **residential relocation** might increase or decrease the **car ownership** of a household (Toasin et al., 2014) [5a]. Besides, this relation might correlate [5b]. The same applies to the relations between residential relocation and change in the use of carsharing [4a, 4b].

A **residential relocation** will cause a **change in the built environment** [18]. A **residential relocation** will cause a **change in the built environment** [18]. Several studies (Burkhardt & Millard-Ball, 2006; Cervero, 2003; Jorritsma, Harms, & Berveling, 2015; S. A. Shaheen & Rodier, 2015) indicated that the **use of shared cars** is higher in densely populated areas and in the very strongly urban areas. Previous studies found a significant relation **between built environment** and travel behaviour [11]. Self-selection may disturb this association, self selection is "the tendency of people to choose locations based on their abilities, needs and preferences" (Litman & Steele, 2018). In the conceptual model, several indirect relations between **change in built environment** and **change in use of carsharing** are indicated. These indirect relationships ensure that self-selection is included in the model. Heinen et al. (2018a) concluded that there is no single perfect conceptualisation that applies for everyone, therefore all options are included in this conceptual model. For example, **attitudes** can have an influence on the relationship self between **built environment** an **use of carsharing** [17]. Another example is the **change in attitudes** that indirect influence **built environment** and **use of carsharing** [9, 12, 14, 16]. The same applies for **change in built environment** and **change in car ownership** [7, 10, 9, 14].

The conceptual model shows that use of carsharing and change in car ownership can be described by many other factors and in many ways. So in addition to parking requirements and offering shared cars, more factors must be taken into account. It appears that it is very complex to describe how the change is influenced, and measuring it is therefore very difficult. This is confirmed with the results of the interviews with carsharing providers, municipalities and developers. The carsharing organisations indicated that the preferences of people are essential; if this is properly anticipated, the use of shared cars can be increased. Besides, municipalities and developers focus on specific socio-demographic factors, mid-tenants and young urban people. These people are also seen as typical users, according to literature. The experiences concerning the use of shared cars vary. Two organisations experienced low use, and two experienced a high use.

[5] Moments in life that have a strong influence on (the financial needs of) a person or household, such as: leaving home, moving out, cohabiting/getting married, having children, breaking up, retirement.

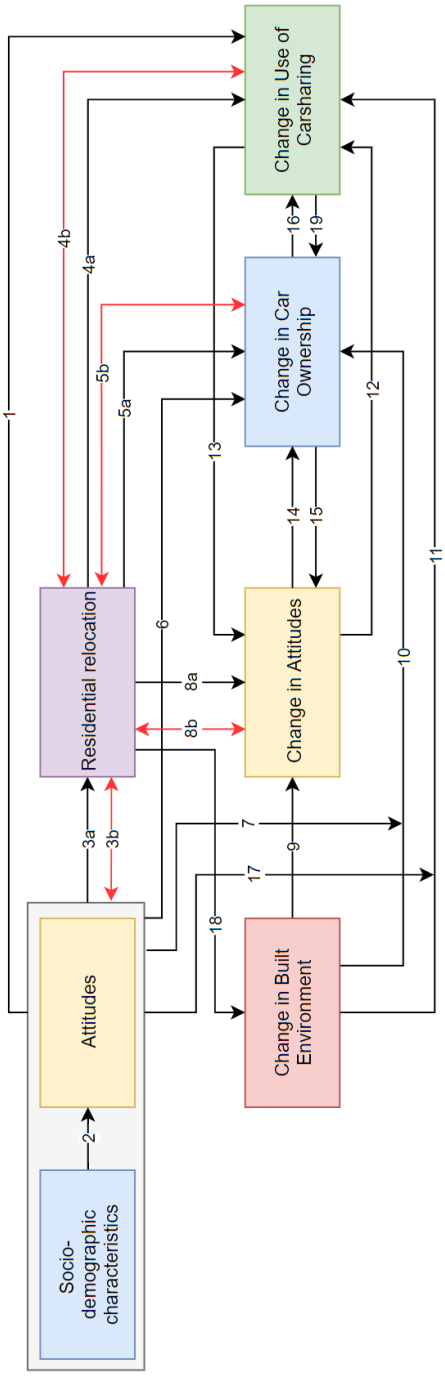

Fig. 2: A Conceptual Model describing the relationships between socio-demographic and change in use of carsharing through intermediary factors (a black single-headed arrow represent causation, the red double-headed arrow represents correlation)

TABLE I: Overview of stakeholders interests, goals, and experiences regarding to carsharing and parking requirements

	Interests	**Goals**	**Experiences**
Carsharing providers	Market expansion	Reduce the number of cars, better use of space and better air quality	The carsharing concepts are used less than expected, only in one case they are used more than expected. People find sharing cars and electric cars exciting, people are used to their private cars. People have a habit that is hard to break. People must be motivated to use shared cars (for marketing, discount, calculation tools, etc.). People have preferences for a car that is nearby or in the building, and the service level needs to be high.
Developers	Optimal use of space, market expansion	Provide a service, provide mobility, economically, to increase liveability, environmental, to have less congestion, to go along with the latest development, to build less parking spaces, lower CO2 emissions	People can have a preference for a petrol car or an electric car. People find sharing cars and electric cars exciting. Parking spaces have never been sold all, however people still want parking spaces. Besides, people park their car somewhere else or sell their car. The carsharing concepts are used less than expected and are not (yet) profitable, but other cases conclude that the shared cars are used very well. People have a habit that is hard to break. It is not possible to have more green.
Municipalities	Improve the quality of city with reduce carbon emissions, improve air quality, optimal use of land use	Carsharing is used to reduce car ownership. The discount is an incentive for car sharing in new area developments. Reduce development costs and create more flexibility for developers.	People find sharing cars and electric cars exciting. There are many parking spaces empty and there are garages occupied. Communication about parking spaces not always clear for residents, exceptions have been made and people have nevertheless received a permit.

In addition to experiences with carsharing, the experiences concerning the use of parking spaces vary (which indicates the factor car ownership). Many parking spaces seem to be empty that belong to residential buildings. However, there are also examples showing that the garage is full. It appears that the effects of the cases interviewed differ, and besides, the effects may also be influenced by other factors such as those in the conceptual model. An overview of the interests, goals and experiences of developers, municipalities and carsharing providers with providing low parking requirement and carsharing services are presented in Table I.

It is difficult to indicate whether parking standards and the offering of shared cars affect car ownership and use of carsharing. Therefore, data were collected to measure the effects and see the differences between the two groups. Based on the following criteria, 2 survey cases were identified:

- The building should have a lower parking requirement than 1.
- The project has shared cars on their property.
- All residents that live in the building are not allowed to get an on-street parking permit from the municipality.
- The buildings are located in one of the major cities in the Netherlands, in the inner centre.
- The houses of the project must be occupied for at least three months.
- The buildings may not consist of student accommodation only.

Besides, six control cases were identified, the buildings are located in the same defined area of the municipality as the selected cases. Surveys were mailed to all households of the units. This covered 86 units out of a possible 761 (11.3%).

The results of the descriptive statistics of the collected data of the cases show small differences between the two groups (households that live in buildings with a low parking requirement and carsharing, and buildings without) in relation with car ownership. The following differences are not significant but show the descriptive of the two groups. The descriptive aims to summarise the sample, but cannot be used to learn about the population. In the sample, a higher percentage of the households in the selected cases did not have a car before they moved, and they had fewer cars compared to the control cases (Figure 3). However, a higher percentage of households dispose of their car in the control cases (Figure 4). Although, none of the respondents indicated that they had disposed of the car because they were using a shared car, and only one household indicated that they had no parking space and therefore had disposed of the car. However, four households did give up their car and join carsharing.

In relation to carsharing, a higher percentage of the households in the selected cases have a membership (Figure 5). However, a big part of these members does rarely use shared cars (Figure 6). In the sample, three accessors (households that had no car and joined carsharing) were present. However, it is not known how their travel behaviour used to be.

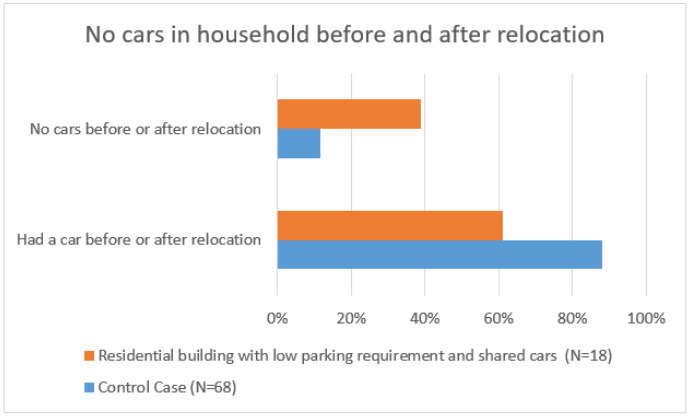

Fig. 3: Households with no cars before or after relocation

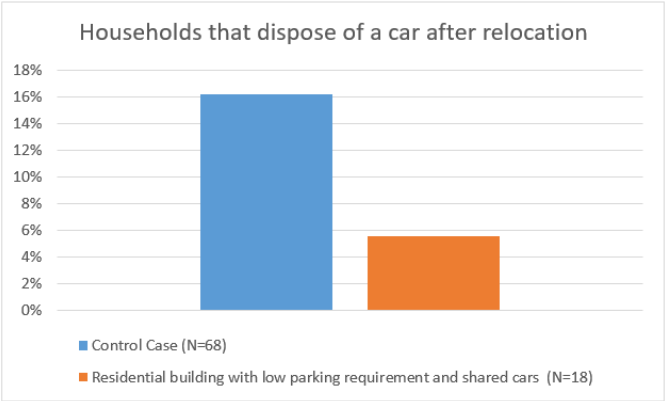

Fig. 4: Households that dispose a car after relocation

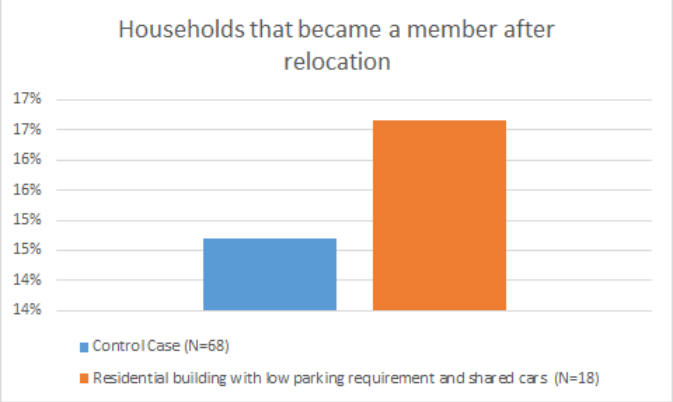

Fig. 5: Households that became a member after relocation

Further, there are no notable differences in the use of carsharing. The correlations between the dependent variables and the distinction of the two groups do not show any significant associations. However, this sample shows some small

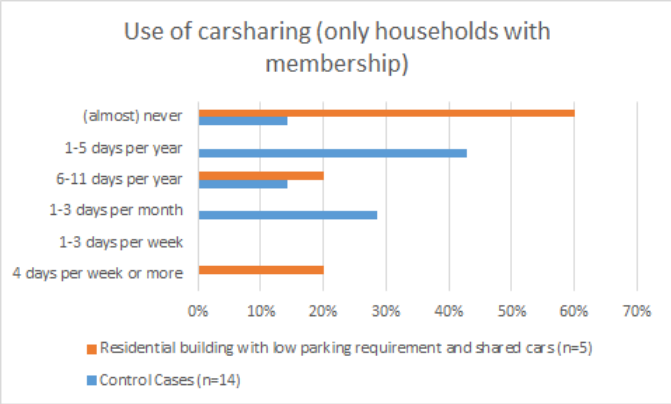

Fig. 6: Use of carsharing (only households with membership)

differences. It must be noted that this is only the direct effect; it was intended to make a structural equation model to analyse the pure effect. Despite the model fit was overall good, it did not succeed to test the hypotheses with the use of multi-group analysis. This is devoted to the sample size.

V. Conclusion

To conclude, this research has shown that different factors influence car ownership and use of carsharing. Because of this, the relation between 'a low minimum parking requirement and offering carsharing' and the use of carsharing and car ownership, needs to be investigated indirectly. However, the factors that will have the most influence are socio-demographic factors, attitudes, residential relocation and built environment.

The effect of a low minimum parking requirement in combination with dedicated carsharing at a residential building on car ownership and use of carsharing, appears in this sample as follow. The number of cars per households in a building with a low parking standard is lower. However, it often appears that people did not have a car beforehand. The residential buildings will therefore mainly attract people who did not already have a car. A low parking standard has no visible influence on the disposal of a car; when households dispose of their car this is not because they use a shared car. Moreover, offering a shared car does not have a clear influence on its use. However, no significant differences were found between the two groups. Besides, the use of the shared car and the car ownership of households may be explained by other factors.

The results of this research are merely based on the selected cases. This means that the results are based on the features of these specific case. By using the selected cases, it means that the results are based on the insights gained from studying only these. Besides, the cases differ in several ways that are not included in the analysis. For example, the number of shared cars and parking policies. Therefore, the results can be different when using other cases. Moreover, the results of the data analysis are dependent on more factors that could be included in the study. Therefore, the use of shared cars or car ownership could also depend on factors other than those included in the study. Furthermore, the results are based on the residents who live there, while other people could give different results.

As discussed, the conceptual model shows that there are many indirect effects, therefore a Structural Equation Model would fit very well this study. However, the sample size was too small to build a Structural Equation Model. At the start of this study, the author could not have known that the number of respondents could not be achieved. It was thought that more cases met the selection requirements, two of the cases appeared to have no shared car or no low parking standard and could therefore not be included. Due to the small sample size, no significant differences could be found between the two groups, while these are probably there.

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B

Travel behaviour models and theories

Table B.1: Overview of reason for move (Ihrke, 2014)

Reason for move	Description
Family-Related	
Change in marital status	Person moved because of family formation or dissolution resulting in a change to their marital status.
To establish own household	Moved out of an existing household in order to establish a separate one.
Other family reason	All other family-related reasons not listed above.
Job-Related	
New job or job transfer	Moved because of a new job or location of existing job moved. This can include military transfers.
To look for work or lost job	Moved in order to find work or due to a loss of employment.
To be closer to work/easier commute	Moved to be closer to their work and/or reduce their commuting time.
Retired	People who, after retirement from a job, changed their place of residence.
Other job-related reason	All other job-related reasons not listed above.
Housing-Related	
Wanted own home, not rent	People who wanted to own their home and not rent a house/apartment.
Wanted new or better home/apartment	People who wanted to move from their current home/apartment to a new, bigger/better house/apartment.
Wanted better neighbourhood/less crime	Moved to improve the neighbourhood of their residence and/or moved to an area with less crime.
Wanted cheaper housing	Moved to a cheaper/less expensive house/apartment.
Foreclosure/eviction	Moved due to a foreclosure or eviction.
Other housing reason	All other housing-related reasons not listed above
Other Reason	
To attend or leave college	People who move to attend or leave college.
Change of climate	People who moved to a better climate.
Health reasons	People who moved for health-related reasons, either of the individual or another person.
Natural disaster	People who were forced to move due to a natural disaster.
Other reasons	All other reasons not listed.

Table B.2: Overview of variables used in the research of (Scheiner et al., 2013)

Variables	**Measured by...**
Household context (state and change)	Number of adults and number of children in the household before the last relocation (baseline value); change in the number of children and in the number of adults in the household (individuals aged 16 and older count as adults in the data)
Car ownership (state and change)	Number of cars in the household before the last relocation; change in the number of cars since then
Relocation type	Derived from the difference in urbanity between the current and the previous place of residence
Built environment changes	Change in the quality of shopping facilities and services (used for non-motorised transport (NMT) models); change in the quality of the PT system (used for car and PT models) after the relocation
Changes in location attitudes	Change in level of satisfaction with shopping facilities and services after the relocation (used for NMT models); change in level of satisfaction with PT after the relocation (used for car and PT models)
Travel mode use changes	Estimated change after the last residential move in the frequency of use of four transport modes: the private car, PT, bicycle, and walking
Duration of residence	Duration of residence in the dwelling as well as in the neighbourhood in years (used only for control analyses)

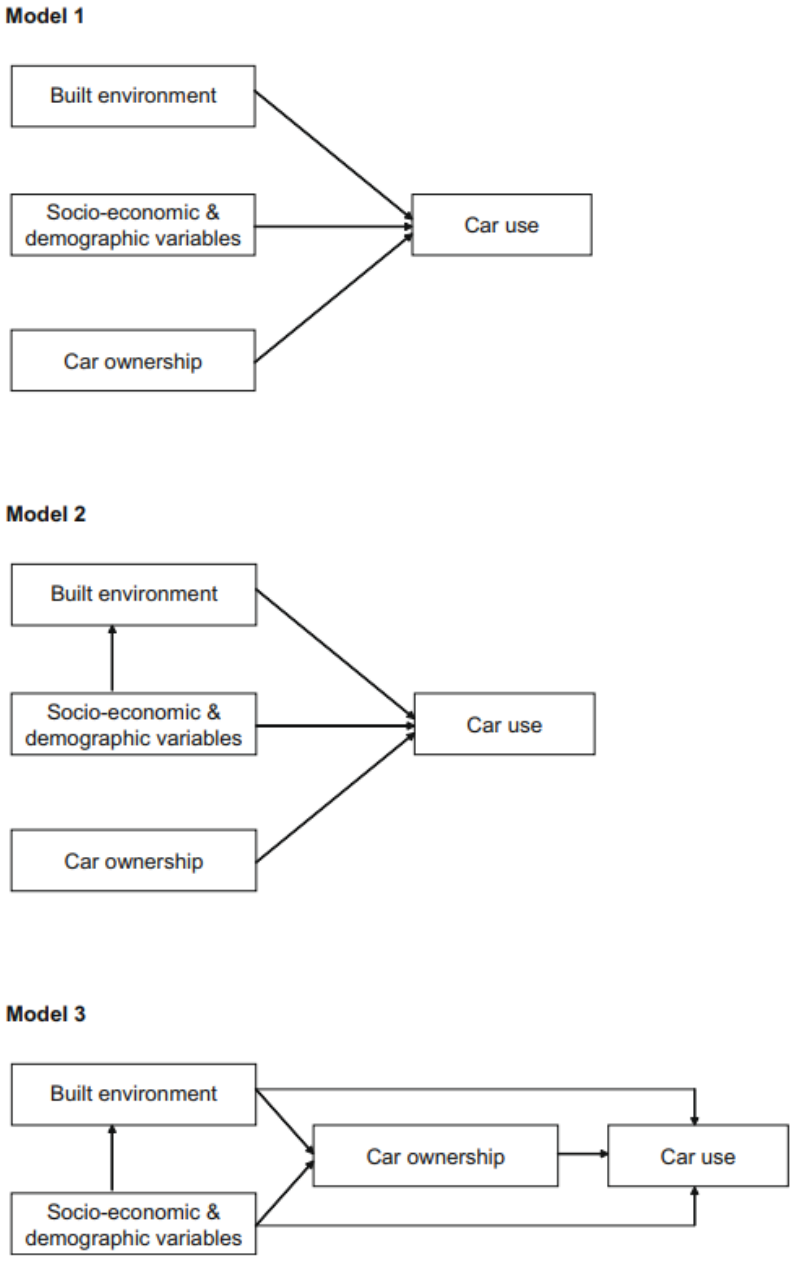


Figure B.1: Conceptual model describing the relationships between the built environment and travel behaviour (Van Acker & Witlox, 2010)

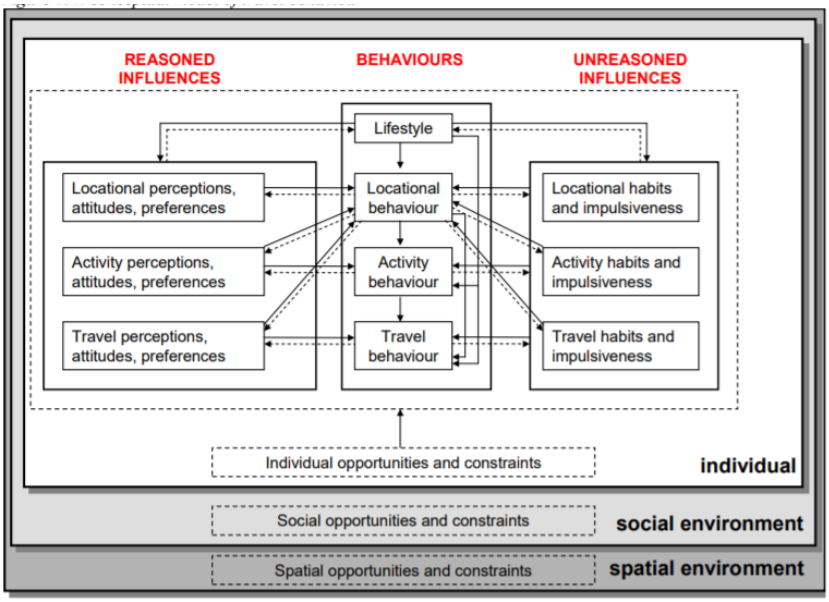


Figure B.2: A conceptual model of travel behaviour (Van Acker et al., 2010)

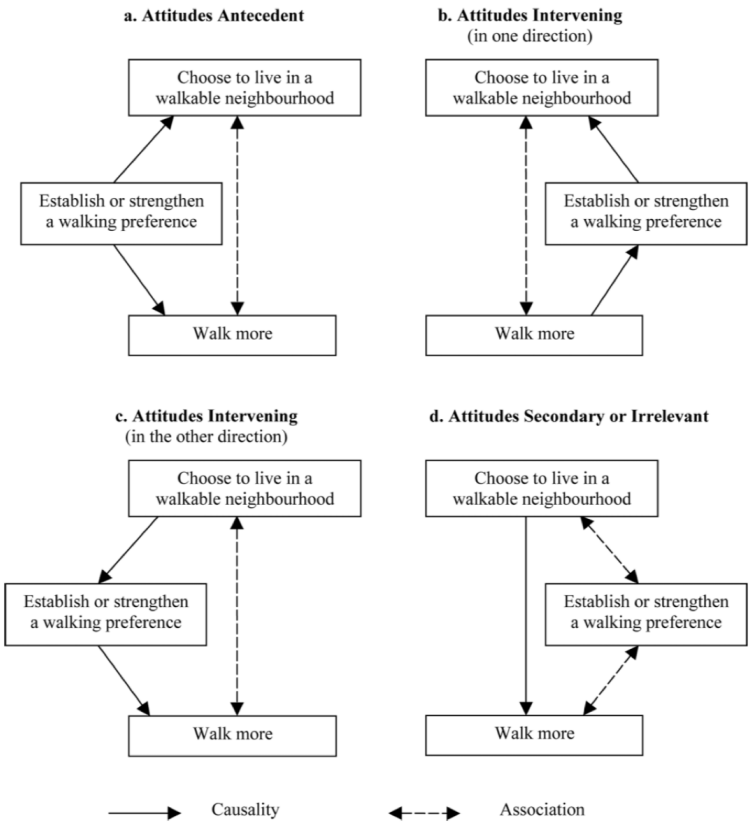


Figure B.3: Some potential relationships among travel attitudes, built environment and travel behaviour (Cao et al., 2009)

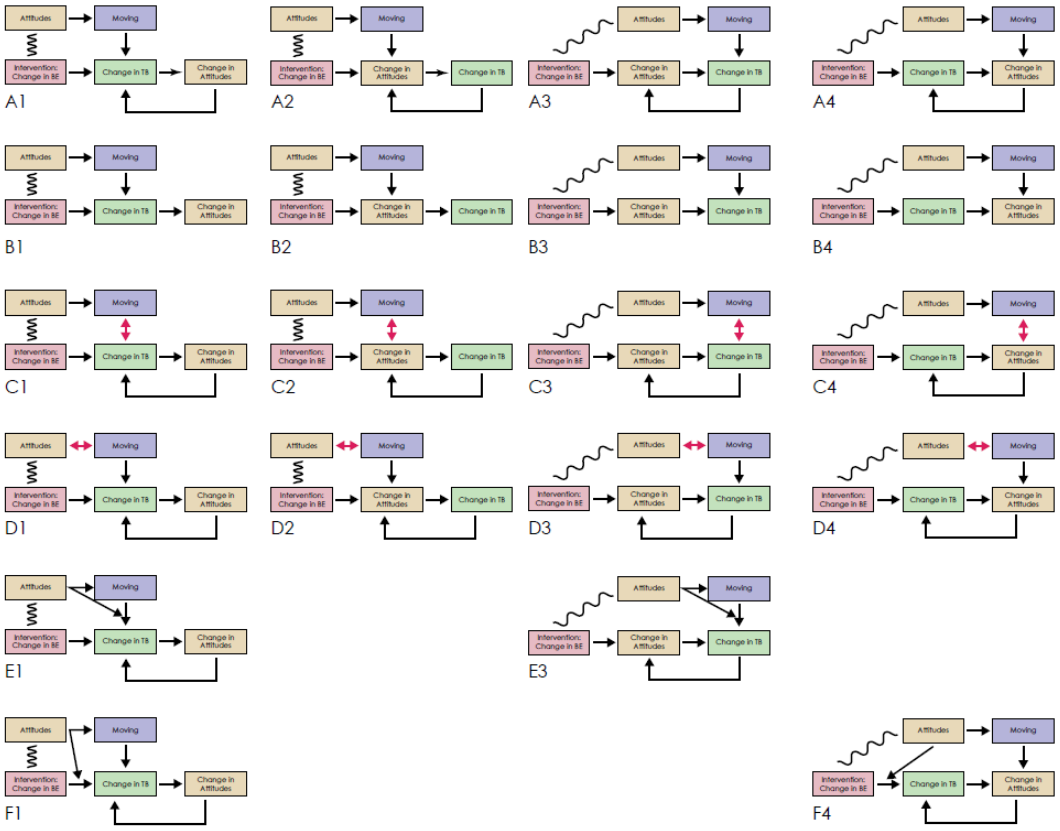


Figure B.4: Conceptualization of the relationship between the built environment, travel behavior, and attitudes for movers in quasi- and natural experimental studies (Heinen et al., 2018)

C

Parking requirement in Amsterdam, Rotterdam and Utrecht

C.1. The role of municipalities

Based on the interviews with policy makers and advisors of mobility of the municipalities, it has been found that little can be said about the effects. The parking requirements in combination with the new exemptions about offering shared cars are very new. Therefore, only a few buildings include both and do not exists for long. So, they say they cannot really conclude about the effects yet. However, their are some experiences. For example, the parking garages of residential buildings are in some cases half empty. Residents of these buildings do not get permission for street-parking, but in some cases the municipality still gave these, due to the fact that the garages are completely full and the communication from developers to residents was unclear. What interviewees also think is that the effect of a low parking requirement depends very much on the target group for whom the low parking standard has been applied. The municipality draw up the policies, but the effect will be determined by how developers will react. However, the municipalities have noticed that fewer parking spaces are being built due to their parking requirements. The intended effect is to use the space better, for example for cyclists. However, they think it is important that sufficient parking spaces are offered. Furthermore, a municipality is a very large organisation. Causes that within a municipality there might be different interests.

Municipalities draw up a parking policy to achieve certain goals. However, how people and developers deal with the parking policy determines the final effect. The parking policy drawn up by the municipalities interviewed is as follows. The municipalities have set a minimum and / or maximum parking requirement that a developer must adhere to. The purpose of the minimum parking requirement is that there are enough parking spaces. The aim of a maximum parking requirement is that not too many parking spaces are built, so that the land space can be used optimal. In addition, the intended effect of the minimum parking requirement is to reduce the number of cars. The parking requirements depend on various factors, because car ownership is thought to depend on different types of characteristics of residential homes, and therefore on the characteristics of people. The parking requirement depends on the location of the buildings, since municipalities see that this is related to the needs of people. Besides municipalities have added in their parking policy that developers can get a discount on the number of parking spaces by offering shared cars. In this way, municipalities want to create the preconditions for further growth of carsharing. The intended effect of carsharing is also to reduce car ownership. Both the low parking requirement and the offering of shared cars will have to contribute to reducing car ownership.

C.2. Parking requirements in Amsterdam, Rotterdam and Utrecht

According to Shoup (1999) parking requirements have to be flexible, and should not be determined by national guidelines. The parking norms have to find a good balance between the needs of public organisations and private developers. An important argument for municipalities is that they do not want to promote car usage, for developers it applies that they want low building costs (Mingardo et al., 2015). What municipalities could do is to take into account the total parking facilities in the entire area when determining the parking

need and make use of the existing parking facilities. Besides, the policy-makers could include the accessibility by other modes (such as public transport). The parking requirement in the Netherlands differs from 0,3 till 3,0 (Provincie Zuid-Holland, 2017). On top of that, mostly a parking norm for visitors of 0,3 must be handled. In Table C.1, Table C.2 and Table C.3 an overview of parking requirements for the cities Amsterdam, Rotterdam, and Utrecht is given. It is important to know what the current parking standards are for the selected cases. For example, it is useful to know what factors municipalities use to differentiate between their parking standards (BPD, 2018). In this research, it will be investigated with which factors car ownership is related. Furthermore, the parking requirement can be based on the minimum or maximum requirement. Rotterdam only has a minimum parking standard, while Amsterdam and Utrecht use a minimum and a maximum. As can be seen in the tables, the parking requirement is differentiated by the location (zone), the type of the building, and the size of the home. Another theme that can be included according to BPD (2018) is property type (rented or purchased).

Table C.1: Parking requirements of Amsterdam (Gemeente Amsterdam, 2017)

	Zone A		**Zone B**		**Zone C**	
Residential function (m2 gbo)	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**
<30 m2	0	1	0,1	1		
30 - 60 m2	0	1	0,3	1	Custom	Custom
>60 m2	0	1	0,6	1		
Social- en medium rent	0	1	0	1	Custom	Custom

Table C.2: Parking requirements of Rotterdam (Gemeente Rotterdam, 2018)

Residential function (m2 gbo)	**Zone A**	**Zone B**	**Zone C**
<40 m2	0,10	0,10	0,10
40-65 m2	0,40	0,50	0,60
65 – 85 m2	0,60	0,80	1,40
85 – 120 m2	1,00	1,00	1,60
>120 m2	1,20	1,20	1,80

Table C.3: Parking requirements of Utrecht (Gemeente Utrecht, 2013)

	A1 en A2		**B1**		**B2**		**C1**		**C2**	
Residential function (m2 gbo)	**min**	**max**	**min**	**max**	**min**	**max**	**min**	**max**	**min**	**max**
<55 m2	0.38	0.80	0.43	0.80	0.50	0.80	0.60	0.80	0.60	0.80
55-80 m2	0.83	1.20	0.94	1.20	1.10	1.20	1.20	1.40	1.30	1.50
80 - 130 m2	0.90	1.40	1.02	1.40	1.20	1.40	1.35	1.60	1.60	1.80
>130 m2	0.98	1.50	1.11	1.50	1.30	1.50	1.50	1.75	1.70	2.00
<45 m2 studentcomplex	0.10	0.30	0.10	0.30	0.10	0.30	0.10	0.30	0.10	0.30

Exemptions for parking requirement

The municipality of Rotterdam adjusted the parking standards in 2018, because of the changing mobility and innovations (Gemeente Rotterdam, 2018). To introduce more flexibility in the parking standards, special exemptions are possible. For example, if a development is realized in the vicinity of public transport stations,

the parking requirement can be reduced by -5% to -50%. If development is equipped with additional bicycle parking facilities on site, a reduction of 10% can be applied. Offering shared cars for at least 10 years can reduce the parking requirement with 20% and/or making Mobility as a Service (MaaS) available to residents for at least 10 years can apply a reduction of 20% (Gemeente Rotterdam, 2018). In Amsterdam and Utrecht they have also drawn up similar exemptions. To illustrate the impact of the exemptions in each jurisdiction, in Table C.4 an overview of the exemptions for parking requirements is given, including the cities Amsterdam, Rotterdam, and Utrecht. The municipality of Amsterdam changed its parking requirement in 2017. The parking note of Utrecht consists of 2013, however, Utrecht will come up with a new version in 2019. Where according to the alderman it will even be up to 0.3 or lower in some parts of Utrecht (Huisman, 2019). The new parking standards and exemptions are very important for this study,

The parking standards with the exemptions are very new, not many buildings have yet been delivered using the new parking requirements. Therefore, the effects are not yet known. In Section 4.1, interviews with the municipality and developers will examine what the expected and experienced effects are.

Table C.4: Overview of exemptions for parking requirement. Data from (Gemeente Amsterdam, 2017; Gemeente Rotterdam, 2018; Gemeente Utrecht, 2013)

	Amsterdam	Rottedam	Utrecht
Nearby Public Transport	included	-5% till -50%	included
Offering bicycle parking facility on site	-	-10%	-10%
Offering shared cars	-20%	-20%	-20%
Making MaaS available	-	-15% till -25%	-

Moreover, the percentages of the exemptions can be added together, so if a developer include all these opportunities the parking requirement can be reduced with 100%. A condition for the lower parking standard on site is that residents of new projects lose their right to a parking permit on the street. To get an idea of the parking permission prices and the parking price of the selected projects, an overview is made in Table C.5. Furthermore, these parking prices should also be taken into account when drawing conclusions, because a parking price will also affect car ownership.

Table C.5: Overview of parking permission prices. Data from (Gemeente Amsterdam, 2019b; Gemeente Rotterdam, 2019a;b; Gemeente Utrecht, 2019)

City	**Type**	**Costs [euros per month]**
Amsterdam	Complex de boel	n.a.
	Campus Diemen Zuid	
	Residents on-street (area Zuid-6)	8,00
	Companies	12,80
Den Haag	iLofts	n.a.
	Residents on-street	
	Companies	
Rotterdam	Timmerhuis garage	± 250,-
	Residents on-street	9,60
	Companies on-street	38,80
Utrecht	Museo	
	Neudeflat	
	Oudenoord	± 100,-
	SSH Johanna	-
	Residents on-street	28,57
	Carsharing on-street	14,29

D

List of Participants in semi-structured interviews

Table D.1: List of participants in semi-structured interviews

No.	Name	Organisation	Position	Date
1	Niki Sie	Juuve	Co-founder	22 January 2019
2	Raymond Schäperkötter	Vesteda	Technical Manager Acquisitions	30 January 2019
3	Arnaud van der Knaap	Heijmans	Developer	1 February 2019
4	René Kamperman	BPD	Head of Project-management	5 February 2019
5	Robert Koene	Syntrus Achmea	Project developer	5 February 2019
6	Jouke Baarda	Mobiliteitsmeester	Operational manager	11 February 2019
7	Robin Berg	WeDriveSolar	Founder	11 February 2019
8	*Anonymous*	-	-	13 February 2019
9	Quirijn Oudshoorn	Gemeente Rotterdam	Advisor sustainable mobility	14 February 2019
10	Jasper van der Hoop	Gemeente Rotterdam	Advisor Mobility	18 February 2019
11	Jorden Steenge	Gemeente Amsterdam	Policy advisor parking	19 February 2019
12	Eefke Verheij	Gemeente Utrecht	Policy advisor mobility	28 February 2019

E

More information about cases

Table E.1: Overview of case studies and their characteristics. Data from (Bewust nieuwbouw, 2017; BMW Group, 2017; 2018; Jelyta, 2015; VastgoedBerichten, 2017)

City	Building	Developer	# Housing	Since	Parking req.
Rotterdam	Het Timmerhuis[1]	Heijmans	84	Dec. 2015	2
Utrecht	Museo	Syntrus Achmea	58	June 2018	0.34
Utrecht	Neudeflat	Syntrus Achmea	88	2016	1
Utrecht	Oudenoord	Syntrus Achmea	70	May 2017	0.64

Table E.2: Overview of possible case studies with shared cars. Data from (Bewust nieuwbouw, 2017; BMW Group, 2017; 2018; Jelyta, 2015; VastgoedBerichten, 2017)

Building	# Cars	Service provider	Fuel	Parking location	Parking spaces
Complex de Boel	10	WeGO/BMW	Electric	Garage	0
iLofts	2	BMW	Electric	On-street	12
Het Timmerhuis	2	Juuve/BMW	Electric	Garage & On-street	120[2]
Museo	2	We Drive Solar/Renault	Electric	Garage?	20
Neudeflat	1	Greenwheels/Volkswagen	Petrol	Garage	8[3]
Oudenoord	3	We Drive Solar/Renault	Electric	On-street	45
SSH Johanna	4	MyWheels	Both	On-street	0

[1] the parking norm is not low, but very high rent for the parking spaces
[2] Parking spaces are also for employees
[3] The Neudeflat was first an office / residential building, so could therefore take over the low parking standard.

F

Survey

Beginpagina

Beste deelnemer,

Deze vragenlijst is onderdeel van een afstudeeronderzoek van de TU Delft. Het doel is om in kaart te brengen wat het effect is van het aanbieden van deelauto's op het reisgedrag van bewoners. Hiervoor zijn een aantal woningen uitgekozen waar weinig parkeerplekken aanwezig zijn.
Het invullen van deze vragenlijst zal ongeveer 5 minuten duren.
Uw gegevens zullen anoniem en vertrouwelijk worden behandeld. Indien u vragen of opmerkingen heeft over de vragenlijst kunt u contact opnemen via C.E.vandenberg@student.tudelft.nl
Het invullen van de vragenlijst kan tot en met 3 april.
Succes bij het invullen van deze enquête en alvast bedankt!

Met vriendelijke groet,
Charlotte van den Berg

Vragen over uw reisgedrag

1. Tot welk complex behoort uw woning?

- ○ Rotterdam, Het Timmerhuis (Halvemaanpassage)
- ○ Rotterdam, De Hofdame (Binnenrotte/Oppert)
  ➡ Ga verder met vraag *Wanneer u niet weet wat deelauto's zijn, hier een korte toelichting*
- ○ Utrecht, Oudenoord
- ○ Utrecht, Zijdebalen (Korenschoofstraat) ➡ Ga verder met vraag *Wanneer u niet weet wat deelauto's zijn, hier een korte toelichting*
- ○ Utrecht, Museo (Lange nieuwstraat)
- ○ Utrecht, Hollandse Toren
  ➡ Ga verder met vraag *Wanneer u niet weet wat deelauto's zijn, hier een korte toelichting*
- ○ Utrecht, Neudeflat (Vinkenburgstraat)
- ○ Utrecht, Vredenburgplein
  ➡ Ga verder met vraag *Wanneer u niet weet wat deelauto's zijn, hier een korte toelichting*

2. Bent u bekend met de aangeboden deelauto('s) bij uw woning?

- ○ Ja, ik gebruik de deelauto
  ➡ Ga verder met vraag 3.
- ○ Ja, maar ik gebruik de deelauto niet
  ➡ Ga verder met vraag 3.
- ○ Nee

Hier een korte uitleg over de aangeboden deelauto's bij uw woning:

De ontwikkelaar van uw woning heeft er voor gekozen om (een) deelauto(’s) aan te bieden aan alle bewoners.
Een deelauto is een auto die u kan gebruiken, zonder dat u de auto zelf in bezit hebt.
De auto(‘s) staat/staan dag en nacht klaar in de garage of voor de deur van uw appartement.
De deelauto(‘s) kan/kunnen worden gereserveerd en geopend worden met een app op uw mobiele telefoon, de auto(’s) is/zijn te gebruiken tegen een vergoeding.

3. Is het deelauto-project bij uw woning een beweegreden geweest om te verhuizen naar deze woning?

- ○ Ja
- ○ Nee

4. Bent u lid geworden van de deelauto organisatie, omdat er een deelauto bij uw woning aanwezig is?

- ○ Ja
- ○ Nee

5. Als u een toelichting wilt geven, kan dat in onderstaand tekstvak:

Wanneer u niet weet wat deelauto's zijn, hier een korte toelichting.

Het delen van auto’s kan op verschillende manieren:

- Een auto gebruiken via een deelauto aanbieder. De organisatie biedt een auto aan en deze kunt u reserveren via een app of website. Bekende organisaties zijn Greenwheels, ConnectCar, Car2Go, Flexcar, Stepp.in
- Een auto kunt u van een particulier huren via een platform op een website. Op het platform

bieden mensen hun eigen auto aan om te verhuren, op deze manier kunt u een auto huren van iemand anders in de buurt. Bekende platforms zijn SnappCar en MyWheels.
- Een auto kan worden gedeeld in een besloten kring, met familie, buren of bekenden.
- Een deelauto kan worden aangeboden bij een appartementencomplex, deze staat dan in de garage of voor de deur

6. Was uw huishouden in het laatste jaar voordat u verhuisd bent naar deze woning lid van een deelauto organisatie?

- ○ Ja
- ○ Nee

7. Zo ja, bij welke deel auto organisatie?

8. Is uw huishouden sinds de verhuizing (nu) lid van een deelauto organisatie?

- ○ Ja
- ○ Nee

9. Zo ja, bij welke deel auto organisatie?

Als deelautolid1 gelijk is aan 2
EN deelautolid2 gelijk is aan 2 → *Hoeveel auto's waren er aanwezig in uw huishouden in het laatste jaar voordat u verhuisd bent naar deze woning?*

---

10. Hoe vaak heeft uw huishouden gemiddeld gebruik gemaakt van de genoemde vormen van autodelen in het laatste jaar voordat u verhuisd bent naar deze locatie?

- ○ 4 dagen per week of vaker
- ○ 1-3 dagen per week
- ○ 1-3 dagen per maand
- ○ 6-11 dagen per jaar
- ○ 1-5 dagen per jaar
- ○ (Vrijwel) niet

11. Hoe vaak maakt uw huishouden sinds de verhuizing gemiddeld gebruik van de genoemde vormen van autodelen?

- ○ 4 dagen per week of vaker
- ○ 1-3 dagen per week
- ○ 1-3 dagen per maand
- ○ 6-11 dagen per jaar
- ○ 1-5 dagen per jaar
- ○ Vrijwel (niet)

12. Hoeveel auto's waren er aanwezig in uw huishouden in het laatste jaar voordat u verhuisd bent naar deze woning?

- ○ 1 auto
- ○ 2 auto's
- ○ 3 auto's of meer
- ○ Geen

13. Hoeveel auto's waren daarvan een leaseauto?

- ○ 1 auto
- ○ 2 auto's
- ○ 3 auto's of meer

- Geen

14. Hoeveel auto’s zijn er sinds de verhuizing aanwezig in uw huishouden?
- 1 auto
- 2 auto's
- 3 auto's of meer
- Geen

15. Hoeveel auto’s zijn daarvan een leaseauto?
- 1 auto
- 2 auto's
- 3 auto's of meer
- Geen

16. Geef aan wat van toepassing was in het laatste jaar voordat u verhuisd bent naar deze woning:

In mijn vorige woning was het ...
- wel mogelijk om een parkeervergunning op straat aan te vragen
- niet mogelijk om een parkeervergunning op straat aan te vragen
- niet nodig om een parkeervergunning op straat aan te vragen, er kon gratis geparkeerd worden

17. Geef aan wat van toepassing was in het laatste jaar voordat u verhuisd bent naar deze woning:

In mijn vorige woning ...
- was er een parkeergarage waar ik mijn auto kon parkeren
- was er een parkeergarage waar ik meer dan 1 auto kon parkeren
- was er geen parkeergarage waar ik mijn auto kon parkeren
- kon ik parkeren op mijn eigen terrein
- had ik geen parkeergarage en kon ik ook niet parkeren op eigen terrein

18. Is/zijn de auto('s) in uw huishouden veranderd sinds u bent verhuisd naar deze woning?
- Ja, er is/zijn (een) auto('s) weggedaan
- Ja, er is/zijn (een) auto('s) vervangen (nieuwe gekocht, oude weggedaan)
  ➡ Ga verder met vraag 20.
- Ja, er is/zijn (een) auto('s) bijgekomen
  ➡ Ga verder met vraag 20.
- Nee, de auto('s) is/zijn hetzelfde gebleven
  ➡ Ga verder met vraag 20.

19. Wat zijn de (hoofd)redenen geweest om de auto weg te doen? (meerdere antwoorden mogelijk)
- [ ] Ik gebruik de deelauto van ons appartement
- [ ] Ik gebruik een andere deelauto
- [ ] Ik leen een auto van anderen
- [ ] Ik moest mijn lease auto inleveren
- [ ] Ik heb geen auto meer nodig op deze locatie
- [ ] Ik heb geen parkeerplek op deze locatie
- [ ] Ik vind de parkeerplek te duur op deze locatie
- [ ] Mijn dagelijkse verplaatsingen kan ik nu doen met het openbaar vervoer
- [ ] Mijn dagelijkse verplaatsingen kan ik nu lopend of fietsend doen
- [ ] Vanwege financiële redenen
- [ ] Anders, namelijk: …

20. Wat is de postcode van uw vorige woning? (bijvoorbeeld: 1234AB)

21. Wat was de meest belangrijke reden om te verhuizen naar deze woning (huidige woning)?

- De samenstelling van mijn huishouden was veranderd (alleen wonen, samenwonen, kinderen, of kinderen uit huis)
- Een nieuwe baan of de locatie van baan was veranderd
- Pensioen
- Ik wilde graag een koophuis i.p.v. een huur huis (of andersom)
- Ik wilde graag in een andere buurt wonen
- Ik wilde een goedkoper huis
- Ik wilde graag in een grotere/kleinere stad wonen
- Ik wilde graag meer/minder in het centrum wonen
- Anders, namelijk: …

Persoonlijke kenmerken

22. Wat is uw geslacht?

- Man
- Vrouw
- Zeg ik liever niet/anders

23. Wat is uw geboortejaar? [jjjj]

24. Wat is de samenstelling van uw huishouden?

- Alleenstaand zonder thuiswonende kinderen
- Alleenstaand met thuiswonende kinderen
- Samenwonend / getrouwd met thuiswonende kinderen
- Samenwonend / getrouwd zonder thuiswonende kinderen
- Anders, namelijk:

25. Wat is het netto maandinkomen (zonder toeslagen) van alle leden (exclusief thuiswonende kinderen) van uw huishouden samen?

- Minder dan €1500
- €1500 tot €3000
- €3000 tot €4500
- €4500 tot €6000
- Meer dan €6000
- Zeg ik liever niet

26. Wat is uw hoogst genoten opleiding?

- Geen
- Basisonderwijs
- LBO, MAVO, VMBO
- HAVO/VWO
- MBO
- HBO
- WO
- Zeg ik liever niet

27. Wat is uw huidige werksituatie?

- Werkend
- Studerend
- Anders, namelijk:
- _____

28. Is uw huishouden in het bezit van een rijbwijs (type b)?

- Ja
- Nee

29. Wat is ongeveer de oppervlakte van uw woning?

- < 30 m2
- 31-40 m2
- 41- 50 m2
- 51-65 m2
- 66 - 85 m2
- 86-120 m2
- > 120 m2
- Weet ik niet

30. Zou u open staan voor een (telefonisch) interview over dit onderwerp?

- Nee
- Ja, ik geef hierbij toestemming om contact op te nemen met mij via mijn mailadres of telefoonnummer:
  _____

G

Interviews

In the exploratory phase of this research, a number of interviews were conducted to get an idea of the view developers and municipalities.

G.1. Niki Sie, Juuve - 22/01/2019

Algemeen over het Timmerhuis
Alle bewoners hebben toegang, ze hoeven alleen een app te downloaden, en een rijbewijs hebben. Maar in principe kan iedereen binnen vijf minuten de auto instappen. Je betaald per uur, kilometer of je hebt een abonnement. Kan ook dat mensen x bedrag aan VVE betalen, en dan een maximaal aantal kilometers kunnen rijden. De auto's zijn ook beschikbaar voor de werknemers in het gebouw.

De deelauto's
Er staan nu 2 elektrische auto's. Ze mochten minder parkeerplekken bouwen, omdat er deelauto's waren. De deelauto's waren beschikbaar bij oplevering. Ze zijn wel veranderd van provider, het verschil daarbij was een pasje. De auto's kunnen nu verder rijden, maar de vorige auto's hadden wel benzine voor extra afstand. Er waren verschillende partijen die zich hadden aangeboden voor het Timmerhuis, Juuve werd gekozen omdat zij het meest betrouwbare platform waren. Maar de app en de marketing was belangrijk, eigenlijk alle concurrenten zijn een reserveringsplatform. Al die partijen doen geen marketing, daar bedoel ik mee Uber/Felix die advertising doen. Vervolgens proberen we loyalty toe te passen, als je x aantal kilometer hebt gereden krijg je korting. Met Valentijn of kerst korting, dat soort dingen. Blijkbaar is dat nodig, want we kopen al 100 jaar auto's en het is een gedragsverandering. Mensen denken er niet aan om een deelauto te nemen. We hebben ook een rekentool op de website staan.

Parkeernorm
Er staat 1 auto op straat, en 1 op de garage. De parkeerplekken zijn veel te duur, dan krijg je de business case niet dichtgetimmerd. De Gemeente heeft een vast tarief voor de parkeergarage, commercieel tarief 226 euro per maand. Op staat is dat een 10tje. Dat is een groot verschil. De bewoners mogen geen vergunning op straat. In eerste instantie kregen ze 1 jaar of meer een gratis parkeerplek in de garage. Dat scheelde dus dik 2000 euro. Er is ruimte zat in de garage, als je verhuist naar een appartement waar je meer dan 200 euro per maand moet betalen voor een parkeerplek. Dan denk ik dat je hem ook echt nodig hebt, want het blijft veel geld. Je kan ook meerdere parkeerplekken huren als je wil. Ik denk dat de helft van de parkeerplekken leeg is. Volgens mij krijgen alleen hele bijzondere mensen van de mensen die er werken een parkeerplekje.

Beoogde effect
Doelgroep is wat lastig, maar qua gebruiksprofiel en mobiliteitsbehoefte die mensen hebben. Structurele gebruikers, maar niet dagelijks. Die specifieke auto's zijn dan wat duur. Maar het gekke is, dat als je heel regelmatig zou gebruiken, zou je op dezelfde kosten uitkomen als kopen of leasen. Dus dat is best bijzonder. We zien ook wel dat mensen in het Timmerhuis kleine auto's, zoals een Twingo willen gebruiken die in de wijk staat die maar 1 euro per uur kost. Normaal gesproken heb je wel wat te besteden aan een auto, dus dan kopen mensen doorgaans een wat duurdere auto. Maar nu maakt dat toch niet zo heel veel uit. De ontwikke-

laar heeft er baadt bij, wanneer hij minder parkeerplekken hoeft te bouwen houdt hij meer ruimte over voor woningen. En elektrische BMW's aanbieden is ook een verkoopargument. Bij bestaande woningen is dat lastiger, mensen zitten al in een gewoontepatroon, of hebben al een auto, er zijn waarschijnlijk al parkeerplekken. Het gedrag is lastiger te veranderen. Terwijl als mensen verhuizen van buiten de stad, naar binnen de stad. Dan gaan ze kijken, heb ik die nog nodig, de kosten zijn hoog. Als tweede auto gebruiken mensen dan de deelauto.

Jullie doel:
In meeste westerse steden is 50% van alle ruimte toebedeeld aan de auto, met de verstedelijking dan gaat dat niet passen. Dan is er geen zonlicht en geen ruimte voor de mens. Tot 90% van alle emissies komt van auto's, dus zoveel mogelijk elektrische auto's. Mensen vinden elektrische auto's wel spannend. We hebben gemerkt dat de mix heel belangrijk is. We hebben gezien bij een project met 6 deelauto's , waarvan 1 benzine was. Dat die ene benzine auto meer kilometers maken dan die 5 elektrische auto's allemaal bij elkaar. Vooral helemaal grappig als je weet dat het een fiat 500 was, en de rest BMW's. Het waren medewerkers van een bedrijf, dus die hoefde niet eens te betalen. De fiat 500 was een back-up, kleine auto. Van alles reed daar in, mannen en vrouwen. Dus daarom hebben voor deze transitie, deelauto is nieuw en elektrische rijden is nieuw. Dus onze doelstelling is: ruimte en luchtkwaliteit. Alle 20'ers waarvan je altijd in de media leest, autobezit is minder belangrijk. Jongeren willen geen auto's meer, dat blijkt toch niet helemaal waar te zijn als je andere onderzoeken leest. Ze stellen de aankoop van auto's alleen maar uit. Zeker, mijn generatie (ik ben 29) al mijn vrienden zijn allemaal afgestudeerd midden in de crisis. Dan is een auto kopen niet he eerste waar je aan denkt, maar nu eind 30 en verdient goed. Iedereen heeft een (lease) auto, en ook de vriendinnen van mijn vrouw. Die niets met auto's hebben, hebben allemaal een auto gekocht, en wonen ook nog midden in de stad. Volgens mij alle 10, op 1tje na die hartje Leiden woont. We willen ons enerzijds dus focussen op autobezitters, maar anderzijds willen we ook voorkomen dat mensen ooit een auto gaan kopen. Als je eenmaal een auto hebt, dan ben je er aan gewend, en is het moeilijk om er vanaf te komen.

Zijn er onverwachte positieve/negatieve effecten zijn opgetreden?
Er zijn ook mensen die van ons platform gebruik maken omdat we elektrische auto's hebben, niemand anders biedt elektrische auto's aan in een openbare ruimte. In Utrecht is er wel 1tje, en Greenwheels heeft er 5 over heel Nederland. We zijn pas een jaartje live, dus ik heb nog niet heel veel data. Felyx, Bird en Lime ontlasten het OV, maar aan de andere kant gaan mensen misschien nu i.p.v. lopen of fietsen met de scooter. Op zich maakt dat niet uit voor de lucht, want het is elektrisch, maar mensen worden minder vitaal omdat ze niet meer bewegen. Het is allemaal zoals verwacht verder. Het is wel zo, ook al kosten die auto's maar 1 euro per uur. Het is niet zo dat het massaal binnenstroom, dat is ook goed, dat betekent dat mensen niet zomaar een auto gaan pakken voor alles. Dus dat vind ik ook nog wel interessant.

Gebruikers
Er zijn een paar gebruikers, andere mensen 1 of 2 keer per maand. De drempel om de deelauto zonder pasje te gebruiken is handig. Zelfstandig ondernemen die naar zijn klussen gaat, iemand die haar kinderen er elke dag mee naar school brengt, tot iemand die alleen privé de auto gebruikt. Dat is heel Timmerhuis specifiek. Als je kijkt naar Juuve in het algemeen, zitten we wel redelijk in een stad die wel incidenteel. Relatief jonge mensen, tot 40 jaar en vroeg in de 20. Dat is vooral de range. Maar we proberen te kijken naar onze concurrenten. En als je ook mensen strikt die elke dag reizen, ook als doelgroep te nemen. We hebben een tijdje terug, de auto's een 10tje per dag gemaakt. Dat betekent dat als je elke werkdag een auto gebruikt, dat 200 euro in de maand kost. Dat zijn precies de kosten die je hebt bij een private lease auto. Dat is gunstig, want je zit er niet 3 of 4 jaar aan vast. Mensen blijven dat wel doen, en als bedrijf kunnen we hem nog wel steeds in de avonden verhuren. Qua doelgroep: iedereen die een auto nodig heeft, daar proberen we een oplossing voor te vinden.

Contacten
Heijmans had gekozen voor BMW, en BMW had Juuve ingeschakeld. De Gemeente heeft niet heel veel te maken met het project, behalve toestemming voor het aantal parkeerplekken. Achter het timmerhuis komt het Postkantoor, met 300 appartementen met maar 30 parkeerplekken. Als ze de traditionele parkeernorm aanhouden, moeten ze of boven de grond gaan bouwen. Net zoals, bij de Rotterdam, waarbij de eerste 5 verdiepingen parkeerplekken zijn. Daar wordt je stad niet mooier van, en je kan minder of kleinere woningen bouwen. Dan dwing je mensen om er over na te denken om geen auto te hebben. Dus dan ben je echt met

gedragsverandering bezig. Dat is binnen de stad, maar we hebben ook nog buiten de stad. Er bestaat er 1, in Haarlem, aan de rand van de stad. Daar zijn starterswoningen 70, met 3 deelauto's. Dat is het voorbeeld met de VVE. En ook in Groningen hebben we een vergelijkbaar project, waar geen OV is aan de rand van de stad. Dus veel vastgoed, dat is een markt waar we op richten. Want dat is waar je mensen hun gewoonte kan veranderen. 20.55 Het makkelijkste om dat gedrag te veranderen, is om het leven op nieuw in te richten. Dus daarom willen we daar op inspelen.

Onderzoek
Spreken met iemand van Juuve die al bezig is met zijn onderzoek, maar dan commercieel gericht. Bij AN of AM vastgoed kent hij nog wat mensen, een van de grotere. Daar hebben we contact met degene die over duurzaamheid en vastgoed gaat. In de aanloop / oprichting, nu gebruikers zelf vooral onderzoek. Daar hebben we gevalideerd dat mensen benzine auto's prettig vinden. Met dit weer (sneeuw/kou) halen die BMW i3's maar 140 km. Wij interviewen continu de mensen zelf. Wat is het service level? En ook, hoe schoon moet de auto zijn. Greenwheels zijn heel schoon, zelfs de deurposten glimmen. Maar is dat nodig, dat kost ook geld. Wat zijn mensen bereid te betalen? Willen ze uur tarief, dag tarief, een abonnement? We zijn er achter gekomen, dat het service level heel hoog moet zijn. We hebben een 24/7 helpdesk. We dachten laat er een chat mee maken. Elke gebruiker krijgt na eerste reservering een telefoontje van ons. Het bleek, dat wij meteen opnemen, ze overstappen naar ons. Want bij Greenwheels nemen ze niet meteen op, en daardoor konden ze gewoon niet weg. Dat is dus blijkbaar heel belangrijk. Project ontwikkelaars, zijn ook heel belangrijk. Wat drived hun nou. Zij betalen wel mee aan de auto's, het postkantoor gaat van 240 parkeerplekken naar 30, dus die besparen Je krijgt 20% van deelauto's, en in de buurt van stations krijg je ook weer korting, en als je deelauto's integreert nog meer. En je kan uiteindelijk uitkomen op praktisch 0. Maar voor het postkantoor, dat scheelt heel veel geld. Want per parkeerplek kost het 30 tot 50 duizend, dus reken maar uit. Dat scheelt een paar miljoen. Ze betalen altijd mee, dus dan doen wij een aanbieding aan een ontwikkelaar. Het is lang niet altijd kosten, Heijmans zit er in, zij vinden kosten heel belangrijk. Maar andere, zitten op verbeteren, verduurzamen, aantrekkelijker maken van het woonconcept. Die willen dan per se elektrische auto's. Heijmans zit in de green deal, maar die service levels zitten toevallig niet. Maar bij anderen mag het dan wat kosten. Kosten is een overweging, aantrekkelijk maken van woonconcept is een overweging, en kostenbesparing. En soms willen ze gewoon Tesla's.

Overig
Juuve heeft wel wat gebruikers, 8 structurele gebruikers en 30 hebben een account, waarvan 2/3 wel eens een ritje hebben gemaakt. Deelaut onderzoek in leiden, 5% zei waar denk je aan bij deelauto's. Onderdelen van een auto. Dus mensen hadden geen idee wat het was. Wij hadden eerst een sticker met Deelauto er op, en nu hebben we drive 2 euro/uur. Nu komen de aanmeldingen binnen. Deelauto is een hele erge vakterm. Een hotel noem je ook geen deelkamer. Ik zit meer op het tot een succes maken, dus geen parkeerplekken bouwen. Want als er dat is dan gaan mensen gewoon een auto nemen. Als die ruimte er niet is, mensen er ook vrede mee hebben. En er ook rekening mee houden met de aankoop, en dat accepteren dat ze geen eigen auto hebben. En dan kan het prima. Dat is eigenlijk de conclusie in de woningmarkt. Zeker mensen die nog geen auto hebben, als ze gebruik willen maken is dat altijd goed. Tegelijk zien we ook dat de auto's echt in de buurt moeten staan, niet steenworp afstand. Maar echt dat je ze kan aanraken. We hebben in Het Timmerhuis 1 in de garage staan, en 1 op straat. En die in de garage wordt 2x zoveel gebruikt. Terwijl het letterlijk 1 straatje oversteken is. En prijsstelling, als je iets neerzet wat de eigen auto moet vervangen. Moet het wel qua prijsstelling kloppen. Als mensen woon-werk verkeer mee willen doen, moet het ook aantrekkelijk zijn. Anders gaan mensen alsnog een auto nemen voor woon-werk verkeer. Mensen moeten zich er op vertrouwen. Dus, wij zijn een project aan het lanceren waar je zoveel schaal hebt aan auto's dat mensen altijd op het systeem kunnen vertrouwen. Het Timmerhuis zijn maar 2 auto's, op 88 appartementen. Het werkt wel, maar alleen maar voor incidenteel gebruik. Als je daar je woon-werk verkeer mee wil doen, dan moeten het gewoon meer auto's zijn. Liever heel veel auto's en lage tarieven. Lettelrijk alle partijen die in deze markt zitten, zijn allemaal startups. Die niet miljoenen kunnen trekken (voor de schaalvergroting) om auto's' te kunnen kopen. Dus dat is wel een beetje het nadeel is. Daarom is er wel support van de gemeente of ontwikkelaar nodig om dit op te zetten. En top of mind maken, waar wij deelfietsen en deelscooters er op gaan doen. Dan is het gewoon, ik moet ergens heen ik pak de Juuve app. Dan is het steeds aannemelijker dat wanneer ze de auto willen pakken, elke dag gebruik ik de fiets of de scooter. Maar het gebruik van platform zit in het systeem, zodat ze soms de deelauto pakken. Vandaar de combinatie van alles. Je hebt ook MaaS aggregator, dat zijn dan platforms die dan weer alle aanbieders aan elkaar koppelen, zodat je kan reserveren. Ride cloud, van de

ING. Daar kan je alles zien, maar als je wilt reserveren dan moet je nog steeds naar die ander app. En er is nog Whim. En daarmee kan je wel vanuit de app auto's reserveren en openen. Maar je moet er nog naartoe, je bent een gewoonte aan het creëren. Maar als jij tien apps moet hebben, voor 3 verschillende voertuigen. Dat is best wel een oerwoud aan platforms. Mensen laten hun auto thuis, en gaan met OV/fiets naar werk. En pakken dan daar de deelauto van het werk (in het groothandels gebouw). Die auto's rijden echt op volle toeren, maar dat is bestaande bouw. Dus daar bespaar je geen ruimte mee. Maar je bestaat er wel verkeer mee. Dat is misschien wel buiten je scope. Woningen met deelauto's is wel helemaal nieuw nu, daar winnen wij al onze pitches op. Timmerhuis is het eerste in heel Europa, voor zover we weten de hele wereld. Maar dat durven we niet 100% zekerheid te zeggen. Dat hebben we begrepen van BMW en Heijmans. Het was zelfs zo dat in 2015, dat directie vanuit Munchen naar Nederland is gevlogen. Laatst nog een prijs gewonnen voor duurzaamheid, terwijl het project al drie jaar oud is. Dus bet wel gek dat er nu nog nominaties komen.

G.2. Raymond Schäperkötter, Vesteda - 30/01/2019

Doel van deelauto's
Doel van Vesteda is om de CO2 uitstoot terug te dringen door gebruik van deelauto's. Het hoofdkantoor van Vesteda is gehuisvest in haar eigen gebouw, wat over 3000m2 kantoorruimte beschikt en daarboven 154 appartementen. Vesteda is gehuisvest in 7/8e deel van het kantoor. Het overige deel wordt gehuurd door firma Axeco. De deelauto's zijn voor zowel voor de medewerkers van Vesteda als voor haar huurders van het complex (huurders van appartementen en kantoor). De minder ambulante mensen medewerkers van Vesteda hebben hun lease auto ingeleverd, de ambulante mensen niet. Daarnaast stimuleren ze fietsgebruik. Dit is puur gefocust op de medewerkers.

Doelgroep van de woningen
Young professionals, 25-35 jaar, midden huurder.

Beschikbaarheid auto's
De woningen kwamen beschikbaar in april 2017. De deelauto's kwamen pas beschikbaar in oktober 2017, na de renovatie van het kantoor. Vooraf is aan de huurders gevraagd of ze interesse hadden in de deelauto's. Het merendeel had daar interesse in. Elke huurder (kantoor en appartementen) bewoner krijgt een app, beheerd door WeGo (Peter de Jong). Voor de aanmelding hebben ze een activiatielink ontvangen. 10 deelauto's, die zijn allemaal van Vesteda. Er is geen garage voor normale auto's, deze moeten op straat geparkeerd worden met een vergunning van de gemeente. Complex de Boel is als pilot gebruikt, om te bezien in hoeverre deze mobiliteit service tot meerwaarde kan leiden bij verhuur van woningen.

Ervaring
Merken dat door onze medewerkers toch minder gereden wordt, dan in eerste instantie was ingeschat. Medewerkers rijden minder, ze worden meer door de huurders gebruikt. Ze denken dat ze te veel auto's hebben, bezettingsgraad is vooralsnog te laag. 504 auto's zijn voor de bewoners, en 6 voor de medewerkers (overdag) en 's avonds is dat andersom. Vesteda denkt dat mensen het belangrijk vinden om over voldoende keuzevrijheid en flexibiliteit te beschikken op het gebied van mobiliteit. Iets wat mogelijk is met een eigen auto, maar wat ook met voldoende beschikbaarheid van een auto.

Contacten
Er hebben geen samenwerkingen plaatsgevonden met de gemeente. De parkeernorm was al vastgesteld, doordat het een transformatie project was. De gemeente heeft wel laadpalen neergezet, toen ze daar om vroegen omdat ze veel elektrische auto's hebben.

Onderzoek
Er is geen onderzoek geweest of interviews met bewoners, wel een evaluatie na een jaar gebruik.

G.3. Arnaud van der Knaap, Heijmans - 01/02/2019

Prijs van de parkeerplekken
Het Timmerhuis is begonnen met dure appartementen verkopen, dat was midden in de crisis. Dat vonden

wij heel spannend, daar kwamen we eigenlijk er achter in de tenderstukken dat die parkeerplaatsen die de gemeente ging aanbieden tegen commercieel tarief zou zijn. Nou, wij dachten dat is altijd wel goed commercieel. Maar achteraf bleek dat ze daar ongeveer 230 euro per maand voor gingen vragen. Dus toen dachten we shit, als we dure appartementen gaan verkopen, en mensen willen 1 of 2 parkeerplekken erbij dat is dan wel een hele hoop centjes. De appartementen hebben verschillende prijzen, sommige zijn maar 45 m2. Vanaf 143.000 tot 1,7 miljoen. Het is dus een groot verschil, maar dat is ook het leuke van het gebouw.

Deelauto's
Het zijn starters en van alles, er is dus geen specifieke doelgroep. Daar hebben we nooit op gemikt. Dat merk je ook terug in het gebruik van die deelauto's. Maar dat is eigenlijk de hoofdreden om het in te gaan zetten. Dat match ook wel heel erg met de duurzaamheid van het gebouw. Hebben we iets praktisch met deelauto's neergezet. Dit was de eerste keer bij appartementen, het was wel eerder zakelijk gedaan. BMW vond het zo'n goed idee, dus die hadden er 2 bijgezet. Dat we met 4 auto's startte was eind 2015. Het is wel nog steeds pionieren, je moet mensen echt de drempel over hebben. Het loopt op zich goed, maar niet dendert. Het is niet voor niets van 4 naar 2 auto's gegaan. Nog net niet rendabel, Heijmans en BMW moeten dat gewoon elke maand betalen. Maar het is wel de bedoeling dat het ooit een rendabele business case wordt. Dus hier is eigenlijk geen lage parkeernorm.

Parkeernorm
Parkeernorm durf ik even niet te zeggen, het was een andere business case dan andere projecten waar we het wel gewoon concreet hebben. Maar het was een gegeven, omdat de gemeente de opdrachtgever was. We hebben altijd gezegd dat er minimaal 1 parkeerplek per appartement beschikbaar moet zijn. Dus als dat huis wordt doorverkocht, dan is de kans op het huren van de parkeerplek er nog wel. Maar het blijft dat forse bedrag. In de praktijk wil de gemeente deelauto's inzetten, maar dan heb je een andere loketje van de gemeente die over het Timmerhuis gaat. En die wordt er ongelukkig van dat wij plekken gebruiken, want hun wethouders willen hun BMW daar parkeren. De plekken zijn wel dedicated voor iemand van de gemeente, ondanks dat ze leeg staan misschien.

Juuve
Juuve zit wat dichter op het vuur en kent de gemeente beter, gekozen voor een Rotterdamse partij. Ik weet niet of er wel of niet veel lege plekken zijn in Het Timmerhuis. De ambtenaren parkeerde eerst achter het stadhuis, en parkeren nu daar volgens mij. Het is allemaal een beetje politiek, in de praktijk is het wat weerbarstiger. Het is wel aardig dat toch nog heel veel mensen die parkeerplekken huren, terwijl ze ook met die deelauto aan de slag kunnen.

Brochure deelauto's, auto ergens anders parkeren
Toen wij begonnen met de verkoop, en dat is voor ons best uniek, hebben we het in de brochure gezet dat we dit gaan doen. Dus dat betekent dat je er aan vast zit, een pilot van een jaar hebben we toen geroepen. Toen was er al iemand, die woont er toevallig niet meer, maar die staat ook in de brochure met zijn verhaal. Dat hij zijn oldtimers ging verkopen. We hebben ook een andere dame die haar auto heeft verkocht, die stond op het punt om een nieuwe te kopen. En die is ook gaan nadenken, en die doet nu alles met die deelauto. Die brengt iedere dag haar kinderen er mee naar de opvang.

Buitenwijk
Iedereen zegt altijd in de binnenstad is het makkelijk. Maar ik geloof er juist in, en ik ga het nu ook doen in een wijk in Gouda, waar we 4000 woningen moeten neerzetten. Ik denk dat het daar in een buitenwijk beter gaat doen, dan in de binnenstad. Waarom? Omdat in de binnenstad doen al die mensen alles op de fiets, dus waarom zou jij een autootje pakken om je boodschappen doen. Er is nog steeds een groep die een leaseauto heeft, als je die auto elke dag nodig hebt, dan is een deelauto ook niet lucratief. Als je minder dan 3, 4 keer per week nodig hebt. Want die zitten op het fietsje naar het station, en die zitten in een half uurtje in Amsterdam. De grote doelgroep heeft het helemaal niet nodig, die kijken er niet eens naar. Er zijn een aantal die het wel interessant vinden, en een aantal die een eigen auto hebben. Het bleek dat voor 84 appartementen, 4 auto's too much is, eigenlijk 2 al. Je ziet al je moet een groot bestand hebben, want het is niet voor iedereen interessant. Maar in zo'n buitenwijk, ik woon zelf in een yuppen wijk. Daar hebben sommige mensen wel 2, 3, 4 auto's, die eerste auto in een buitenwijk dat is natuurlijk geen issue. Maar een tweede, derde, vierde die heel vaak stilstaat. Mensen met oude kinderen, of een sportauto. Dus ik geloof er ook wel heel erg in voor

buitenwijken. In Gouda heeft de Gemeente gezegd dat je 5 parkeerplekken voor 1 deelauto mag opofferen. Dus je hebt netto vier parkeerplaatsen. Dat scheelt veel in kosten, parkeren is het duurste van het gebouw.

Willen jullie liever minder parkeerplekken bouwen?
Nou wij willen natuurlijk wel ook parkeerplekken kunnen aanbieden. Maar bijvoorbeeld Gemeente Den Haag, die heeft nu gezegd parkeernorm is 0. En dan moet de ontwikkelaar maar kijken hoe die het oplost.

Bestaande projecten
Iedereen heeft het er al over, ik heb ook veel mensen die mij hebben gebeld. Maar het timmerhuis is dus niet een lage parkeernorm, dat valt dus ook wel echt tegen. Dat is toch wel lastig zeggen ze dan he, in de praktijk. In de praktijk is het, nogmaals, wel weerbarstiger. Ik ken persoonlijk niet die projecten, wel in Den Haag Energiekwartier. Maar ik durf niet te zeggen of dat project is opgeleverd. Ik denk niet dat je heel veel voorbeelden treft, waar mensen een jaar ervaring hebben. Praktijkvoorbeelden zijn er niet zo veel.

Parkeernorm
De gemeente bepaald dat, en wij moeten ons daar aan houden. Hangt heel erg af van de gemeente. De gemeente bekijken niet alles per project, heel vaak gewoon hele gemeentes of een gedeelte. Ik weet bijvoorbeeld in Gouda dan in het centrum, dat het daar wat minder mag zijn. En daarbuiten moet ie maximaal zijn, 2. En dan, mogen wij met die deelauto's daar in afwijken, naar 1,8 en dat moeten wij dan onderbouwen. Wij zitten zo vroeg in de ontwikkeling dat we daar gesprekken in hebben. Bij tenders kan het al geëist zijn dat ze deelauto's willen. In Amsterdam voor een gebouw, was dat een kei harde eis. Dat staat nu in de verkoop, maar daar komen ze (deelauto's) ook te staan.

Ontwikkelingen BMW
De gemeente zit ook met BMW aan tafel, daar wordt ook een convenant gesloten. Als er een hybride auto de stad in komt rijden, wordt het automatisch elektrisch. Zodat je geen vervuiling meer hebt in je stad. Daar kennen ze weer een puntentelling aan toe, dan kunnen die BMW dat onder elkaar zien. En dat werkt heel goed, wordt een soort spelletje. De deelauto's zijn gekomen door Heijmans in het Timmerhuis, dit stond niet in de opdracht van de gemeente. Om te vechten tegen die clubjes, de eerste twee jaar heeft de gemeente wel betaald voor die parkeerplekken. Dat hebben wij bedacht, puur met de ogen op de verkoop. Dus als een soort van service. Een auto hoort ook bij een woning kopen, net zoals dat er een school en een supermarkt is. Wij moeten alles bekijken, je moet je auto kunnen parkeren, leuke buurt zijn, etc.

Onverwachte effecten
Dat het wel een drempel is voor mensen, elektrische auto's hebben een maximaal bereik. Dat is best spannend. Ook een tegenstrijdigheid in, dat mensen de auto pakken niet voor korte stukjes maar voor in het weekend naar de schoonouders in Friesland. Dan wordt het al spannend zo'n ding. We hadden eerst een mini staan die veel werd gebruikt, maar met de duurzaamheid wilde we liever met de zonnepanelen op het dak, worden ze mee opgeladen. Ze worden in een oude BMW accu gestopt. Zo'n huishoudaccu, dat is ook een beetje de toekomst. Dat is nu nog niet te betalen. Het is wel de toekomst, dat je dat opslaat in accu's, en als je het nodig hebt weer pakt. 4 jaar geleden was het hét systeem, dachten we toen hyper modern. Iedereen had twee pasjes gekregen, om de auto open te maken. Maar drie jaar later was dat eigenlijk hopeloos verouderd. Dat pasje gaat 24 uur overheen, voordat we dat pasje hebben opgestuurd. Nu doe je dat met een app, als dat 5 minuten duurt, ben je ook al afgehaakt. We zitten nu op 5 seconde, moet die open zijn, dat moeten we er ook even bij doen. Het is wel leerzaam natuurlijk, maar het is niet de bedoeling dat we dit voor elk project gaan doen. Want dan komen we niet meer toe aan huizenbouwen.

Business case
We bekijken dit elke maand samen met BMW en Juuve. Echt met de marktpartijen, niet met de Gemeente. We betalen de Niki (van Juuve). Maar ik hoop dat het rendabel wordt, zodat Juuve het kan overnemen en wij onze handen er van af kunnen trekken. Het opstarten hoort er bij, maar daarna zouden we het het liefst willen overdragen. Maar we merken steeds meer dat het een totaal beeld wordt. We horen ook vaak dat we een gebouw 15 jaar lang moeten onderhouden. Je bouwt het, en je doet ook de exploitatie en de onderhouden. 10 jaar vast voor 20% verlaging in parkeernorm worden we dan ook niet blij van, want 10 jaar is lang. Maar het is ook niet zo dat we dan maar een extra parkeerplek willen bouwen. Het is voor ons wel interessant, maar dan zoek je liever een club op die 10 jaar lang garandeert. Maar de vraag is of de gemeente dat weer accepteert.

Weet niet of dat mag van de gemeente, of wij dat risico moeten dragen of dat we ook een andere club daar voor mogen betrekken.

Fietsenstalling Timmerhuis
Bij het Timmerhuis is er goed over nagedacht, daar is ook een hele fietskelder. Dat is niet zo dat wij dat hebben bedacht. De ervaring met de Rotterdam, dat je daar niet meer je fiets kwijt kon. Dat al die ambtenaren met de fiets kwamen, dan kon je je fiets niet meer kwijt. Dus je moet wel zorgen dat je je fiets netjes kan parkeren.

Dedicated parkeerplekken
Contactgegevens van de Gemeente kan je beter vragen aan Niki Sie. En je hebt daar veel loketjes voor. Rotterdam wil niet dat de parkeerplek buiten dedicated voor ons is, dat is een deelauto plek. Dus daar mag ook iemand anders staan. Maar volgens mij is het een puur elektrische deelauto plek. Maar die zijn er niet zoveel. Het zou wel prettig zijn als dat met een kenteken dedicated is. Je reserveert ze met een app, je kan zien welke 60% vol zit of 80%. Zodat je weet hoe ver je kan. Maar ook de tarieven schommelen heen en weer. Die auto buiten is bijvoorbeeld goedkoper. Dertig euro per dag, de hele dag meenemen. Elke keer zitten te spelen, om daar van te leren. En daar zit BMW ook in, die wil daar ook van leren. Die zien dat toch als toekomst model. Dat ze niet meer hun auto's aan particulieren verkopen, althans een stuk minder. Dat mensen dat steeds meer gaan delen dat gebruik. Dus volgens mij hebben ze nu al de nieuwste 5 serie, een soort software dat je al met je buurman kan delen. Dus jij koopt een auto, maar de mensen in je straat kunnen hem ook openen. En dan kan je dat zo afrekenen, en dat is dan allemaal geregeld door BMW. Dat is allemaal puur om die afzet te garanderen, zodat ze in de toekomst ook nog verkopen. Zodat die deeleconomie steeds beter gaat. Dus toen wij begonnen waren er niet zoveel clubs, maar naast Juuve, heb je u veel meer clubs. Je hebt WeDriveSolar, Buurman, Amber.

Is het bekend wat voor kenmerken de bewoners hebben?
Ja dat is wel bekend, maar tegenwoordig met privacy en regeltjes. In principe ken ik ze allemaal persoonlijk, vanuit de verkoop. Vanaf startende studenten, tot en met gepensioneerde mensen. Alles in die range, niet zo heel veel gezinnen, denk 1 of 2 gezinnen. Dat heeft ook te maken met die prijsklasse. Maar er zijn ook wel een paar investeerders die het hebben gekocht, die het dan weer verhuren. Dus dat is weer een lastige doelgroep voor mensen die er niet langer zitten, of niet tijdelijk. Maar ik denk dat de gebruikers een beetje de doelgroep van tussen de 30 en 50 zijn de meeste. Ik denk dat er nu 30 of 40 parkeerplekken zijn verhuurd. Maar er zijn ook mensen die ergens anders hun sportauto hebben geparkeerd. Je krijgt geen vergunning. Maar mensen regelen het anders, ze parkeren bijvoorbeeld in de markthal. Of ze kopen ergens anders een parkeerplaats, of ze zetten hem ergens buiten de stad. Deze informatie ken ik allemaal uit mijn hoofd. Maar de laatste stand van zaken weet ik ook niet. Een ambassadeur, die woont daar vanaf dag 1. Die gebruikt ook heel vaak die deelauto, een fotograaf die woont er met zijn gezinnetje. We gebruiken hem ook vaak in promo materiaal.

Onderzoek
Is een lopend onderzoek. Juuve houdt interviews, en houden enquêtes. Die zijn best veel gehouden.

G.4. René Kamperman, BPD - 05/02/2019

Introductie
Op dit moment heeft BPD nog geen deelauto's bij projecten neergezet, maar hebben ze wel veel projecten voor het oog waar ze dit willen gaan toepassen. Het Oudenoord van Syntrus is niet hun project, het is een lange straat. Het project wat BPD gaat neerzetten, is nog niet af.

Wat is het doel voor jullie voor het neerzetten van de auto's?
Dit is a, dat niet iedereen de behoefte heeft aan een eigen auto. Dit gaat dan vooral om de binnenstad, waarbij mensen al goed openbaar vervoer hebben. En b, het maken van parkeerplaatsen is erg duur, dus economisch gezien is het voordelig om minder parkeerplekken te bouwen. Nog later toegevoegd, je wil voorop lopen en meegaan met de nieuwste ontwikkelingen.

Heeft dit te maken met de parkeernorm?
Het aantal deelauto's is wel beperkt, het is niet zo dat je 10 deelauto's kan neerzetten, en er dan verder geen

parkeerplekken aangeboden kunnen worden. Je wilt het beste voor de klant. Daarnaast zijn er altijd wel mensen die een auto hebben, en dus een parkeerplek willen hebben. De parkeernorm kan altijd wel besproken worden, maar soms kan er wel wat veranderd worden en soms niet. Ligt er aan hoe gevoelig het is in dat gebied. Er komt een nieuwe 'Nota parkeernormen' aan in Utrecht. De Deelauto gebruiken we niet domweg om de parkeernorm naar beneden te schroeven, het moet wel een toegevoegde waarde hebben.

Aanbieden van deelauto's
Wat wij wel nog lastig vinden is hoe je de deelauto's gaat aanbieden. Door middel van een extern bedrijf, zodat het ook openbaar gebruikt kan worden. Of alleen in de eigen garage. Ook met kosten is dit nog ingewikkeld. Wat is de ideale manier?

Hoe worden het aantal parkeerplekken verdeeld als er maar een beperkt aantal parkeerplekken worden aangeboden bij appartementen?
Eigenlijk krijgen we het aantal parkeerplekken nooit allemaal verkocht. Bijvoorbeeld zojuist een project op de zuid-as, met ook een scherpe norm. Daar zijn niet alle parkeerplekken verkocht.

Zien jullie een probleem met de lage parkeernorm voor in de toekomst?
Nee, wij zien dat steeds minder mensen een eigen auto willen hebben. En ook met de zelfrijdende auto in de toekomst, kunnen mensen van deur tot deur komen. Dan zijn er geen eigen auto's meer nodig. Een auto staat ook zo'n 90% procent stil. Greenwheels is een erg oud bedrijf, maar nu pas komt het echt tot stand. De deeleconomie komt nu pas op. Ook is er wel een toekomst in de elektrische auto, en ben ik erg benieuwd wat er gaat veranderen. Bijvoorbeeld de nieuwste ontwikkelingen met de elektrische auto die opgeladen worden door de zonnepanelen, waarbij de accu van de auto weer gebruikt kan worden om het huis op te warmen.

G.5. Robert Koene, Syntrus Achmea - 05/02/2019

Algemeen Oudenoord
Project Oudenoord heeft 43 parkeerplekken, 70 appartementen en 3 deelauto's van WeDriveSoalr. Deze zijn ook beschikbaar voor omwonende. De auto's worden goed gebruikt. De parkeerplekken zijn op het maaiveld, dit is achter een poort en op straat. Dit is dus niet erg mooi, en hadden hier liever voor in de plaats gehad groen. Want nu is deze functie die we eigenlijk willen, er niet gekomen. Door onderhandeling met de gemeente, was de parkeernorm wel verlaagd. Omdat er deelauto's werden aangeboden. Maar de gemeente werkte niet mee in de zin van dat er meer groen kon komen. De parkeernorm was eerst bijna 1. De parkeerplek kost ongeveer 100 euro per maand, en je kan geen vergunning op straat krijgen. Niet alle parkeerplekken zijn bezet. Er is een abonnement nodig voor de WeDriveSolar auto's. De mensen die er wonen zijn veelal jong, dat is ook het woonproduct. 1 en 2 persoons woningen. Studio/loft. De kenmerken van de bewoners zijn bekend bij Syntrus. Hij denkt dat de doelgroep voor deelauto's iedereen kan zijn. Wel vooral binnenstad, randen van steden spannend.

Doel van deelauto's aanbieden
Er zijn verschillende doelen die hij noemt, leefbaarheid, schone auto's, minder autodruk, wat weer lijdt tot een betere kwaliteit, meer ruimte en meer groen. Maar we willen wel de mobiliteit behouden.

Algemeen Neudelfat
Neudeflat heeft 1 deelauto, deze is wel benzine. De Neudeflat was eerst een kantoor/woning gebouw, dus kon daarom de parkeernorm overnemen. De Neudeflat heeft 5 parkeerplekken en 88 appartementen.

Parkeernorm
Zelf willen we liever minder parkeerplekken bouwen, Het is eigenlijk een poldermodel, je kijkt op locatie, en naar wijk wat je wilt. We denken ook dat een woning WOZ waarde omhoog gaat als er meer groen is, en niet als er een parkeerplek meer is.

Deelauto's
Mensen vinden het wel spannend, een deelauto en elektrisch. Dat is allemaal nieuw, daarom bieden we bij een project Museumkwartier/Museo aan dat ze gratis een deelauto kunnen uitproberen de eerste keer.

En dan met korting een abonnement kunnen afsluiten. Dit project bestaat uit 58 appartementen, 4 deelauto's. (Dit project is al wel af) Zo kunnen ze kennismaken met het concept. Ze krijgen geen subsidie van de gemeente, het zijn allemaal eigen opstart kosten.

Nieuwe projecten
Project in de toekomst, Gerbrandastraat, 3 of 4 auto's. En over 2 jaar, naar 15 auto's. Hoogbouwkavel, op station met deelauto's. Kleine garage, maar hier komt dan een mooie binnentuin. Hier heeft dus minder parkeerplekken wel als doel meer groen. Deze wordt opgeleverd in 2024. Het zijn allemaal groeimodellen, 1 op 2. Nu staan er 3 deelauto's, maar we willen groeien naar bijvoorbeeld 20.

G.6. Jouke Baarda, Mobiliteitsmeester - 11/02/2019

Heeft dit project een lagere parkeernorm?
Het project heeft gaandeweg een lager aantal parkeerplekken gekregen. Het project was niet vanaf het begin bezig met deelauto's, zoals bij andere nieuwbouw projecten wel waarbij al met de architect om de tafel wordt gezeten. Daarbij kan al vooraf worden bepaald hoe de mobiliteit wordt ingericht. Ze wilde eerst het aantal parkeerplekken voor de deelauto's op tellen bij de al afgesproken parkeerplekken. De gemeente Goeree is erg bezig met duurzaamheid, dus zij stonden op en voor 5% minder aantal parkeerplekken.

Als er toch meer deelauto's komen, hoe wordt dat dan opgelost met aantal parkeerplekken?
Dat betekent dat er een hoog gebruik is, dus minder eigen auto's zijn. Dan valt er een normale parkeerplek voor de deelauto.

Zijn er parkeerkosten voor jullie in dit gebied?
Nee, er zijn geen parkeerkosten. In dit gebied is het autobezit echter wel heel hoog, daarom is er een lange weg te gaan om een groot gedeelte van de inwoners in de deelauto te krijgen.

Om hoeveel woningen gaat het?
Er staan twee deelauto's, en er zijn drie fases voor de Havenstad. De eerste twee zijn afgerond, met de derde fase erbij zijn het 80 woningen, zo uit mijn hoofd. De auto's zouden eerst alleen beschikbaar zijn voor het nieuwe project, met het dorp wil er ook gebruik van maken. Dus komen ze ook beschikbaar voor hun, het is een lokaal initiatief. En uiteindelijk als het veel wordt gebruikt, kunnen er meer auto's bij geplaatst worden.

Wanneer is het project opgeleverd en waren de auto's beschikbaar?
In oktober 2018, zo uit mijn hoofd. Maar nog niet alle woningen zijn opgeleverd.

Hebben jullie nog meer auto's staan bij andere woningbouw projecten?
Bij de Gemeente van het eiland, en bij een energiecorporatie, en in het centrum voor bewoners. In Rotterdam en Amsterdam hebben we ook wat auto's staan. Deze zijn wel voornamelijk voor werknemers. In Rotterdam en Amsterdam hebben we ook al wat projecten die live zijn.

Ik wil graag bewoners interviewen, die er al enige tijd wonen.
Je kan contact opnemen met het I-lofts project in Den Haag, die zijn een half jaar bezig en volgens mij is daar de parkeernorm erg laag. Uit mijn hoofd 40 appartementen, 20 parkeerplekken en 2 deelauto's. Het lastige is dat wij een theoretische berekening doen van bijvoorbeeld 80 woningen, dus 15-20 gebruikers daarvoor zijn 4 auto's nodig. Maar dat is erg duur, dus beginnen we meestal met 2 en dan gaan we kijken of er nog meer auto's nodig zijn later. Interviews met onze bewoners zou wel mogen, maar het zou handiger zijn als dit over 4 maanden is. Ander project dat ik kan bedenken is het Timmerhuis in Rotterdam, ook van BMW Nederland. Wij zijn een eigen bedrijf geworden, en bieden een totale mobiliteit hub aan met auto's en fietsen. Een bewoner in de havenstad was van plan om bijvoorbeeld zijn zakelijke auto ook privé te gaan gebruiken, en dan zijn privé auto weg te doen. En dan die andere ritjes met de deelauto te maken. Maar wij weten ook niet of dit dan gebeurd is, dus daarvoor zou het onderzoek wel interessant zijn. Nog een ander project dat al live is, is op de Zuid-As van Vesteda. Ik zou nog even uitzoeken of bij de Havenkade de parkeernorm omlaag is gegaan. Maar dit project is nog niet opgeleverd.

G.7. Robin Berg, We Drive Solar - 11/02/2019

Ik heb begrepen dat de woningprojecten die nu al opgeleverd zijn, het Oudenoord en Museo zijn. Is hier een lagere parkeernorm van toepassing?
Ja, op beide is een lagere parkeernorm van toepassing. Ik denk 0,5 en bij het museo iets lager.

Worden deze elektrische fietsen door jullie geleverd bij het Museo?
Ja, maar deze staan er nog niet.

Zijn de auto's vanaf het begin beschikbaar geweest?
In Museo kwamen ze pas na de zomervakantie, omdat het project was gestart in juni 2018. Oudenoord was gestart in mei 2017. Dit was gedaan, omdat verwacht werd dat de auto's niet gebruikt zouden worden in de vakantie omdat mensen op vakantie zijn. En het geld kost om de auto neer te zetten. We weten niet of het effect heeft gehad dat het kwam.

Hebben jullie kosten aan de parkeerplek? Wat is de prijs?
Nee, dit wordt betaald door de belegger. Het hangt van het project af natuurlijk. Als we later een auto er bij willen, dan zouden we dat wel moeten betalen zelf.

Hebben jullie een specifieke doelgroep?
De bewoners van de gebouwen allemaal, bij Oudenoord ook de omwonenden.

Zijn jullie andere auto's ook gekoppeld aan woningen? Zo ja, welke woningen zijn dit?
We hebben 60 operationele auto's staan in verschillende steden, maar niet bij nieuwbouwprojecten. Dus deze kwamen allemaal later pas in woningen.

Hoe bereiken jullie dan de mensen?
Mond-op-mond reclame, flyers en voorlichtingsavonden.

Zijn er onverwachte positieve of negatieve dingen opgetreden?
Museo had veel meer gebruikers dan verwacht, heel erg hoog. Meer dan de helft van de bewoners. Terwijl dat normaal zo'n 10% is. Dus dat is wel heel erg leuk.

Krijgen jullie subsidie van de gemeente of overheid?
Ja, dat krijgen we van het Europees programma voor duurzaamheid. Dit is voor de app en andere ontwikkelingen.

Hebben jullie eigen onderzoek gedaan naar het concept?
Wij doen klanttevredenheidsonderzoek. En Duurzaam Utrecht? Doet onderzoek voor ons.

G.8. Anonymous, - 13/02/2019

This document is not included in the appendix.

G.9. Quirijn Oudshoorn, Gemeente Rotterdam - 14/02/2019

Introdutie
Vanuit de Gemeente willen wij deelauto's in gebouwen om aan de toe te voegen mobiliteitsvraag. Wij geven vanuit de Gemeente een korting op de parkeernorm wanneer er deelauto's worden aangeboden. Dit moet dan wel voor 10 jaar zijn. Zij krijgen deze korting, maar dan moeten ze dus wel de behoefte aan de mobiliteit van bewoners meegeven.
In Rotterdam hebben we weinig deelauto's vergeleken met andere grote steden in Nederland. Dat komt omdat bij ons op straat parkeren nog erg goedkoop is, wij hebben denk ik wel de laagste parkeerkosten in Rotterdam. De prijs is wel net omhooggegaan, maar dat is maar een paar euro. Vanuit mijn functie willen wij deelmobiliteiten faciliteren, en nu zijn dat vaak nog wel experimenten. GreenWheels heeft zo'n 100 tot 200 deelauto's in Rotterdam. Er zijn ook nog veel SnappCars in Rotterdam, maar niemand weet hoeveel die ge-

bruikt worden. Daarnaast zijn er veel deelauto's zakelijk aangeboden, bijvoorbeeld door Amber. Er is wel duidelijk een groei in deelauto's. Er zijn ook steeds meer aanvragen. Maar het verschil zit er vooral in wat de partij aanbiedt, een goed product is belangrijk.

Maakt het uit of er een elektrische deelauto of benzine deelauto wordt aangeboden?
Wij hebben geen harde regels hiervoor, maar willen natuurlijk liever elektrische deelauto's. We hebben een brede parkeervergunning voor alleen elektrische deelauto's. Het is wel moeilijk voor mensen, zij moeten wennen aan een deelauto en ook elektrisch is nieuw. We hopen natuurlijk dat vastgoedontwikkelaars met een voorstel komen. En we willen niet alleen auto's faciliteren, ook kleine auto's, bakfietsen normale fietsen of elektrische fietsen. Een combinatie van mobiliteiten dus. Je hebt ook diensten die per seizoen variëren, mensen willen in de winter misschien liever overdekt. Next mobility van PON kan dat ook. Als je variatie aanbiedt, dan heb je een groetere kans op een alternatief.

Zijn er vooral City Deal ontwikkelaars die met deze voorstellen aankomen?
Heijmans zit in deze deal. Maar ook Vita Bolsius (Heijmans) in de City Deal. Maar je merkt dat Heijmans vooral wil ontwikkelen en bouwen, zij willen zich niet bezighouden met de exploitatie van de deelauto. We willen de stichtingskosten (het opzetten) verlagen, door de parkeernorm korting aan te bieden. Maar dan moet er wel wat anders mee worden gedaan, niet alleen maar een voordeel voor de vastgoed partij. Er zijn ook veel plekken die niet gebruikt worden blijkt uit onderzoek. In Zuid-Holland waren er veel gebouwen met veel lege parkeerplekken. Bijvoorbeeld het rode gebouw bij de westersingel naast de kerk? We hopen dat steeds meer mensen gaan fietsen. We hebben ook gesproken met BMW Duitsland, hoe passen steden zich aan in de auto en andersom. Scooters doen het ook goed, bijvoorbeeld Felyx. Gebruik is boven verwachting. Ze gaan enquêtes uitvoeren om te kijken hoe de modal shift veranderd. Maar dit moet nog gedaan worden. Dit willen we ook weten van de deelauto's, en wat het effect hier nou eigenlijk van is. Die zijn nog niet beschikbaar. Van Car2Go is er wel onderzoek beschikbaar misschien in Amsterdam. Maar Amsterdam is een andere stad met andere mobiliteitssystemen, meer geld, ander soort mensen. Het hangt heel erg af van hoe snel het ontwikkelen en gebruiken gebeurt. Maar ook de markt speelt een rol, hoe de app werkt, de marketing is, wat voor abonnement, en de schaal is afhankelijk. De schaal is erg belangrijk, als er maar paar auto's zijn kennen mensen het niet en wordt het ook minder snel gebruikt. Buurauto is heel erg lokaal, dus dat zal nog lang duren. Voor maar een paar gebruikers is dat. Maar Amber is bijvoorbeeld wel een grote partij, die sneller zal gaan werken denk ik. Amber kan vraag-aanbod goed inschatten. En dat lukt ze ook aardig. Daardoor zijn ze geïnteresseerd en een business case is gericht op het gebruik. De Felyx scooter kijken ook naar de wensen van gebruikers, bijvoorbeeld het station in Schiedam. Het is belangrijk dat het aanbod aansluit bij de vraag van de mensen.

Zijn er meer gebouwen, naast het Timmerhuis, waar deelauto's worden aangeboden?
Ik dacht bij de Wijnhaven, bij The Red Apple. Dat is aan de overkant van Rebel. We zitten ook in de Green Deal, en City Deal elektrische deelmobiliteit dus.

Geven jullie subsidie aan deelmobiliteiten?
Nee, maar wel dus een korting op de parkeernorm. En de parkeervergunningen bieden wij aan voor netjes tarief. Maar het zal tijd nodig hebben. Mocht je je onderzoek willen delen op een platform zou je kunnen kijken naar de GreenDeals. Andere interessante mensen die je kan spreken zijn Bas van I&W, Martien, die zit aan tafel bij de deals. Als je ze googelt vind je ze zo.

G.10. Jasper van der Hoop, Gemeente Rotterdam - 18/02/2019

Introductie
De normeringen zijn niet aangepast in de Gemeente Rotterdam, wat we wel hebben veranderd zijn de kortingen die doorontwikkelaars toegepast kunnen worden. Daardoor kan de parkeereis wel omlaag gaan. De kortingen zijn afhankelijk van openbaar vervoer in de buurt, MaaS, deelauto's en fietsenstalling op eigen terrein.

Is er een overzicht van projecten die al zijn opgeleverd met een aangepaste, lagere parkeernorm?
De normering is nu 1 jaar oud, daardoor is er nog niet veel gebouwd met deze parkeernormen. Er wordt wel

veel gebouwd nu, dus dat komt er wel binnenkort allemaal aan. De nulnorm moet eigenlijk weer toegevoegd worden aan de nota, want in het centrum hoeven nieuwe hotels geen parkeerplekken zelf te bouwen vinden we. Zij kunnen gebruik maken van Q-parks en andere garages. Een voorbeeld van een project is de Bright toren bij de markthal, hierbij is de doelgroep erg belangrijk. Hier worden geen parkeerplaatsen gebouwd maar hebben de bewoners ook geen recht op straatvergunningen.

Hanteren jullie een minimum en/of maximum norm?
Wij geven alleen een minimum norm, geen maximum. Maar de ontwikkelaar mag kiezen hoeveel parkeerplekken hij gaat bouwen. De korting kan hij aanvragen, maar hij mag er dus ook boven gaan zitten. De kortingen zorgen voor een flexibiliteit voor de ontwikkelaar die zo zelf ook minder parkeerplaatsen kan bouwen als de inschatting is dat meer niet nodig is. Dit verlaagt ook de bouwkosten waardoor gemakkelijker kan worden gebouwd. De meeste ontwikkelaars willen wel zo'n korting. Saldeer vraagstukken zijn wel lastig. Een oude school die omgezet wordt naar woningen, dat vraagt een ander aantal parkeerplekken. Het maatgevende moment voor de parkeerdrukte door woningen is anders dan de school. Dit wordt dus gezien als een nieuwe parkeereis. Als dit niet gerealiseerd kan worden kan worden besloten de ontwikkeling door te laten gaan en de adressen ook uit te sluiten van het recht op parkeervergunningen. Ik denk zelf dat er wel een doelgroep is voor woningen met geen of weinig parkeerplekken. Echter zien we ook dat soms een garage toch helemaal vol staat, en we dan bewoners een tijdelijke vergunning geven voor op straat. Bijvoorbeeld bij de kop van zuid, daar was die volgens mij verlaagd. Maar zijn er 60 tijdelijke vergunningen gegeven. Ik kan in de omgevingsvergunning terugvinden wat de parkeernorm daar was als het goed is. Little C, een project aan het einde van de Coolhaven. Toekomstige bewoners zijn uitgesloten van het aanvragen van parkeervergunningen. Een toekomstige bewoner was bij een informatie avond, en hij zei dat hij daar niet van op de hoogte was. En dat hij nu gedwongen is zijn auto weg te doen. Hij vroeg om een uitzondering voor hem, maar dat konden wij niet geven. Dus dat geeft wel een probleem. Hier kan je misschien de ontwikkelaar vragen, hoe ze dit aankondigen. Ook interessant als je maar een aantal parkeerplekken te verdelen hebt, hoe je dit dat eerlijk doet.

Wat voor mogelijkheden zien jullie op dit moment m.b.t. parkeernota/normen?
Toepassen op straat parkeren, dat salderen wat ik vertelde. Als we korting geven, dan mogen bewoners niet op straat parkeren. Toch kan deze korting strikt genomen ook worden toegepast bij herontwikkelingen waar al op straat wordt geparkeerd. Dit zorgt voor onduidelijkheid. Het moet worden verduidelijkt, en hoe verdeel je deze parkeerplekken dan? Ook bieden we korting aan op MaaS, maar ook op deelauto's. Terwijl dit vaak samen gaat, dus geven we een soort van dubbelkorting. MaaS moet dus echt een meerwaarde hebben bovenop het aanbieden van deelauto's. Bij kleinere ontwikkelingen (woonprojecten tot 300m2) doen we overigens niet moeilijk. Bij transformatie projecten zijn we wel heel streng. Maar er zijn meerde afdelingen binnen de Gemeente, die andere belangen hebben. Zoals ruimte & wonen, en gebiedsontwikkeling. Al deze belangen moeten bij iedere ontwikkeling worden afgewogen. De uitstraling van de wijk is belangrijk. Nieuwbouw moet zelfvoorzienend zijn.

Moeten de ontwikkelaars iets terug geven, nu ze minder parkeerplekken hoeven te bouwen?
Groen ga je sowieso niet halen. Maar de ruimte beter gebruiken kan wel, voor fietsers, deelauto's, en minder vergunningen geven. Daar moet de focus op liggen. Je merkt dat je bij een verandering ruzie krijgt met de buurt, als er een fietstrommel komt gaan de bewoners klagen dat ze hun auto niet kwijt kunnen. De ruimte is schaars in Rotterdam, dus het is niet gek dat er een prijs kaartje aan een vergunning hangt. Al vinden mensen altijd dat het gek is dat je moet betalen voor een parkeerplek, terwijl dat ook gewoon ruimte is dat je inneemt.

Op welke manier hebben jullie de kortingen bepaald?
Hier is geen onderzoek voor geweest denk ik, ik werkte hier toen nog niet. Maar ik denk dat het een basis percentage is geweest. Misschien dat ze wel rond hebben gevraagd, of hebben gekeken. Feitelijk is dat oudere gebouwen met veel parkeercapaciteit over hebben. Nu hebben ontwikkelaars de mogelijkheid minder te bouwen en zo een lagere capaciteit te hebben. Er is ook een project aan de Maas bij de Boompjes waar alleen deelauto's staan. Dat is nu in aanbouw. Maar daar kan ook een gemeentelijk belang bij zitten. Zoals ik mailde kan je ook kijken naar PON, zij zijn ook bezig met deelauto's en MaaS concept. Half jaar terug was daar een presentatie van. Ze hebben al zakelijke projecten, maar bewoners zal de eerste keer zijn.

Wat is de parkeereis van het Timmerhuis, kan je dat terugvinden?

Ik zal voor je kijken, en ook voor andere gebouwen met een lagere parkeernorm en die zal ik je dan mailen.

G.11. Jorden Steenge, Gemeente Amsterdam - 19/02/2019

Is er een database waar alle parkeernormen van projecten teruggevonden kunnen worden in Amsterdam of Nederland?
Nee, er is geen overzicht. We geven wel advies over projecten, maar we weten niet van ieder project hoeveel parkeerplekken ze hebben. Er is dus geen lijst met adressen. Dus dat wordt lastig.

Is er een overzicht van projecten die al zijn opgeleverd met een aangepaste, lagere parkeernorm?
Ik heb gekeken, we hebben wel nieuwbouw in Buiksloterham. Dat is een buurt in Amsterdam Noord, waar veel bedrijven zijn en ook woningen toegevoegd worden. De woningen zijn onder de nieuwe parkeernormen waarschijnlijk toegepast. De bewoners zijn uitgesloten van vergunningen. Een ander project bij Amstel Station is op de Spaklerweg, deze is recent opgeleverd. Daar zijn veel woningen gerealiseerd, ook op de Zuidas. Geen lijst van adressen dus helaas. De Nota is er sinds halverwege 2017, de woningen die nu gebouwd worden met de nieuwe nota zitten net op het randje of er al wel of niet bewoners zijn. Vanaf 2017 zijn de projecten wel beoordeel met het nieuwe beleid.

Zijn er onverwachte dingen/situaties opgetreden door de nieuwe parkeer nota?
De norm is te jong om dit te kunnen zeggen, de eerste woningen zullen net bewoond gaan worden. Wat ik verwacht is dat er meer vraag naar deelauto's zal komen.

Worden er meer of minder parkeerplekken gebouwd dan voorheen?
Sowieso minder. Eerst was er alleen een minimum norm, nu is er ook een maximum norm. In de meeste gevallen knelt dat niet met project ontwikkelaars. Ontwikkelaars willen eigenlijk nooit meer parkeerplekken dan de maximum van 1. Alleen bij kleinere projecten soms, maar daar is eventueel nog maatwerk voor. Al met al worden er minder parkeerplekken gebouwd.

Zijn de effecten die jullie hadden verwacht ook tot stand gekomen?
Het effect weten we nog niet. We weten nog niet wat corporaties van nieuwbouw van sociale huurwoningen gaan doen. Wat ze kunnen en willen doen. We zien bij een aantal projecten dat ze geen parkeerplekken maken, dus 0 parkeerplekken.

Gaan jullie hier onderzoek naar doen?
Wel in een algemene zin. In centrum gebieden betekent het al dat er betaald parkeren is, dat betekent dat mensen een oplossing moeten vinden in hun eigen locatie. Mensen kunnen wel parkeren in buiten gebieden, maar dit is vaak ver weg. Het is niet relevant voor mensen, om eerst 8 kilometer te gaan fietsen. Dat soort effecten hadden we al voor we beleid hadden gemaakt meegenomen. We doen dus geen onderzoek, het moet nog een beetje zetten, deze nieuwe nota. Het is wel interessant wat mensen doen. Het kan zijn dat mensen minder lang op deze plekken gaan wonen in autoloze gebieden. Dat zou bijvoorbeeld kunnen.

Weet u wat de parkeernorm voor Complex de Boel was?
Nee. Het was een renovatie project, maar het waren al woningen en werden woningen. We kijken wel opnieuw naar de parkeernorm bij transformatie projecten, maar in dit geval gingen we geen veranderingen toepassen. Er waren voorheen geen plekken op eigen terrein, en dat bleef hetzelfde. Dus als er zelden een reden is, dan zullen we mensen niet uitsluiten van parkeervergunningen.

Wat voor mogelijkheden zien jullie op dit moment m.b.t. parkeernota/normen?
Op dit moment zijn er in de stad veel discussies over de ruimte van de stad. Hoeveel ruimte er aan project ontwikkelaars er gegeven moet worden. De norm tussen de 0 en 1 is een erg grote bandbreedte. Er zijn veel stichtingskosten, misschien moet de maximale norm ook lager. Bij Haven-stad, in het westen van Amsterdam worden 70,000 woningen gerealiseerd. Tussen bestaande bedrijven en woningen. Het moet een autoluwe wijk worden, maar hoe kan je dan nog een brede marge geven aan projectontwikkelaars. Dit is wel een discussie punt. Het nieuwe beleid is nog te nieuw, we hebben al wel effecten van Sloterdijk. Als je alle projecten optelt dan kom je uit op een norm tussen de 0,2 en 0,3. Onzeker over sociale en vrije sector woningen, wat

corporaties zouden gaan doen. Bij studenten woningen zeggen corporaties wel dat ze geen parkeerplekken gaan maken. Maar dit zijn voorzichtige conclusies, maar het gebied van Sloterdijk is goed bereikbaar en heeft een IC station.

Wat betekent precies autoluw?
Is inderdaad een onduidelijk woord, en kan alle kanten op. Voor Haven-stad geldt 0,2 in parkeernorm. Autoluw betekent in de rest van de stad, minder ruimte voor parkerende auto's en rijdende auto's.

Merk je dat bewoners gaan klagen als ze geen vergunning krijgen?
Belangrijk is dat aan de voorkant het beleid goed is. Dit zijn de spelregels, dan kan je wel zeggen ik vind de spelregels niet leuk. Maar het is een bewuste keuze van de mensen om daar te gaan wonen. Er is wel een geval waar de communicatie niet goed gegaan is, waar we toch hebben moeten zeggen dat ze een aantal vergunning kregen. Maar de communicatie ligt bij de verhuurder, daar moeten de bewoners eerst heen. En onder die voorwaarde worden de woningen gekeurd.

Waarom gebruiken jullie autobezit als leidraad voor de parkeernorm?
We hebben dat genomen voor de minimale norm als uitgangspunt. Inderdaad gebaseerd als totaal van de stad. Voor de vrije sector is dat een vrij lage verplichting. Ik geloof dat geen enkel iemand heeft gezegd die 0,3 is te hoog. In principe zijn er geen klachten van ontwikkelaars dat er te veel of te weinig gebouwd moet worden.

Hoe hebben jullie de parkeernomen bepaald in de verschillende locaties, is daar een berekening voor gedaan?
We hebben de locaties ingedeeld op zeer goed OV, dat is in het centrum van Amsterdam. Intercity binnen 800 meter. En ingedeelde op relatief minder goed bereikbaar, en C locaties. Goed, maar niet extreem bereikbaar is de rest.

Op welke manier hebben jullie bepaald dat de parkeernorm met het specifieke getal van 20% omlaag kan met een deelauto?
Er zijn wel onderzoeken gedaan. Utrecht heeft dat ook laten doen, en er is een onderzoek van CROW. Maar ik moet wel zeggen dat het een beetje moeilijk blijft. Er is aan deelnemers gevraagd van deelauto's, maar daar zit altijd wel een bias in. Bij de 20%, hebben wij ons aangesloten.

Wilt u zelf nog iets toevoegen aan dit gesprek?
Het onderwerp speelt nu erg, er komen veel ontwikkelingen aan met plannen. Bijvoorbeeld Bajes Kwartier, AM is hier de ontwikkelaar, ook hier zeggen ze dat ze deelmobiliteit (deelfietsen, deelauto's en deelscooters) gaan aanbieden. De 1200 woningen worden door ontwikkelaar opgepakt. Verder zijn alle projecten nog zo jong. Je zal een buurt vinden waar deelauto's zijn en gebruikt worden. Maar er nog geen effecten zijn. Ander project dat er gaat komen is in Meerwede, Utrecht. Ook dat zijn plannen, iedereen hoop er van te leren. Je zult pas de effecten weten als het er 20 jaar staat.

Jullie zijn niet aangesloten bij de City Deal, is hier een redden voor?
Wij sluiten binnenkort aan bij de City deal of de Green deal. Onze agenda autodelen is nu vastgesteld, en we willen deelmobiliteit stimuleren en uitstoot verminderen. Maar de vraag van de City Deal was toen op een ongunstig moment voor ons, vandaar dat we toen niet getekend hebben.

G.12. Eefke Verheij, Gemeente Utrecht - 28/02/2019

Is er een overzicht van projecten die al zijn opgeleverd met een aangepaste, lagere parkeernorm?
Nee, we hebben geen lijst met gebouwen. Er zijn ook vaak maatwerkmogelijkheden toegepast. Maar hier is geen overzicht van. Zelf ben ik heel erg bezig met het beleid en niet met de uitvoering, daar zijn andere collega's weer mee bezig. Deze week hebben veel mensen vakantie. Ik kan nog wel rondvragen of mensen voorbeeldprojectenweten, daar kan ik een lijstje van maken en naar je toe mailen. Ik weet zo uit mijn hoofd het gebouw in de uithof waar ook deelauto's staan.

Dit is SSH studentencomplex Johanna. De projecten die ik zelf in Utrecht al gevonden heb zijn, Neudeflat,

Museo en Oudenoord.

Ervaringen
In de laatste jaren hebben we wel veel ervaring op kunnen doen met het beleid. Over een tijdje komt er een nieuwe parkeernormennota aan. Het is wel belangrijk dat je niet alleen beleidsmaatregel goed regelt, maar het ook in de praktijk goed regelt. Dat wanneer er deelauto's komen, dat ze dan ook voor langere periode goed geregeld worden. Je wilt voorkomen, dat twee jaar na oplevering er dan alsnog een tekort komt. Dit zijn we tegengekomen, hier moet je vroegtijdig over na denken.

Ik las ook over het voorbeeld van de woningen die kleiner werden gemaakt zodat er minder parkeerplekken gebouwd hoeven te worden in het voorstel van het addendum.

Het verschil in parkeernorm tussenwoningen tot 55m2 bvo en woningen groter dan 55 m2 bvo is groot. En we maken in Utrecht nu alleen onderscheid in de grootte van de woningen. We maken geen onderscheid in sociale en midden huurwoningen, dit doen andere gemeenten wel. CROW heeft kerngetallen voor sociale- en midden huur. Als het goed is, heeft Amsterdam zelfs voor sociale huur een minimum norm van 0.

Utrecht heeft een maximum norm om het verkeer te beperken, dat is ook echt nodig in sommige gebieden in Utrecht. Mijn collega weet alles van de parkeernormen, ik denk dat de gemeente Rotterdam ook sociale huur aanpassingen heeft. Hij heeft ook meegewerkt aan de nieuwe parkeernormen van Rotterdam.

Addendum op huidige nota
Het addendum zal vooral gaan over specifieke locaties, dus dat gaat niet over wat we overal in de stad willen aanpassen. We zijn bezig met het nieuwe parkeerbeleid, de nieuwe nota. Er wordt nu veel gebouwd, en er zijn veel ontwikkelingen. Dus het moet eigenlijk sneller, dus daarom hebben we een toevoeging op de huidige parkeernormen nota met de addendum.

Over wat voor zaken zal het dan gaan in de nieuwe nota?
Het is moeilijk om aan te geven, wat er precies in het nieuwe beleid gaat komen.

Het addendum gaat dus over speciale locaties, zodat we nu verder kunnen gaan. Wil je nog minder parkeerplekken willen kunnen aanleggen, dat zal moeten gaan met bijvoorbeeld aanbiedingen zoals MaaS en deelauto's. Waar we ook naar kijken is naar parkeren op afstand. P&R aan de rand van de stad.

Is dit hetzelfde als een mobiliteitshub?
Hub is meestal in het gebied zelf. Maar sommige mensen gebruiken hun auto niet dagelijks. Dus als je zorgt voor een goede verbinding, met de fiets of het ov. Dan is het helemaal niet zo gek om een parkeerplek op afstand te hebben.

Hoe zit dat met mindervalide, hier willen jullie ook een aanpassing in de addendum doen?
Dit gaat over het parkeren op loopafstand in het huidige beleid. In A gebieden gaat dit om 1000 meter, en in C gebieden over een maximale loopafstand (niet hemelsbreed) van 50 meter. Dit willen we tot 100 meter verlengen. Wanneer een gedeelte buiten loop afstand zal zijn, moet hier wel rekening mee gehouden worden voor de mensen met een beperking. Het uitgangspunt is wel dat mensen met een beperking, wel in het gebied kunnen parkeren dichtbij.

Hebben jullie eigen onderzoek gedaan?
We gebruiken getallen van CROW, en kijken ook naar andere gemeenten. We werken wel zelf aan mobiliteitsconcepten. Wat misschien interessant is, is de Merwede kanaalzone, daar staat ook vrij veel van online. Dat is een goed voorbeeld van hoe we er mee bezig zijn.

Hoe gaan jullie om met transformatie (bij projecten waar de functie van het gebouw veranderd) projecten en de parkeernormen?
Daar geldt gewoon de huidige parkeernorm voor. Hoe dat in het nieuwe beleid uit gaan zien, durf ik nog niets over te zeggen.

G.13. Resident I - Het Timmerhuis

Vanaf wanneer woon je hier?
Vanaf het begin, in 2015 is het geopend.

Wat waren de belangrijkste redenen om te verhuizen?
Wij woonde al best dichtbij, de plek was voor ons al, ja een fijne plek. Ik ben niet naar de plek verhuist, ben zelfs lopend verhuisd. Ik woonde vlakbij in een andere flat. Ik vond het sowieso fijn om in de binnenstad te blijven wonen, dichtbij het openbaar vervoer, dichtbij alle voorzieningen. Leuk om in de stad te wonen, ondanks dat ik nu twee kinderen heb. Meeste mensen vluchten dan de stad juist uit. Maar ik vind het juist fijn, om juist omdat je in de stad woont, heb je die vrijheid. Je leven wordt al wat kleiner, in de zin van dat je iets minder makkelijker de deur uit kan. Als je dan ook nog buiten de stad woont, dan wordt je leefwereld, in mijn ogen, echt heel erg klein. Op deze manier kan je toch net iets makkelijker dingen combineren, of even de deur uit. Naar culturele dingen gaan. Dus de reden was we wilde een koophuis, en omdat ik in de architectenwereld zit. Wist ik al dat er een vraag was, er was een prijsvraag. Ik was eigenlijk al geintersseerd, maar ik had niet het idee dat ik het zou kunnen betalen. Het was crisis, dus we hadden ook wel mazzel. De prijzen waren relatief laag, ik denk dat we ons eigen huis nu niet meer zouden kunnen betalen. Zo erg is het gestegen in drie jaar tijd. En we waren getriggerd door dit appartement, omdat het nieuw is, heel veel ramen heeft, je kijkt echt drie kanten uit over de stad. En we hebben een heel groot dakterras dat aanvoelt als een tuin. Dat waren de ingredienten waarvan we hadden dat apartement is sowieso goed. Ondanks dat het nu heel slecht gaat. Zoals ze in het begin dachten, wat als we het niet verkocht krijgen. Dat is echt het omgekeerde, het is echt bizar.

Waren er andere redenen dat jullie wilden verhuizen, ondanks de locatie?
We hadden voor het verhuizen nog maar 1 kind. We zijn niet groter gaan wonen, het is 10 m2 groter. Maar het is vooral veel groter. Hiervoor woonde in een jaren 80 woningen, met kleine ramen. Nu hebben we grote ramen, en sta je altijd in contact met het weer en je hebt heel veel licht in je huis. En de buitenruimte vonden we ook heel fijn. De buitenruimte was misschien nog de grootste. En dit zijn appartementen met 50 m2 terras aan je woonkamer grenzend. Dat was een reden voor ons.

Heb je een auto in het huishouden?
In het huishouden wel, die auto is van mijn vriendin, ik zie het wel echt als haar auto. Maar we hebben dus 1 auto.

Hoeveel auto's waren er in het huishouden voor het verhuizen?
Ook 1.

Is het een leaseauto?
Nee, een eigen auto.

Heb je een voorkeur voor benzine, gas of elektrisch?
Ja, ik heb wel een voorkeur voor elektrisch. De auto van mijn vriendin is overigens niet elektrisch. Dat is gewoon een benzine auto. Maar we hebben wel zoiets van, we willen deze auto oprijden. En de volgende auto zal dan hopelijk wel een elektrische auto worden. Ik rij relatief veel in de elektrische huurauto. Ik vind elektrisch rijden gewoon echt heel fijn rijden. Dat is het verschil met of je van paard en wagen overgaat naar de auto. Nee de benzine auto voelt als een log apparaat, met trillende onderdleen, veel geluid, veel herrie. Een elektrische auto rijdt gewoon super soepel, en maakt geen geluid. Geen geluid vind ik heel fijn. Angst om uit de range te halen, raak ik ook wel aan gewend. Als je naar Groningen gaat moet je iets beter plannen, maar naar Amsterdam op en neer redt je makkelijk op 1 accu. En in de grote steden kan je hem toch wel opladen. Ik heb ook wel eens bij de snelweg, bij een snellaadding opgeladen. Even koffie en dan is hij zo weer 80% opgeladen. Ik vind het belangirjk dat er meer elektrisch wordt gereden in de stad, vanwege de luchtkwalitiet. De luchtkwaliteit is echt wel belabberd in de stad. Tuurlijk kan je ook zeggen dat het maken van die auto's ook vervuilend is. Maar die fabrieken staan niet in de stad of in de bebouwde kom. Ik vind het wel belangrijk dat waar mensen wonen de lucht goed is.

Vind je auto rijden leuk?
Ja, dat vind ik wel leuk.

Rijdt je wel eens een andere atuo van vrienden of familie?
Nee alleen de deelauto of die van mijn vriendin.

Gebruik je ook geen andere deelauto's, zoals Snappcar of Greenwheels?
Nee, alleen Juuve. Ik heb wel voorheen auto's echt gehuurd bij verhuurbedrijven in de stad, zoals Hertz. Daar maak ik nu amper gebruik van, omdat dit veel makkelijker dan gaat, en dichterbij. Huurbedrijven is veel gedoe, je moet naar een balie, je moet er omheenlopen, formulier ondertekenen, is net wat omslachtiger. Ik maak daar alleen gebruik van als ik echt een auto voor lange tijd nodig heb, voor een week als ik naar het buitenland moet.

Waarom?
Dat is goedkoper, en dan is het wel fijn om een benzine auto te hebben. Als je op en neer naar Italie moet.

Is de auto vervangen sinds de verhuizing?
Nee, dit is dezelfde auto.

Was het aantal auto's veranderd denk je als er geen deelauto was?
Ja, ik denk dat ik er een auto bij had genomen dan.

Zijn jullie van plan om in de nabije toekomst het aantal auto's te veranderen?
Een tweede auto zou alleen gebeuren als het concept van de deelauto weg gaat. Stel BMW of Juuve zegt we trekken de stekker er uit in het Timmerhuis. Dan zal ik wel overwegen om een auto te kopen, ik heb die mobiliteit nodig. En het kopen van een nieuwe auto, ja deze auto die we nu hebben die nu weg doen. Dat speelt vaag op de achtergrond, maar dat gebeurd niet binnen nu en een jaar. Hangt er ook een beetje van af hoe die auto het blijft doen.

Nu staat er 1 deelauto op straat, en 1 in de garage. Heb je voorkeur voor 1 van de twee?
Ja, die in de garage.

Waarom?
Omdat het dichtbij is, je gaat met de lift naar -1, en daar staat hij naast. Sterker nog als ik zie dat de auto in de garage gereserveerd is, en ik moet die van straat pakken dan heb ik altijd zoiets van, een baalmomentje. Shit ik had hem eerder moeten reserveren.

Hoe ver van te voren moet je het reserveren?
Vaak doe ik het redelijk last minute, maar ik heb een paar keer net misgegrepen. Alle twee de auto's weg, heb ik nog niet meegemaakt. Maar als ik weet wanneer ik een auto nodig heb, dan boek ik hem al een paar weken van te voren vast. Ik heb hem nu al voor een aantal dagen, omdat mijn vriendin de auto heeft, dan heb ik hem al voor de zekerheid gereserveerd.

En als je hem dan annuleerd, kost dat geen geld?
Dat kost wel een bepaald percentage van de reservering, maar ik gok er wel gewoon op dat ik hem dan gewoon nodig heb.

Gebruik je wel eens het openbaar vervoer?
Ja.

Wanneer kies je voor het openbaar vervoer en waneer voor de deelauto?
Uhm, nou voor mijn werk is het. Ik moet vaak op verschillende plekken zijn, dus vaak kies ik de auto omdat ik op verschillende locaties moet zijn om meerdere projecten te fotograferen. En vaak kom ik op plekken die omslachtig te bereiken zijn met het openbaar vervoer. Dus het OV pak ik dus eigenlijk alleen maar als ik in het centrum van een van de grote steden moet zijn, Den Haag, Utrecht of Amsterdam. En zelfs dan pak ik soms nog wel eens een huurauto, omdat ik grote spullen moet meenemen. Maar het is wel vervelend om je auto te parkeren in de grote steden.

Ik begreep dat parkeren met Juuve in het centrum van Rotterdam gratis is.
Dat klopt, maar daar buiten niet. Het is ook sneller als je in het centrum moet zijn met het openbaar vervoer. Dus ik moet echt de afweging maken met hoe groot de spullen zijn, zoals een groot statief. Als het wel moet, dan ga ik wel met de auto.

Gebruik je de deelauto nu meer dan de huurauto voor de verhuizing?
Je bedoelt dan de huurauto voorheen, ja veel meer.

Hoe vaak denk je dat je hem gebruikt?
Drie keer per week.

Is het gebruik in de loop van de tijd sinds je lid bent veranderd?
Ja, ook meer. Het wordt steeds gebruiksvriendelijker, het is makkelijk om het voor korte duur te gebruiken. Bij een huurauto, gebruik je minimaal 8 of 24 uur. Maar dit kan je ook gebruiken voor een kwartiertje, en dan betaal je bijna niets. Toen moest ik iets ophalen in Rotterdam. Dat kostte denk ik 2,50. Je betaald echt alleen maar per minuut, en geen abonnement. Dus dat is wel het aantrekkelijke. Dus je weet ook exact wat je kwijt bent, als je 2 uur moet rijden. Dus dat is ook wel fijn, je krijgt meteen een overzicht zodra je je rit hebt afgerond. Heel transparant.

Staat jullie eigen auto ook in het Timmerhuis?
Ja, die zijn wel duur.

Maar dat is geen reden geweest om de auto weg te doen?
Nee, mijn vriendin is verloskundige, dus voor haar is een huurauto echt een no-go. Zij heeft 24 uurs diensten, en is dan oproepbaar, dus moet dan 's nachts weg. En er liggen ook medische spullen in de kofferbak. Dus dan kan je niet met een huurauto, medisch beroep is denk ik wel de uitzondering waarbij je geen deelauto kan gebruiken. We zullen dus helaas altijd 1 auto moeten houden. We zouden in principe ook een artsenpaal kunnen aanvragen, die kan je op straat kunnen krijgen als medisch beroep.

Wat voor soort reizen gebruik je de deelauto?
Ik gebruik hem bijna alleen maar voor werk, zakelijk.

Zijn dat gepland of ongeplande reizen?
Beiden.

Is dat dan doordeweeks of ook in het weekend?
Ook in het weekend.

Wat als er geen deelauto zou zijn, hoe zou je dan je reizen maken?
Dat heb ik nog nooit meegemaakt, maar er is altijd wel een deelauto. Ja, want dat is ook wel het goede, op zich heb ik het nog niet zo hoeven te gebruiken. Maar Juuve die heeft twee deelauto's van het Timmerhuis, maar er zijn ook andere auto's in de stad. Dus er zijn altijd wel andere auto's, het wordt dan wel iets minder aantrekkelijk. Want dan moet je eerst daar naar toe. Dus ik zal dan ook wel gaan kijken naar het openbaar vervoer. Kan dat allemaal niet, dan kan ik nog naar het Groot Handelsgebouw of het Industriegebouw, daar staan volgens mij ook wel wat auto's. Volgens mij hebben ze er een stuk of 10 over de stad staan. Dus ik zou altijd wel een auto kunnen vinden.

En als de deelauto's weg gaan?
Toch een eigen auto.

Geen andere deelauto organisatie?
Zoveel zijn er niet toch. Alleen maar GreenWheels?
Nou, ik weet niet welke precies er in Rotterdam zitten. In Amsterdam zitten er natuurlijk heel veel, Car2Go.
Nee, dat hebben ze hier nog niet, we lopen hier nog wel achter. Maar dat heeft ook wel met de dichtheid van de stad te maken. Daar heb je ook al veel meer nieuwbouwprojecten waar je geen parkeerplek kan krijgen, maar dat komt in Rotterdam ook wel, maar wel iets trager. *Greenwheels zijn wel benzine auto's geloof ik.* Ja, ik

weet niet of ik me daar door zou laten tegenhouden. Maar ik zou dat moeten uitzoeken, omdat de mobiliteit en flexibiliteit voor mij heel belangrijk is.

Heb je een OV-kaart?
Nee, nouja ik heb een businesskaart. Dat wordt automatisch afgeschreven. Misschien korting in de daluren, eerlijk gezegd weet ik het niet. Het gaat naar de boekhouding. Ik denk daar helemaal niet over na, hoelaat ik ga reizen.

Heeft de deelauto invloed gehad op andere vervoersmiddelen, dit kan ook fietsen, openbaar vervoer en lopen zijn?
Openbaar vervoer dan denk ik, dus niet lopen of fietsen, dat zijn toch andere afstanden.

Heeft het weer daar geen invloed op?
Nee.

Is de manier waarop je je reizen plant veranderd?
Ja, ik probeer vooruit te plannen waar mogelijk. Maar bij mij is het zo lastig, dat het niet altijd te doen is. Het enige wat ik kan doen, is dat wanneer ik weet dat er echt geen auto is in ons huishouden. Dus de dagen dat mijn vriendin, de dinsdag en de vrijdag, dan heeft mijn vriendin altijd vaste dienst. Dus ik heb hem dan al gereserveerd voor de zekerheid. En die andere dagen, heb ik altijd haar auto om op terug te vallen. Maar als zij hem niet nodig heeft, dan pak ik toch de deelauto. Dat komt omdat ik bij haar auto de kilometers moet doorgeven, en dat naar de boekhouder moet doorsturen. En bij de deelauto gaat de hele factuur naar de boekhouder. Dus fiscaal is het ook wel ook relaxt. Dus de kilometers moet ik bijhouden anders, maar de benzine kan niet, want het is een prive auto.

Maak je reizen die je anders niet zou maken?
Nee, het is voornamelijk voor reizen.

Afstand tot je werk en reistijd?
Dat verschilt.

Winkel je meer online dan voorheen?
Ik gebruik de deelauto nooit voor boodschappen.

Dit waren de vragen. Wil je zelf nog iets toevoegen aan dit gesprek?
Ik hoop gewoon vooral da het een succes wordt, en da het uitgerold wordt over meerdere projecten. Dan heet het denk ik een grotere kans van slagen. Maar bij het postkantoor, daar krijgen ze ook geen parkeerplaats voor 400 huizen 30 parkeerplekken. Voor alleen maar deelauto's. Als ze dat koppelen aan Juuve, dan zou dat wel echt handig zijn. Als we ook die auto's kunnen gebruiken, dan heb je in een keer een schaalvergroting. Dan is de kans veel groter dat er auto's beschikbaar zijn. Dan zou je het tot een succes kunnen brengen, en dat zijn aantrekkelijke afstanden, loop afstanden. Dus het zou dezelfde of een samenwerkende partij moeten zijn. Er zijn ook mensen in ons appartement die ergens anders een parkeerplek huren, bijvoorbeeld in de Hofdame. Maar niet iedereeen huurt een parkeerplek in het Timmerhuis.

H

Interviews Analysis

Table H.1: Results Interview Analysis Carsharing providers

Organisation	Interview texts	Label	Key Topics
Juuve	App en marketing zijn belangrijk	Motivatie deelauto gebruik	Experiences
Juuve	Het is nodig om mensen korting te geven, om het gedrag van mensen te veranderen	Motivatie deelauto gebruik	Experiences
Juuve	Mensen denken er niet aan om een deelauto te nemen	Motivatie deelauto gebruik	Experiences
Juuve	We hebben een rekentool op de website staan om mensen bewust te maken van het voordeel van deelauto's	Motivatie deelauto gebruik	Experiences
Juuve	Doelgroep zijn structurele gebruikers, maar niet dagelijks	Doelgroep gebruik	Socio-Demo
Juuve	Mensen zitten al in een gewoontepatroon in bestaande woningen, hebben al een auto en parkeerplek	Gedragsverandering	Experiences
Juuve	Verstedelijking	Doel ruimte	Goals
Juuve	Mensen vinden elektrische auto's wel spannend	Nieuw elektrisch	Experiences
Juuve	De benzine auto meer kilometers maken dan de 5 elektrische auto's bij elkaar samen	Nieuw elektrisch	Experiences
Juuve	mannen en vrouwen, van alles	Doelgroep geslacht	Experiences
Juuve	Ruimte en luchtkwaliteit	Doelen ruimte en milieu	Goals
Juuve	Focussen op autobezitters	Doel autobezit	Goals
Juuve	Voorkomen dat mensen ooit een auto gaan kopen	Doel autobezit	Goals
Juuve	Als je eenmaal een auto hebt, dan ben je er aan gewend, en is het moeilijk om er vanaf te komen	Gedragsverandering	Experiences
Juuve	We zijn pas een jaartje live, dus ik heb nog niet heel veel data	Onderzoek	Research
Juuve	Het is allemaal zoals verwacht	Ervaring	Experiences
Juuve	Het is niet zo dat het massaal binnenstroom.	Ervaring gebruik	Experiences
Juuve	Naar klussen voor werk gaat	Ervaring doelgroep gebruik	Experiences
Juuve	Iemand die haar kinderen er elke dag mee naar school brengt	Ervaring doelgroep gebruik	Experiences
Juuve	Iemand privé gebruikt	Ervaring doelgroep gebruik	Experiences
Juuve	Tot 40 jaar en vroeg in de 20	Ervaring doelgroep	Experiences
Juuve	Binnen en buiten de stad	Doelgroep built environment	Built Environment
Juuve	Geen OV is aan de rand van de stad	Doelgroep built environment	Built Environment
Juuve	Gevalideerd dat mensen benzine auto's prettig vinden	Elektrisch benzine	Experiences
Juuve	Service level heel hoog moet zijn	Ervaring voorkeuren deelautogebruik	Experiences
Juuve	Auto moet in de buurt staan	Ervaring voorkeuren deelautogebruik	Experiences
Juuve	Auto moet je kunnen aarnaken	Ervaring voorkeuren deelautogebruik	Experiences
Juuve	Auto in garage wordt 2x zoveel gebruikt dan die op straat	Ervaring gebruik	Experiences

Table H.1: Results Interview Analysis Carsharing providers

Organisation	Interview texts	Label	Key Topics
Juuve	Schaal hebt aan auto's dat mensen altijd op het systeem kunnen vertrouwen	Doel groeien	Goals
Mobiliteitsmeester	Het lastige is dat wij een theoretische berekening doen van bijvoorbeeld 80 woningen, dus 15 20 gebruikers daarvoor zijn 4 auto's nodig. Maar dat is erg duur, dus beginnen we meestal met 2.	Aantal deelauto's	Experiences
WeDriveSolar	De bewoners van de gebouwen allemaal	Doelgroep iedereen	Socio-Demo
WeDriveSolar	Museo had veel meer gebruikers dan verwacht, heel erg hoot.	Ervaring deelauto gebruik	Experiences

Table H.2: Results Interview Analysis Developers

Organisation	Interview texts	Label	Key Topics
Vesteda	Doel van Vesteda is om CO2 uitstoot terug te dringen	Doel Milieu	Goals
Vesteda	Young porfessionals	Doelgroep leeftijd	Socio-Demo
Vesteda 35 jaar	25 Doelgroep leeftijd	Socio-Demo	
Vesteda	Midden huurder	Doelgroep inkomen	Socio-Demo
Vesteda	Bezettingsgraad is vooralsnog te laag	Ervaring gebruik	Experiences
Vesteda	Keuzevrijheid en flexibliteit op het gebied van mobiliteit is belangrijk voor mensen	Doel Mobilieit	Goals
Heijmans	Er is geen specifieke doelgroep	Doelgroep iedereen	Socio-Demo
Heijmans	Je moet mensen echt de drempel over hebben	Gedragsverandering	Experiences
Heijmans	Nog net niet rendabel	Ervaring deelauto gebruik	Experiences
Heijmans	Het is wel aardig dat toch nog heel veel mensen (dure) parkeerplekken huren, terwijl ze ook met die deelauto aan de slag kunnen.	Ervaring parkeerplekken	Experiences
Heijmans	Oldtimers ging verkopen	Ervaring autobezit verandering	Experiences
Heijmans	Dame die haar auto heeft verkocht, die stond op het punt om een nieuwe te kopen	Ervaring autobezit verandering	Experiences
Heijmans	Ik denk dat het in een buitenwijk beter gaat doen, dan in een binnenstad	Doelgroep built environment	Built Environment
Heijmans	Het bleek dat voor 84 appartementen 4 auto's too much is, eigenlijk 2 al	Ervaring deelauto gebruik	Experiences
Heijmans	Focus op tweede auto, derde, vierde auto die vaak stil staat	Doelgroep autobezit	Socio-Demo
Heijmans	Deelauto's puur met de ogen op verkoop	Doel Verkoop	Goals
Heijmans	Als een soort van service	Doel Service	Goals
Heijmans	De mini (benzine) werd eerst veel gebruikt	Ervaring benzine/elektrisch	Experiences
Heijmans	Als het 5 minuten duurt, ben je ook afgehaakt	Ervaring voorkeuren deelautogebruik	Experiences
Heijmans	10 jaar vast voor 20% is lang, daar worden we niet blij van	Ervaring beleid	Experiences
Heijmans	het zou fijn zijn als je een dedicated parkeerplek hebt	Ervaring beleid	Experiences
Heijmans	Er zijn ook mensen die ergens anders hun auto hebben geparkeerd	Ervaring parkeerplekken	Experiences
BPD	Niet iedereen heeft de behoefte aan een eigen auto in de binnenstad	Doel mobiliteit	Goals
BPD	Binnenstad, waarbij mensen al goed openbaar vervoer hebben	Doelgroep built environment	Built Environment
BPD	Maken van parkeerplaatsen is erg duur	Doel Economisch	Goals
BPD	Je wil voorop lopen en meegaan met de nieuwste ontwikkelingen	Doel Ontwikkeling	Goals

Table H.2: Results Interview Analysis Developers

Organisation	Interview texts	Label	Key Topics
BPD	De deelauto gebruiken we niet domweg om de parkeernorm naar beneden te schroeven, het moet wel een toegevoegde waarde hebben.	Doel Service	Goals
BPD	Eigenlijk krijgen we het aantal parkeerplekken nooit allemaal verkocht	Ervaring parkeerplekken	Experiences
Syntrus Achmea	De auto's worden goed gebruikt	Ervaring deelauto gebruik	Experiences
Syntrus Achmea	Er kon niet meer groen komen	Ervaring ruimte	Experiences
Syntrus Achmea	Niet alle parkeerplekken zijn bezet	Ervaring prakeerplekken	Experiences
Syntrus Achmea	De mensen die er wonen zijn veelal jong, dat is ook het woonproduct	Doelgroep bewoners	Socio-Demo
Syntrus Achmea	Doelgroep voor deelauto's kan iedereen zijn.	Doelgroep iedereen	Socio-Demo
Syntrus Achmea	Vooral binnenstad	Doelgroep built environment	Built Environment
Syntrus Achmea	Leefbaarheid	Doel kwaliteit	Goals
Syntrus Achmea	Schone auto's	Doel milieu	Goals
Syntrus Achmea	Minder autodruk	Doel autobezit	Goals
Syntrus Achmea	Betere kwaliteit	Doel kwaliteit	Goals
Syntrus Achmea	meer ruimte en groen	Doel ruimte	Goals
Syntrus Achmea	Willen we de mobiliteit behouden	Doel mobiliteit	Goals
Syntrus Achmea	Minder parkeerplekken bouwen	Doel ruimte	Goals
Syntrus Achmea	Mensen vinden het wel pannend, een deelauto en elektrisch	Nieuw elektrisch	Experiences
Syntrus Achmea	We willen groeien naar bijvoorbeeld 20 deelauto's	Doel groeien	Goals

Table H.3: Results Interview Analysis Municipalities

Organisation	Interview texts	Label	Key Topics
Gemeente Rotterdam Advisor sustainable mobility	Ontwikkelaars krijgen deze korting, maar dan moeten ze dus wel de behoefte aan de mobilteit van bewoners meegeven	Doel mobiliteit	Goals
Gemeente Rotterdam Advisor sustainable mobility	Het is wel moeilijk voor mensen, zij moeten wennen aan een deelauto en ook elektrisch is nieuw.	Nieuw elektrisch	Experiences
Gemeente Rotterdam Advisor sustainable mobility	We willen de stichtingskosten voor het opzetten verlagen, door de parkeernorm korting aan te bieden. Maar dan moet er wel wat anders mee worden gedaan, niet alleen maar een voordeel voor de vastgoed partij.	Doel ontwikkelaar helpen	Goals
Gemeente Rotterdam Advisor sustainable mobility	Veel gebouwen met lege parkeerplekken in Zuid Holland	Ervaring prakeerplekken	Experiences
Gemeente Rotterdam Advisor sustainable mobility	Amsterdam is een andere stad met andere mobiliteitssystemen, meer geld, ander soort mensen	Doelgroep built environment	Built Environment
Gemeente Rotterdam Advisor sustainable mobility	De schaal is erg belangrijk	Aantal deelauto's	Experiences
Gemeente Rotterdam Adivsor Mobility	Flexibiliteit voor de ontwikkelaar, car sharing is used to reduce car ownership	Doel ontwikkelaar helpen	Goals
Gemeente Rotterdam Adivsor Mobility	Saldeer vraagstukken zijn wel lastig. Een oude school die omgezet wordt naar woningen	Ervaring beleid	Experiences
Gemeente Rotterdam Adivsor Mobility	Ik denk zelf dat er wel een doelgroep is voor woningen met geen of weinig parkeerplekken.	Doelgroep autobezit	Socio-Demo
Gemeente Rotterdam Adivsor Mobility	Echter zien we ook dat soms een garage toch helemaal vol staat, en we dan bewoners een tijdelijke vergunning moeten geven voor op straat	Ervaring parkeerplekken	Experiences
Gemeente Rotterdam Adivsor Mobility	Toekomstige bewoners was niet op ee hoogte van geen parkeerplekken . . . Hij vroeg om een uitzondering.	Ervaring communicatie parkeerplekken	Experiences
Gemeente Rotterdam Adivsor Mobility	MaaS moet echt een meerwaarde hebben bovenop het aanbieden van deelauto's	Doel beleid	Experiences
Gemeente Rotterdam Adivsor Mobility	Groen ga je sowieso niet halen	Ervaring ruimte	Experiences
Gemeente Rotterdam Adivsor Mobility	Je merkt dat je bij een verandering ruzie krijgt met de buurt	Ervaring parkeerplekken	Experiences

Table H.3: Results Interview Analysis Municipalities

Organisation	Interview texts	Label	Key Topics
Gemeente Amsterdam	De norm is te jong om dit te kunnen zeggen, wat ik verwacht is dat er meer vraag naar deelauto's zal komen	Ervaring	Experiences
Gemeente Amsterdam	Er is wel een geval waar de communicatie niet goed gegaan is, waar we toch hebben moeten zeggen dat ze. een aantal vergunningen kregen.	Ervaring communicatie parkeerplekken	Experiences
Gemeente Amsterdam	Ik geloof dat geen enkel iemand heeft gezegd die 0,3 is te hoog. In principe geen klachten van ontwikkelaars dat eer te veel of te weinig gebouwd moet worden	Ervaring parkeerplekken	Experiences
Gemeente Amsterdam	Parkeernorm is afhankelijk van OV, afstand intercity, bereikbaarheid	Doelgroep built environment	Built Environment
Gemeente Amsterdam	We willen deelmobiliteit stimuleren	Doel mobiliteit	Goals
Gemeente Amsterdam	uitstoot verminderen	Doel milieu	Interests
Gemeente Utrecht	Het is belangrijk dat je niet alleen beleidsmaatregel goed regelt, maar het ook in de praktijk goed regelt.	Ervaring beleid	Experiences
Gemeente Utrecht	Het addendum zal vooral gaan over specifieke locaties	Doelgroep built environment	Built Environment
Gemeente Utrecht	Dus als je zorgt voor een goede verbinding met de fiets of het ov	Doelgroep built environment	Built Environment

H.1. Developers

Through personal communication with developers (BPD, Heijmans, Syntrus Achmea and Vesteda), is looked at what the goals of developers to apply shared cars in the residential sector are. There are several reasons mentioned. According to R. Kamperman (Appendix G.4) "Parking spaces are costly, so economically it is advantageous to build less parking spaces.". Developers of residential buildings want to reduce costs by offering shared cars in combination with few parking spaces. Since building parking spaces is very expensive, and offering shared cars according to the municipality's policy results in building fewer parking spaces, it will ultimately result in lower costs when sharing cars are used more. Furthermore, sustainability is important for many people at the moment. Sharing cars can contribute to cleaner air and less car pressure. Less parking spaces indirectly ensure more space for green spaces or children playgrounds. The latter can contribute to the last indirect effect that developers want to achieve, increase live-ability. For example, an interview (Appendix G.4) with a developer said that "Not everyone needs a private car. This mainly concerns the city centre, where people already have good public transport.". An effect that they want to achieve is thus to provide a service to residents. Another developer (Appendix G.3) confirmed that too: "As a kind of service. A car also belongs to a home purchase, just as there are a school and a supermarket. We have to look at everything, you have to be able to park your car, have a nice neighbourhood, etc.". Furthermore, R. Koene (Appendix G.5 said: "We also think that a home property value (WOZ) goes up when there is more green, and not when there are parking spaces.". According to interviewed R. Koene (Appendix G.5) there are various goals; "liveability, clean cars, less car pressure, which in turn leads to better quality, more space, and more green. However, we do want to maintain mobility." Another purpose of providing carsharing was to reduce CO2 emissions (R. Schäperkötter, personal communication, January 30, 2019, Appendix G.2). Last, developers expect that with providing the combination these people will change their car ownership. In one of the cases, a developer has heard from residents that people have disposed of a car. Although, in previous experience, it has also been noticed that many parking garages are empty, so that car ownership was already lower than the number of parking spaces. Moreover, the availability of a shared car is essential, if there are not enough cars available, this may affect the use next time.

Besides the effects, the following experiences with carsharing and low parking requirement have emerged. Different interviewees said that it is a threshold for many to use a shared car, and another threshold is an electric one. Syntrus Achmea has therefore decided to let the new residents try out a shared car for free, afterwards they can request a subscription with a discount (Appendix G.5). All the developers said that there was no problem with selling or rent out the houses, despite the number of parking spaces. Remarkable is that the parking places have never been sold all. The interviewed developers do not observe the low maximum parking requirement as a problem, and they also recognise that fewer people have a private car. Besides, with the self-driving car in the future, it will be not a problem. A. van der Knaap (Appendix G.3) and R. Kamperman (Appendix G.4) both still said that you always want to be able to offer parking spaces since there are always people that have a car. Carsharing was always included in the introduction when selling the houses. Potential residents responded positively to this; this also means that the developer was attached to providing the cars. In the end, it turned out that the cars were used less than wished. In 'Het Timmerhuis' it is not yet profitable, Heijmans and BMW have to pay the cars every month. It is the intention that it will once become a profitable business case. Heijmans prefer to take their hands off, and that the carsharing provider Juuve can take it over. However, they notice more and more, that the municipality and other clients, that housing becomes a total picture. It also includes exploitation and maintenance e.g. 15 years (Appendix G.3).

H.2. Carsharing providers

Carsharing organisations of course mainly want shared cars to be used more; their goal is therefore to have a good business case for residential buildings. Sharing car organisations would like to scale up, because if more sharing cars are available, then there would also be more users. They noticed that the new parking policy causes more developers are looking for car sharing organisations. A goal of car sharing organisations is that car ownership decreases, which will indirectly lead to more people using shared cars. An interview with N. Sie showed some insights into a project with six shared cars, where one car was petrol, and five cars were electric. Namely, the petrol car made more kilometres than the five electric cars together (Appendix G.1). Furthermore, he said: "Hilarious when you know it was a fiat 500, and the other big BMW's. The users were employees of a company, so they did not even have to pay. . . . Different types of people drove in the car, men, and women." This may be due to the maximum distance that an electric car has. However, they have also seen that people prefer their platform because they have electric cars.

Another interesting, unexpected effect is that the shared car in the garage of 'Het Timmerhuis' is used twice as much, as the car that is parked on the street. So, it is possible that the walking distance to the car can affect the use. The car that is placed on-street does not have a dedicated parking space. Currently, it is a parking space for shared electric cars in general. The car of 'Het Timmerhuis' is the only one at the moment, but this can cause problems in the future.

In the case of Museo, more than half of the residents use the shared car, and normally this is around 10%. Another carsharing organisation has noticed that the target group can be critical. The not mentioned carsharing organisation had places shared cars at a pilot project with mainly young residents, where the public transport was perfect. Therefore, probably the cars were not used at all. Furthermore, not all houses have been rented out in this building, which means that the number of potential users is even lower. They also think it is because people think it is too expensive, but no research has been done to confirm this.

H.3. Municipalities

Besides the findings of the interviews, some findings are based on references. The municipalities themselves write these reports and support the statements. The objectives of the municipality are to reduce the number of car kilometres in the city, to encourage more sustainable mobility and to facilitate construction by reducing the parking requirement. To get 'the discount(s)' on the number of parking spaces, developers must meet the needs of mobility differently. The municipality of Rotterdam said that applying the special exemption is also new to them, and they need to find out what the use of these concepts will be like in the future. Carsharing is one of the measures to reduce car ownership and to solve the problem of insufficient space for parking spaces (Gemeente Amsterdam, 2019a).

According to Q. Oudshoorn of the Municipality of Rotterdam, the reason for the municipality to integrate shared cars into parking requirements is that 'we want shared cars in buildings to meet the mobility demand. We give a discount to the parking standard from the municipality when shared cars are offered. Shared cars must be offered for ten years.' Utrecht confirms this too, they already have some experiences with the new standards. Therefore, E. Verheij said: 'You want to prevent a shortage of shared cars after two years of completion the residential building. We have come across this, you have to think about this early. " Advisor mobility, J. van der Hoop, thinks there is a target group for homes without parking spaces, but he also says, "However, we also see that sometimes a garage is full, and we then give residents a temporary permit for on the street.' It appears that residents are not always aware of the number of parking places, but the developer must announce this.' It appears that the municipalities all use the standards suggested by CROW. More information about parking requirements, parking policies and some examples of large cities in the Netherlands can be read in Appendix C.

General Descriptive

I.1. Data and assumptions

In Chapter 2, it was explained that data is collected with the use of different sources. Before it is possible to use this data, it was needed to define new variables. In this section, it will be explained how data is transformed into new variables. Furthermore, it is described why these steps are performed. The data described here are not all included in the final model because only a limit number of variables can be included in the final model. Moreover, it appears that not all data is useful. However, data preparation is nevertheless described because it may be useful for further or other research. Section I.1.1 the computed built environment factors will be exemplified. Thereafter the new group variables of use of carsharing are explained in Section I.1.2. In Section I.1.3 the new variables of car ownership that are defined are presented. Lastly, the data preparation for further analysis is described in Section I.1.4.

I.1.1. Built Environment factors

In Chapter 2, it was explained that data is collected using surveys, desk research, interviews and GIS. The built environment factors are collected with a combination of these, and in this Section, an explanation will take place.

Change in built environment factors before and after relocation

First of all, the built environment factors, such as neighbourhood characteristics, local land use, population density were found by using GIS. Respondents had to fill in the location of their current home. Besides, they had to fill in the zip code of their last home. With this information, the same built environment factors could be found. With the information of the zip codes-6 (or when missing zip codes-4), the neighbourhood names could be found in CBS data (CBS Open data StatLine, 2018a;b;c; pdok, 2019). The latest data available were chosen to use in the research. However, it was not clear when the respondent moved. So this data may have changed in the meantime, but we assume that this will not result in substantial differences. Furthermore, when people had filled in their zip code incorrect, or when they lived before abroad, it was indicated as missing data. For every respondent, a new variable could be made with the difference of the built environment factors of their current and last home. However, it is time-intensive to find also information such as the number of shared cars. Therefore it was decided to only make new variables for the difference of distances to locations before and after relocation, population density before and after, and difference of the number of locations within 5 km before and after the relocation. However, only one person in the household has filled in the survey, so it could be possible that people first live apart and come from 2 different areas. So the new variable may be incorrect for the entire household.

Number of shared cars

For the number of shared cars the location of the current home is used, with an online GIS application, the number of shared cars in an area could be found (Ritjeweg, 2019). Only the availability of shared cars of MyWheels, GreenWheels and Witkar were available. The number of shared cars with neighbourhood boundaries are added together. So, the number of shared cars can be divided by the number of residents in that neighbourhood. However, it is possible that there are more shared cars available.

Change of parking policy
Respondents had to fill in what the type of parking policy was in their previous home. So, together with the information of the parking policy of the current home (Utrecht, 2019) a new variable could be made. The change of the parking policy before and after the relocation. The new variable was classified ordinal, from least major change to most major change. In the direction that it was harder to get a permit. Respondents may not be well aware of what the previous parking policy was in their neighbourhood. Therefore information could be incorrect.

Parking requirement
The parking requirements that are used, are not the requirements given in advance by the municipality, but the final parking requirement. These are calculated by dividing the number of parking spaces by the number of houses. So, it is possible that these parking requirements are not correct. However, it will still be used. Otherwise, important information will be missing. Furthermore, the information will be good enough for this study. The number of houses is collected during desk research. The number of parking spaces available was found in desk research. However, it was not always possible to find this number. Furthermore, no developers of the control cases were interviewed. Therefore, Owner Associations and residents are asked by email.

I.1.2. Defined Variables - Use of Carsharing
In the survey, it was asked if people had a membership of a carsharing organisation before relocation and after the relocation. Therefore new groups are defined with the information of members.

- Joined carsharing after relocation: People that become a member after the relocation.
- Always been a member: People that were a member before and after the relocation.
- Member before or after: People that were a member before or after the relocation.
- Cancel subscription: People that have cancelled their subscription.
- Increasing in frequency use of carsharing

Besides, it was asked what the frequency of use carsharing before and after relocation was. Because the research question is what the effect is on the use of car sharing, the difference between before and after will be more interesting. Therefore, the difference in use was calculated, a growth of use is presented as a higher number.

I.1.3. Defined Variables - Car Ownership
In the survey, it was asked how many cars people had before relocation and after the relocation. Because the research question is what the effect is on the change of car ownership, the difference between before and after will be more interesting. Therefore, new groups are defined:

- Dispose of a car: People who dispose of their car after moving.
- Add a car: People who add (a) car(s) after moving.
- Shedders: people who give up a car and join carsharing.
- Accessors: people who do not have a car and join carsharing.
- The change of car ownership: the difference of car ownership before and after the relocation.

I.1.4. Data Preparation
In order to be able to interpret the data properly, several data codes have taken place. Some questions were present in the survey with only a nominal answer. In order to be able to use this data in the regression analysis of SEM, these variables are coded into dummy variables. Variables with two nominal values are coded into one dummy variable while variables with three nominal values are coded into two dummy variables. To give indicators a factor load in the same direction some scales are mirrored.

Case screening
First, the missing data in rows are checked. Missing data in rows are deleted. Second, the answers to open questions have been viewed, to see if there is something that needs to be adjusted. For example, someone had checked the box 'other', but wrote down an answer that was one of the options given. In these cases, the missing value is adjusted to the correct value. Besides, the outliers of continuous variables were checked. Third, some answers were (re)categorised, such as age.

Data screening
Before starting further statistical analyses, data screening must be performed. This is needed to ensure the data is clean and useable. The data is screened on the following issues:

Missing
Missing data can cause several problems when there is not enough data analysis cannot run. The best thing to do is to left out the missing data. However, only when a data set is large, this is preferred. Because a Structural Equation Model need enough data points, it is chosen to replace the missing data. The missing data will be replaced by the median or mean; this depends on the type of data (Hair et al., 2014). By replacing data with the mean, it is self-evident that the value is incorrect. However, because it is preferred to keep the sample size large enough, the missing data will be replaced.

Normality
Normality assumption is critical because tests such as the F-test and t-test require normality (Hair et al., 2014). To check normality, Skewness and Kurtosis tests were performed.

I.2. Introduction of the case studies

The signed parties of the City Deal will gain experience along with the shared EVs in combination with residential solar energy. That is the goal of the 'City Deal' concluded with the cities of Amsterdam, The Hague, Rotterdam, Utrecht, Amstelveen, Amersfoort, and Apeldoorn. Organisations that participate in the City Deal, and are involved in the case studies of this study, include Syntrus Achmea, Heijmans, and Smart Solar Charging (to which We Drive Solar is connected). The deal should lead to fewer emissions, cheaper homes, a smarter energy system and more space for green spaces or children playgrounds (Ministerie van Infrastructuur en Waterstaat, 2018). However, these innovative housings do not yet exist. Therefore, for this research, multiple existing buildings have been chosen.

Case study I: Het Timmerhuis, Rotterdam
'Het Timmerhuis' is located in the port city Rotterdam, in West of the Netherlands, the city has a population of 638,712 (CBS, 2018). In the Second World War Rotterdam was bombed, as a result in 1941, a Reconstruction Plan took place where the route schedule was the starting point (Kalma, 2007).

On the ground floor of 'Het Timmerhuis' there are shops, restaurants, and a museum. From the 1st up to the 5th-floor work 1800 civil servants from the municipality of Rotterdam. From the 6th up to the 14th floor there are 84 apartments, and it includes two shared cars (Heijmans, 2015). The shared cars are provided by Juuve, two 100% electric BMW i3s that can drive 300 kilometres on one battery charge. Besides they have a parking permit for the whole area of Rotterdam. One of the cars is parked on-street, and one is in the garage placed. The parking spaces cost around 250 euros per month in the garage, residents do not have a permission for a parking space on-street, which costs 9.60 euro per month. However, Juuve can get a parking space on-street (for a higher fee of 38.80 euro per month).

The cars can be used by all residents in the building, and people who work in 'Het Timmerhuis'. People only need an app for their mobile phone, and it is not needed to have a subscription. Before Juuve, another company (Alphabet) was providing the cars (from 2015, the start of the building), for this a card was needed. In a conversation with the co-founder of Juuve appeared that after conversations with the residents of 'Het Timmerhuis' it became clear that the cards were a big barrier to using the shared cars (N. Sie, personal communication, January 22, 2019, Appendix G.1).

Case study II: Museo, Utrecht
'Museo' is located in the City of Utrecht, in the neighborhood called museumkwartier. With 347 483 (CBS, 2018) inhabitants, Utrecht is the fourth largest city in the Netherlands by population. The city is located in the Randstad. In Museo you will find 58 two-room apartments, The surface varies from 58 to 82 m2. The delivery was in June 2018. In Museo there are two shared cars places by We Drive Solar, the cars are owned by BPL Pensioen. The first two years residents can rent a car every month for free. If both cars are reserved, they can use another We Drive Solar car in the city. Furthermore, the cars are placed in the garage of Museo.

Case study III: Neudeflat, Utrecht
'Neudeflat' is also located in the City of Utrecht in the centre, the building first had an office function. The

building only has 3 parking spaces, making it seem as if the parking requirement is very low. However, during this research it was found that people can get a parking permit for on the street. In Neudeflat there are 88 apartments, with a surface between 49 and 57 squared meter.

Case study VI: Oudenoord, Utrecht
Also the 'Oudenoord' is located in Utrecht. The residential building has 70 apartments, the surface of the apartments are between 48 and 70 squared meters. There are three shared cars available, the carsharing provider is We Drive Solar and the developer of the residential building is Syntrus Achmea.

Control cases
In addition to the four selected projects, there are four control cases. For every case, a control case close to the selected case is chosen. With this, it is possible to compare buildings with and without shared cars. However, it was impossible to only find buildings with a low parking requirement. It is not clear which buildings have a low parking standard, besides municipalities also do not now this from every building. As a result, the buildings do not have a low parking requirement. However, the buildings will have the same built environment factors, and the cases are selected in areas where residents are not allowed to get a parking permission on-street.

I.3. Collected survey data

The Figures I.1 to I.6 show the socio-demographic characteristics of the respondents. In Figure I.1 it can be seen that there are no respondents within the age group 0-17 year and 75+. Most of the respondents are between 25 and 34. In the survey the year of birth was asked, for this reason it could be that the age is incorrect. Although, with this information age groups could be made. The categorisation are made concerning lifestyle and identity groups (Bytheway, 2011). The ages of all household members were not asked, and children did not fill in the survey themselves. However, it can be seen that only 9% of the households have children living at home. Since it was asked in the survey whether someone in the household was in possession of a driver's license, it is not that strange that the percentage of the sample is 100%.

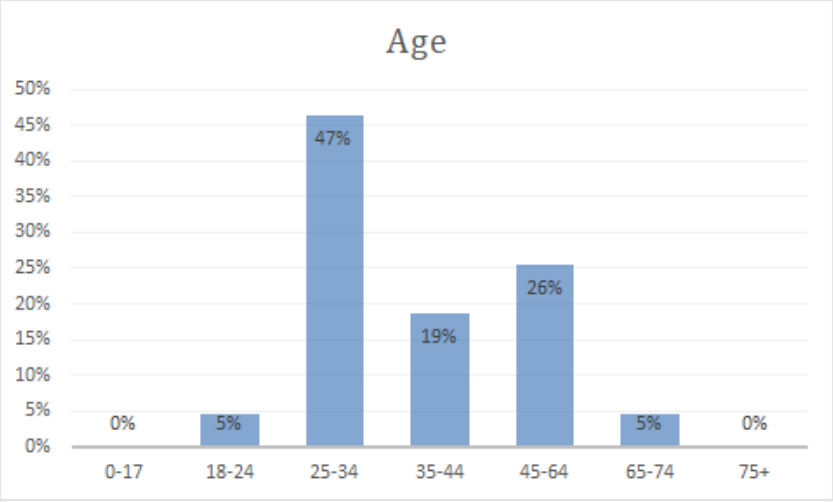


Figure I.1: Age

The gender division is male 54% and female 43%, besides 3% did not wish to answer or define them self as other. In Table I.1 the sample characteristics and 'Dutch residents in a very strong urban neighbourhood' population characteristics average are shown. Most common household type of the sample are households without children and single person household. In the population is their another division, as can be seen in Table I.1. This may be because the respondents live in the same type of apartments and these homes are probably more suitable for people with a small household. The amount of people that had a square footage of the house smaller than 30 is 0, als the amount under 40 is 0. Therefore, these two are combined as can be seen in Figure I.9. There is no data available of the 'Dutch residents in a very strong urban neighbourhood' of personal income, employment status, educational level, membership and drivers' license. However,

Table I.1: Sample characteristics and 'Dutch residents in a very strong urban neighbourhood' population characteristics (CBS Open data StatLine, 2018b)

Variable	**Level**	**Percentage sample**	**Percentage in Sample population**
Gender	Male	54%	50%
	Female	43%	50%
Age	≤ 14 years	0%	12%
	15-24 years	5%	17%
	25-44 years	65%	36%
	45-55 years	10%	22%
	≥ 56 years	20%	13%
Monthly net personal income	<1500	2%	-
	1500-3000	9%	-
	3000-4500	22%	-
	4500-6000	31%	-
	>6000	24%	-
	Did not wish to answer	10%	-
Employment status	Working	84%	
	Students	5%	-
	Other	12%	-
Household type	Single person household	21%	59%
	Household without children	67%	21%
	Household with with children	9%	19%
	Others	2%	0%
Education level	Without high education	7%	-
	With high education	93%	-
Car ownership	Car ownership per household	0.89	0.55
Membership	Yes	21%	-
	No	79%	-
Drivers' license	Yes	100%	-
	No	0%	-
Square footage of the house	<40 m2	0%	-
	41-50 m2	2%	-
	51-65 m2	29%	-
	66-85 m2	28%	-
	86-120 m2	21%	-
	>120 m2	19%	-

it was already stated that the survey can not be seen as a sample for the 'Dutch residents in a very strong urban neighbourhood' population. Figures I.7 to I.16 show the results of the survey related to carsharing, car ownership and reason to move.

Table I.2: General descriptive of the depending variables

	Use of carsharing before moving	**Use of carsharing after moving**	**Car ownership before moving**	**Car ownership after moving**	**Change of car ownership**
Min	2	1	0	0	-1
Max	6	6	2	3	3
Median	6.00	5.00	1.00	1.00	0.00
Mode	6.00	5.00	1.00	1.00	0.00
Mean	5.16	4.47	0.87	0.90	0.02

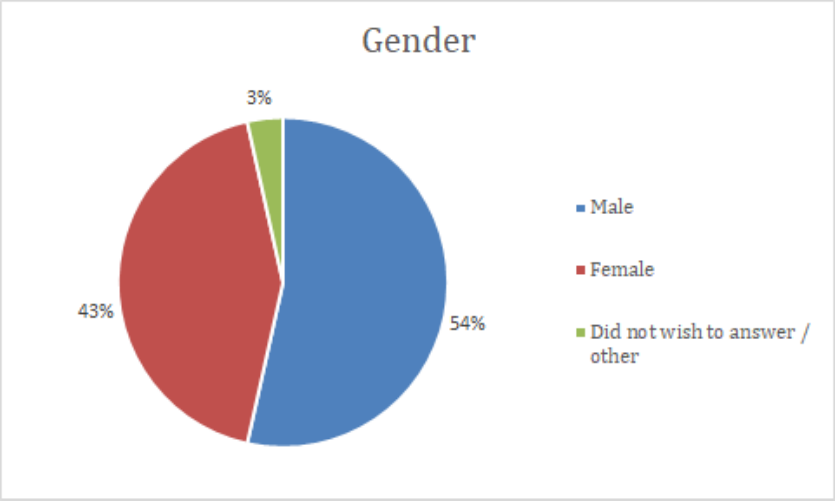


Figure I.2: Gender

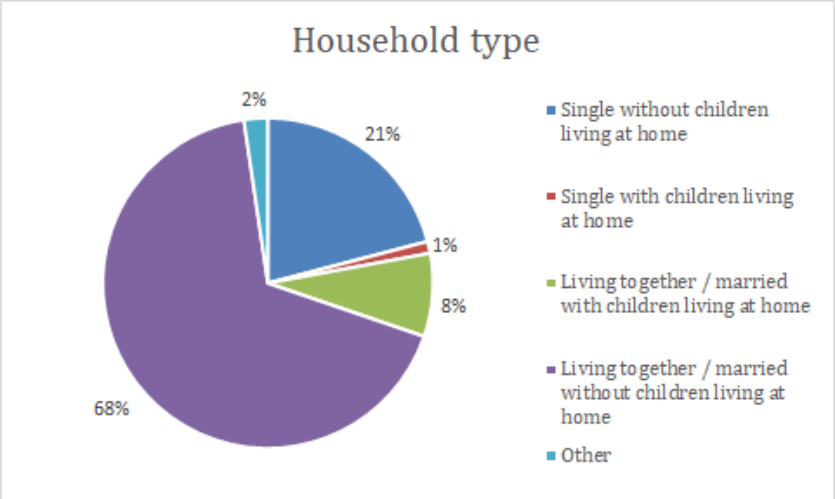


Figure I.3: Household type

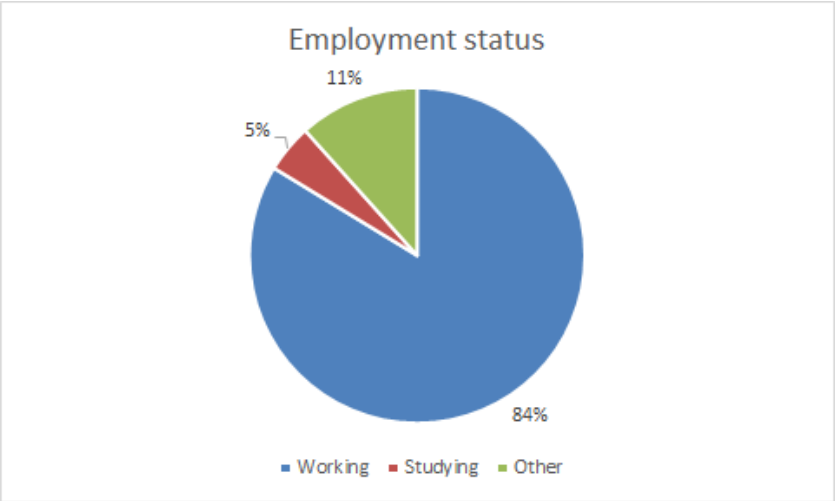


Figure I.4: Employment status

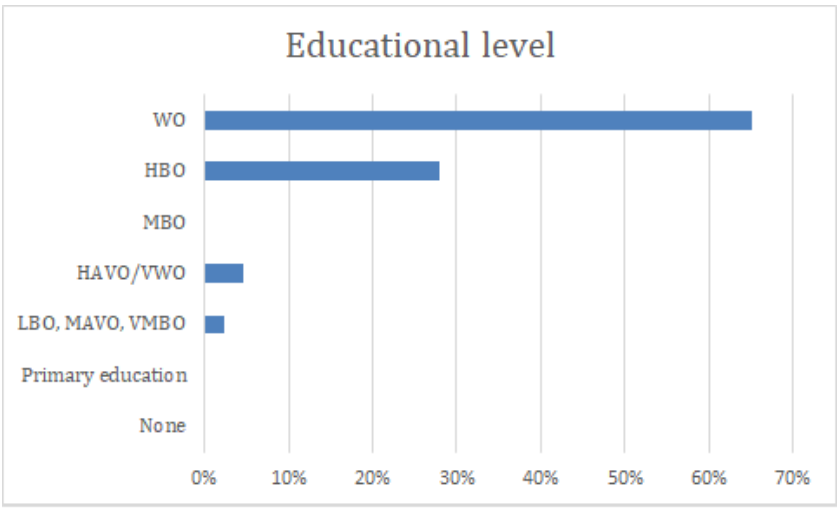


Figure I.5: Educational level

Figure I.6: Income

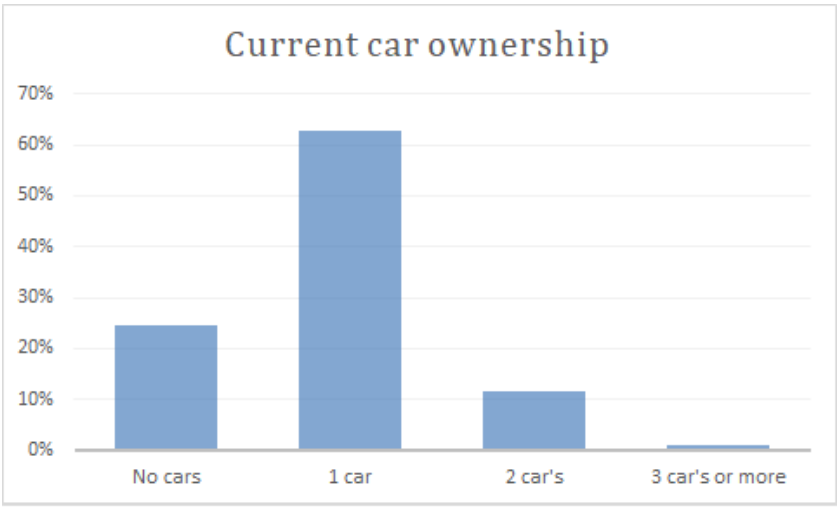


Figure I.7: Current car ownership

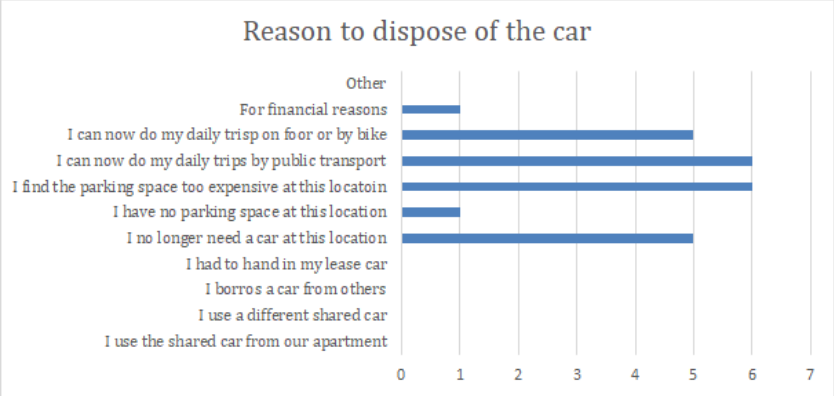


Figure I.8: Reason of disposing the car

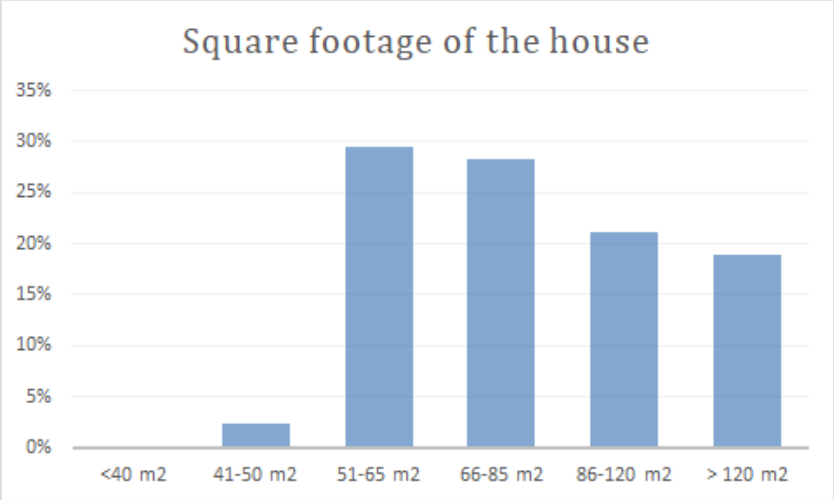


Figure I.9: Square footage of the house

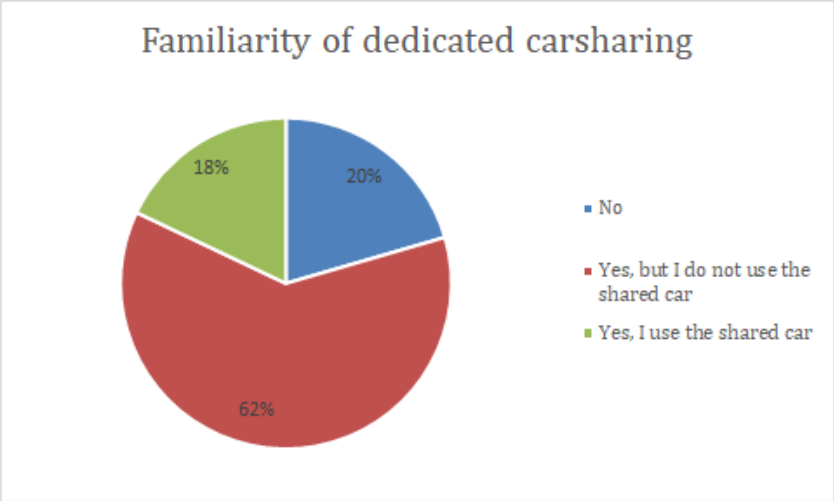
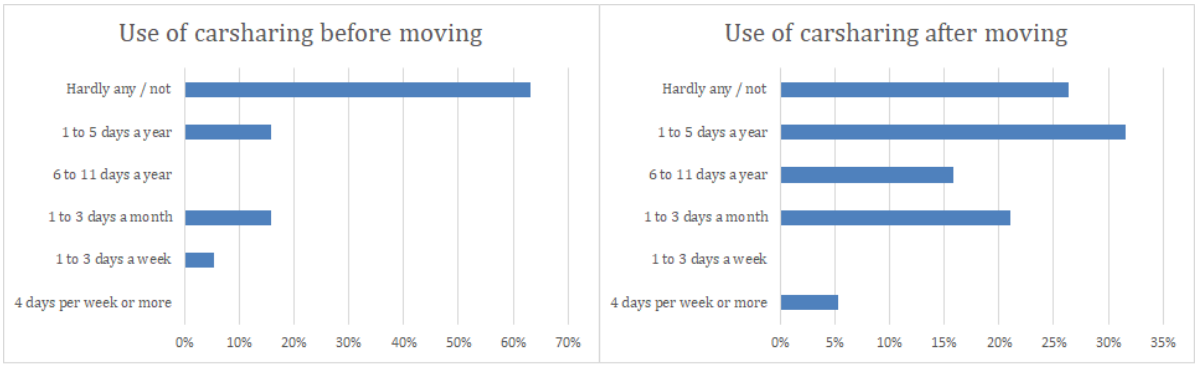


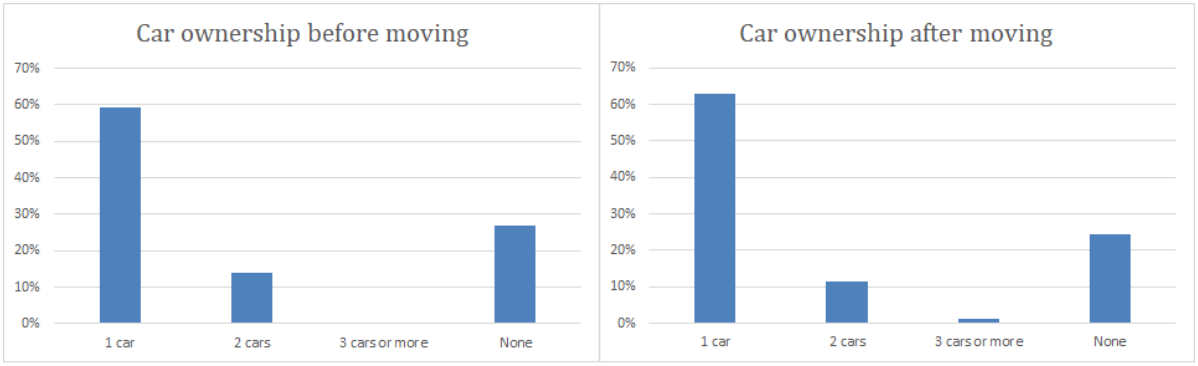
Figure I.10: Familiarity of dedicated carsharing



(a) Use of carsharing before moving

(b) Use of carsharing after moving

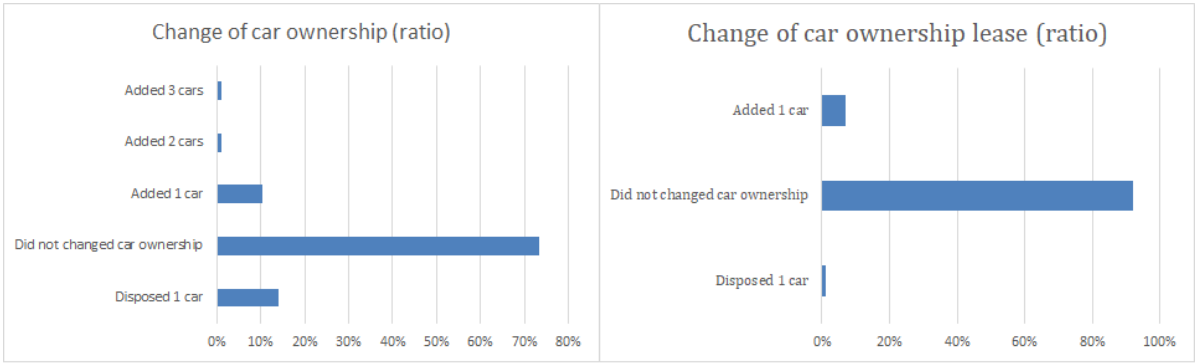
Figure I.11: Use of carsharing before and after moving



(a) Car ownership before moving

(b) Car ownership after moving

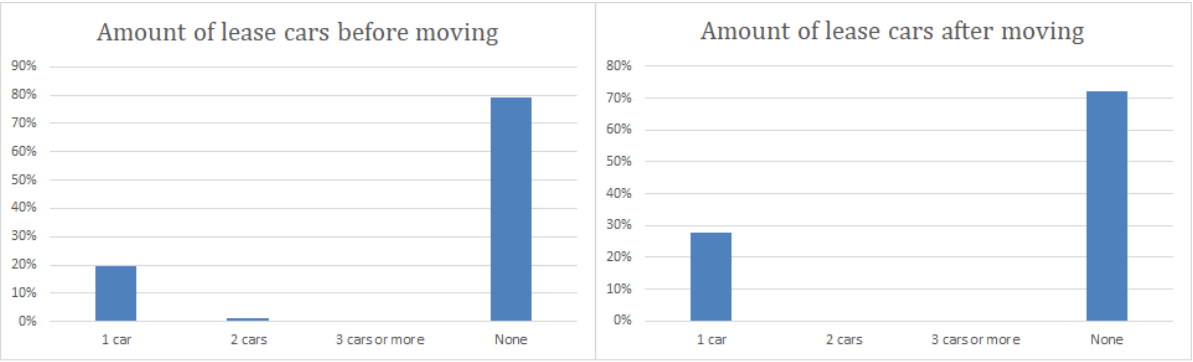
Figure I.12: Car ownership before and after moving



(a) Change of car ownership (ratio)

(b) Change of car ownership lease cars (ratio)

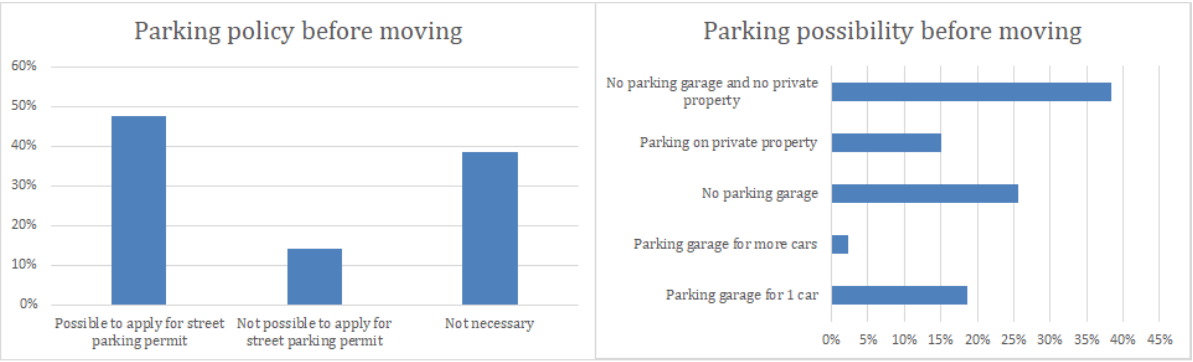
Figure I.13: Change of car ownership (ratio)



(a) Amount of lease cars before moving

(b) Amount of lease cars after moving

Figure I.14: Amount of lease cars before and after moving



(a) Parking policy before moving

(b) Parking possibilities before moving

Figure I.15: Parking information before moving

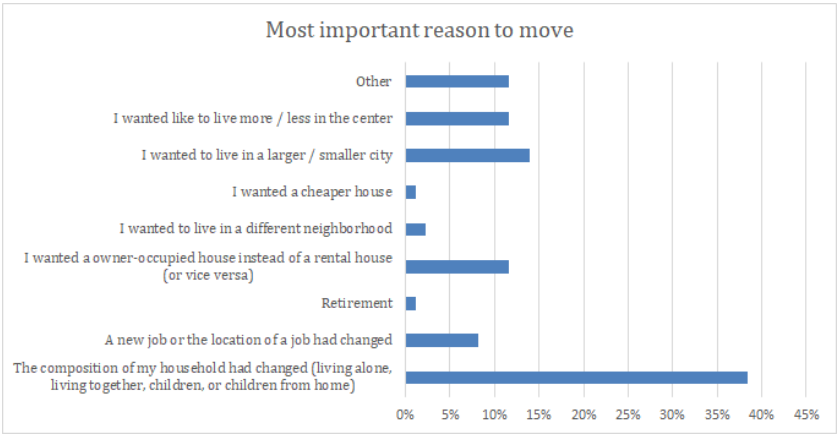


Figure I.16: Most important reason to move

I.4. Determining the number of respondents

It is hard to determine the population for this research. The only two cases that include parking requirements and carsharing and met the other criteria, to the authors' knowledge, are Oudenoord and Museo. Together 128 households live in these buildings. So, when calculating the number of respondents needed for group 1, 128 households can be used. However, the number of respondents that is needed to describe the control cases is unknown. To determine the number of respondents to a survey, the following formula can be used (Surveymonkey, 2018):

$$n = \frac{z^2 \cdot \hat{p}(1-\hat{p})}{\epsilon^2} \tag{I.1}$$

$$n' = \frac{n}{1 + \frac{z^2 \cdot \hat{p}(1-\hat{p})}{\epsilon^2 N}} \tag{I.2}$$

Where:

n	=	population size
n'	=	sample size
z	=	standard error
$\hat{p}$	=	estimated standard deviation
ϵ	=	margin of error

With the use of the presented formula above, the sample size calculated with different confidence level and margin error, results can be seen in Table I.3. The standard deviation is depending on the confidence level. For example, for the reliability of 95% value of z=1.96 is used. However, for this research due to time limitations, it was not possible to reach many respondents.

Table I.3: Sample size

Population size	128	128	128	128
Confidence level (%)	80	80	95	99
Margin of error (%)	10	5	5	3
Sample size	32	73	97	115

J

Measurement levels of attributes

Table J.1: Final selection of attributes

Attribute	Attributelevels
Socio-demographic factors	
Age	Ratio
Gender	Nominal
Income	Ordinal
Household type	Nominal
Employment status	Nominal
Educational level	Ordinal
Drivers' license	Nominal
Car ownership	
Car ownership	Ratio
Change of car ownership	
Change of car ownership	Nominal
Reason to dispose the car	Nominal
Car ownership before relocation	Ratio
Car ownership of lease cars before relocation	Ratio
Car ownership after relocation	Ratio
Car ownership of lease cars after	Ratio
Change of car ownership	Interval
Change of lease cars	Interval
Use of carsharing	
Frequency of use of carsharing before relocation	Ratio
Frequency of use of carsharing after relocation	Ratio
Membership of carsharing organisation before relocation	Nominal
Membership of carsharing organisation after relocation	Nominal
Residential (re)location	
Square footage of the house	Ordinal
Reason of relocation	Nominal
Location of last home	Nominal
Location of current home	Nominal
Policy parking of last home	Nominal
Policy parking of current home	Nominal
Number of parking spaces current home	Ratio
Parking costs at building	Ratio
Number of shared cars at building	Ratio
Number of housing	Ratio
Parking requirement	Ratio
Built environment	
Population density	Ratio
Distance to hospital, supermarket, etc.	Ratio
Amount of hospital, etc. within 5 km	Ratio
Residential land use density	Ratio
Retail and hospitality land use density	Ratio
Business land use density	Ratio
Total build	Ratio
Shared cars at building	Ratio
Shared cars MyWheels	Ratio
Shared cars Greenwheels	Ratio
Shared cars around Witkar	Ratio
Total shared cars	Ratio

K

Bi-variate analysis

First, the relations between two variables will be tested, to analysing the relations in the data set. With the 25 variables from the survey, there are 25*25/2-25=287 possible relations. Besides the survey data, even more data is collected with GIS and other sources. For this reason, the most relevant relations will be analysed. Different correlation tests are possible, which test will be used is dependent on the measurement scale. The difference between Kendall's Tau and the Spearman' rank correlation is that Kendall's tau is preferred when there are few participants in the data set and there are many equally high observations. For this reason, it is chosen to use Kendall's Tau instead of Spearman's rho. For relations with one binary variable, the Mann-Whitney test is used. For relations with two binary variables, Pearson's correlation analysis is used. For relations with nominal variables more than 2, Kruskall Wallis will be used. For example, the variable Gender is defined in Male, Female and Other. For two binary variables, the Phi-coefficient is conducted.

The Mann-Whitney test is used to determine whether two group means differ from each other (McKnight & Najab, 2010). The Mann-Whitney test gives a Z-score, the Z-scores make it possible in certain cases to compare samples from different populations in a meaningful way. Z-score indicates how many standard deviations an observation is based on the average. So you get the place relative to the average, expressed in a standard size. The expectation of the Z score is always zero and the standard deviation 1. If X is normally distributed, Z is normally distributed normally. In the Tables, the values are present in black when this Mann-Whitney test is used to show the bi-variate analysis. The Pearson Correlation test is used to determine the degree of coherence between two variables. The Pearson Correlation provides information about the extent to which a change in the first variable is associated with a change in the second variable. A major advantage of Correlation (for example compared to Covariance) is that it is a standardized measure: it is always between -1 and 1. Most of the values are calculated with this test (Benesty et al., 2009). In the Tables, the values are present in red when this Pearson Correlation test is used to show the bi-variate analysis. To measure the association for two binary variables, the phi coefficient is used. The phi coefficient has a maximum value that is determined by the distribution of the two variables if one or both variables can take on more than two values Davenport & El-Sanhurry (1991). In the Tables, the values are present in green when this phi coefficient test is used to show the bi-variate analysis.

Table K.1: Bi-variate scores between dependent variables and socio-demographic characteristics

		Joined Membership	Dispose Car	Membership	Frequency Use	Number of Cars
Gender	Value	0.092	-0.011	0.130	-0.625	-0.076
	Sig	0.392	0.919	0.227	0.532	0.939
Age	Value	-0.036	**-2.303**	-0.260	-0.038	0.041
	Sig	0.971	**0.021**	0.795	0.730	0.709
Income	Value	-0.305	-0.131	-1.130	-0.003	0.054
	Sig	0.760	0.896	0.259	0.976	0.622
Employment	Value	0.076	-0.128	0.125	-0.873	-0.327
	Sig	0.479	0.234	0.248	0.383	0.744
Household type	Value	-1.410	-0.114	-0.052	0.023	0.189
	Sig	0.159	0.909	0.959	0.837	0.081
Educational level	Value	-0.878	-1.220	-0.203	-0.002	0.008
	Sig	0.380	0.223	0.839	0.983	0.941

Table K.2: Bi-variate scores between dependent variables and Built Environment

		Joined Membership	Dispose Car	Membership	Frequency Use	Number of Cars
Distance train	Value	-2.038	-0.966	-1.576	-0.093	-0.138
	Sig	0.042	0.334	0.115	0.344	0.154
Number shops	Value	**-2.090**	-1,560	-1.507	-0.093	-0.049
	Sig	**0.037**	0.119	0.132	0.344	0.617
Population density	Value	**-2.119**	-0.805	-1.232	0.067	0.083
	Sig	**0.034**	0.421	0.218	0.495	0.397
Number restaurants	Value	-1.620	-0.966	-0.92	0.026	0.068
	Sig	0.105	0.334	0.357	0.791	0.485
Number big supermarkets	Value	**-2.090**	-1.560	-1.507	-0.093	-0.049
	Sig	**0.037**	0.119	0.132	0.344	0.617

Table K.3: Correlations between dependent variables and distinction case groups

	Joined membership	Dispose car	Membership	Frequency	Number of Cars
Value	.022	-.125	.087	-.545	-1.670
Sig	.836	.248	.422	.586	.095

Factor analysis

L.1. Conditions for factor analysis

According to (Hair et al., 2014), the following requirements must be met to perform a good factor analysis:

Measurement level

- The average measurement level requires data from the interval level
- Some dummy variables may be used

Sample size

- The sample must contain at least 50 respondents, preferably more than 100
- At least 5 cases per variable
- Preferably 20 cases per variable

Correlations

- The correlations must be sufficiently high
- Many correlations must be less than 0.25
- The measure of sampling adequancy (MSA) must be as high as possible. preferably greater than 0.8 but 0.7 is also sufficient
- The bartlett's test of sphericity must have a p-value lower than 0.05 to test whether the correlations between the variables are significant.

Number of factors

- The number of factors that are included is determined on the basis of the self-esteem.
- Factors with a self-esteem that are greater than 1 are included in the analysis.

Table L.1: Properties with threshold (Hair et al., 2014)

Property	Threshold
Normality	Kurtosis
Unidimensionality	KMO
Convergence validity	Average Variance Extracted (AVE) > 0.5
Reliability	Composite Reliability (CR) < 0.7
Discrimant validity	Maximum Shared Variance (MSV) < AVE

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,667
Bartlett's Test of Sphericity	Approx. Chi-Square	113,910
	df	6
	Sig.	,000

Communalities

	Initial	Extraction
BE_T	,321	,274
BE_S	,580	,813
BE_P	,364	,298
BE_D	,522	,576

Extraction Method: Maximum Likelihood.

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Factor	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2,368	59,188	59,188	1,961	49,034	49,034
2	,958	23,940	83,128			
3	,386	9,650	92,778			
4	,289	7,222	100,000			

Extraction Method: Maximum Likelihood.

Factor Matrix[a]

	Factor 1
BE_T	,523
BE_S	,902
BE_P	,546
BE_D	,759

Extraction Method: Maximum Likelihood.

a. 1 factors extracted. 6

Figure L.1: Factor matrix

L.2. Data Screening

Missing values

In Figure L.2, variables with missing values can be seen. The missing data will be replaced with the median, only for continue variables the mean will be used. As can be seen in the Figure, for these variables the median will be chosen. It must be kept in mind, that the missing data is replaced by the factor analysis.

Statistics

		SD_I	SD_H	RL_S	BE_T	BE_S	BE_P	BE_D
N	Valid	77	84	85	80	81	81	81
	Missing	9	2	1	6	5	5	5

Figure L.2: Missing values

Normality

Kurtosis with a greater than 2 and less than -2 are presented in red in the Figure L.3. All variables are not showing normality, and show that the variance of answering people do not differ that much. Although, for this variables it can be explained. Dispose a car is a binary variables. For the variable educational level it was expected that the variance was high, because it was expected that most people that live in the buildings have a high level of education. Although, we can leave this variable maybe better out of the analysis. Furthermore, the household type is divided in four groups. Most people live alone or together, however we cannot change the variables. Use of Carsharing (Frequency) has a very high Kurtosis, more than 10. Also here, this are just facts and we cannot do anything about the fact that people have the same answers. However, it should be kept in mind. In the following step, the factor analysis, we will check especially for these variables if the communalities values are not too low and if they do not load on any single factor.

Kolom1	Kolom1	Distance_train	Number_shops	Populationdensity	Number_restaurants	Number_bigsupermarkts	Age	Income	Householdtype	NumberofCars	Frequency	Dispose_car
	Valid	86	86	86	86	86	86	86	86	86	86	86
N	Missing	0	0	0	0	0	0	0	0	0	0	0
Skewness		-0,421	0,608	0,6	2,159	1,492	0,833	-0,663	1,265	0,37	3,109	2,118
Kurtosis		-1,498	-1,541	-1,452	3,488	3,036	-0,67	0,029	2,127	0,667	10,195	2,543

Figure L.3: Kurtosis

L.3. Exploratory Factor Analysis

The pattern matrix outputs are shown here.

Unidimensionality

The KMO is 0.596, which indicate that the sampling is miserable. See Figure L.3. Although, some authors say that the minimum value is 0.5.

The communalities are shown in Figure L.4, all the variables are included in the factor analysis. In the last pattern matrix there is one variable with a lower number than 0.25. Since it is preferable not to delete important variables, it is chosen to include the before mentioned variable. It was chosen to ask SPSS itself to choose the number of factors, although the conceptual model had two variables. SPSS came up with four factors. It can be seen in that the total variance is 57%, preferred is to have 60%. Which can be seen in Figure L.5.

Adequacy and convergent validity

The Pattern Matrix is shown in L.6, here it can be seen that the adequacy and convergent validity is not met. Although, not all values are very high. Because the response rate is very low, it is preferred to have factors greater than 0.7. However, it is known from the literature that these factors do describe the dimension.

Discriminant validity

To check the assumption of discriminant validity, the factor correlation matrix is checked. This shows the cross loading's between the factors and correlations, values above 0.7 are not desirable. In Figure L.7 it can be seen that there are no values greater than 0.7.

Reliability

Lastly, the reliability is checked by Cronbach's Alpha. The socio-demograhpic factor is presenting a low

Communalities	Kolom1	Kolom2
	Initial	Extraction
Number_bigsuper	1,000	,872
Number_restaura	1,000	,927
Populationdensity	1,000	,993
Number_shops_sc	1,000	,981
Distance_train_sc	1,000	,871
Age	1,000	,518
Income	1,000	,707
Householdtype	1,000	,709
Educational_level	1,000	,858
Extraction Method: Principal Component Analysis.		

Figure L.4: Communalities

Total Variance Explained	Kolom1	Kolom2	Kolom3	Kolom4
Component	Initial Eigenvalues			Extraction Sums of Squ
	Total	% of Varia	Cumulative %	Total
1	3,339	37,096	37,096	3,339
2	1,793	19,917	57,013	1,793
3	1,260	13,994	71,008	1,260
4	1,046	11,621	82,629	1,046
5	,770	8,561	91,189	
6	,512	5.68E+03	96,873	
7	,226	2,516	99,389	
8	,055	,611	100,000	
9	-8.88E-13	-9.87E-12	100,000	
Extraction Method: Principal Component Analysis.				
a When components are correlated, sums of squared loadings cannot be added to obtain a t				

Figure L.5: Total Variance Explained

Kolom1	Kolom2	Kolom3	Kolom4	Kolom5
a Pattern Matrixa				
	Component			
	1	2	3	4
Number_shops_scale	,935	,154		
Number_restaurants_scale	,926	-,565		
Populationdensity_scale	,907	,241		
Number_bigsupermarkets_scale		-,978		-,140
Distance_train_scale	,470	,680		
Householdtype		-,103	,827	-,192
Income			,798	,234
Educational_level		,177		,949
Age		,387		-,505
ria Extraction Method: Principal Component Analysis.				
Rotation Method: Promax with Kaiser Normalization.				
a Rotation converged in 6 iterations.				

Figure L.6: Pattern Matrix and Reliability

Component Correlation Matri	Kolom1	Kolom2	Kolom3	Kolom4
Component	1	2	3	4
1	1,000	,244	-,193	-,154
2	,244	1,000	,083	-,233
3	-,193	,083	1,000	,062
4	-,154	-,233	,062	1,000
Extraction Method: Principal Component Analysis.				
Rotation Method: Promax with Kaiser Normalization.				

Figure L.7: Factor Matrix

(<0.70) Cronbach's Alpha. Because the literature does support that these variables together describes these two factors, these factors are kept this way. The value of the built environment is above >0.7.

L.4. Confirmatory Factor Analysis

Model Fit

First, in AMOS a roughly decent model quickly is build, within this program the model fit can be checked. When needed, it can be improved by removing variables. Variables will be removed due to poor loading. The indicators should load highly on a factor (>0.70), and the correlation between the factors should by lower than 0.80. However, because it is preferred to have at least 3 indicators for one factor, no factors are deleted. Two-indicator factor often results in instability. Modification indices were checked to determine if there was opportunity to improve the model.

M

SEM

M.1. Confirmatory Factor Analysis

It became clear during the bi-variate analysis that the indicators *educational level, age, household type* and *income* correlate with each other. These indicators will present the underlying factor socio-demographic. The factors *gender* and *employment state* will be excluded, since it is highly recommended to include ordinal elements. Besides, educational level is excluded from the analysis, because it became clear that this variable does extremely not perform normality. However, all socio-demographic factors did not present normality. Normality tests are presented in Appendix L.2.

As expected, the five built environment factors are shown in Table K.2, are also all correlating with each other. For the Confirmatory factor analysis, the ordinal indicators *age, income and household type* were included for the latent factor socio-demographic. Also, the five factors of the built environment were included in the Confirmatory factor analysis. During conducting this analysis, it became clear that there are cross-loadings between factors of the built environment and socio-demographics. Therefore, the discriminant validity criteria were not met. Furthermore, the reliability of Socio-Demographic is presenting a low Cronbach's Alpha. This indicates that the reliability of the underlying factor is low. However, it is known from the literature that the factors do describe the socio-demographic factor. Therefore, the underlying factor is kept in this way. Furthermore, it was not possible to delete factors of the socio-demographic variables, because it is preferred to have at least three indicators for one factor. A two-indicator factor often results in instability.

Although not all Confirmatory Factor criteria are met, the latent factors will be described in this way. With the use of the latent variable of Built Environment, it will be possible to make a sum score. With the use of a sum score, one variable can present the total score of the indicators, instead of using three single indicators. It is better to use latent factors with indicators in research. However, as mentioned before, it is preferable to include 20 cases per variable, but ten is also accepted in further analysis. In this study the sample size is 86, the maximum variables that can be used in the factor analysis are therefore 8.6. For this reason, a sum score has been used for the built environment, so that the number of factors in the model will decrease.

The overall model fit of the CFA is shown in Table M.1. It can be seen that the model does not fit well.

Table M.1: Model fit CFA

Indicator	X^2	cmin/df	CFI	RMSEA	PCLOSE
Recommended	As low as possible	<2	>0.9	<0.1	>0.05
Model	23.8	2.982	.944	.153	.010

M.2. Structural Equation Model

In this Section, the final Structural Equation Models (SEM) will be presented. With the use of SEM, the indirect effects can be measured as well. For the interpretation of the relations in the models, it is important to realise that it is not possible to quantitatively determine the direction of the relations within an SEM model. The direction of the relations is determined with the use of literature. Two models are constructed, the first model will describe the endogenous variable the *use of carsharing*, the second mode describes the *change of*

car ownership.

Conceptual Model
According to the modelling steps described in Section 2.3 the models are build based on the conceptual model. Paths should be removed when not significant, however as already found in the bi-variate analysis, not all variables show a significant direct relation. However, it appeared that all paths (direct and indirect) are not significant in the SEM models build. Moreover, building a model with only significant relations did not succeed. Moreover, it was not possible to build the conceptual model that is presented in Chapter 3. A multi-group analysis could not be performed. For this reason, it is chosen to use the binary variable (building with or without providing carsharing and having a low parking requirement) as a mediated variable. So, it can be seen if *a low parking requirement and the use of carsharing* has an indirect effect on the use of car sharing and car ownership. In Figure M.1, it can be seen that the mediating factor has the same relationships as the built environment. This was chosen since the literature review shows that parking demand factor is often seen as a built environment factor. Moreover, based on the theory the combination can have an indirect relationship through the number of cars.

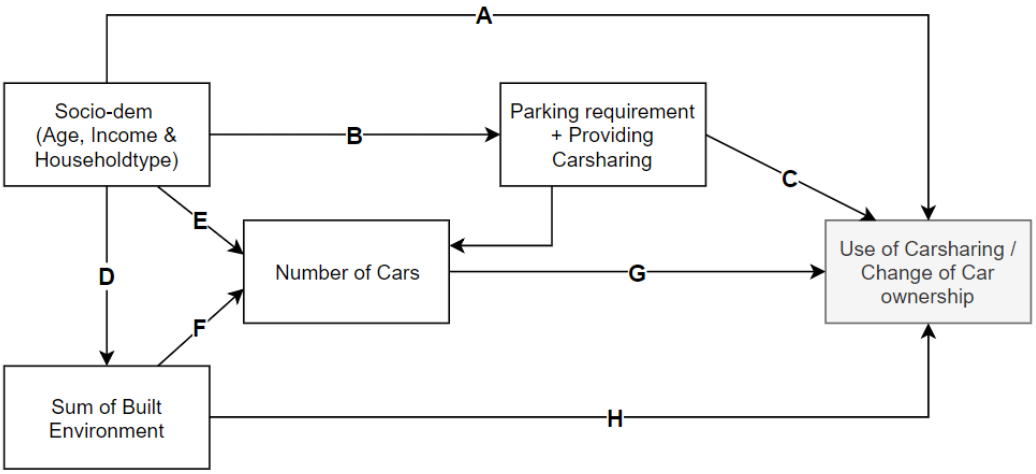


Figure M.1: Conceptual Model for SEM

To conclude, the models that will be presented here, do not have significant relationships. Therefore, the relations cannot be seen as a result of the population described. However, this model can be used for further travel behaviour research. Because this technique can show interesting relations, however, the relations in this model cannot conclude effects or confirm hypotheses.

Use of carsharing as endogenous variable
The first model will describe the endogenous variable use of carsharing. The variable frequency presents the factor use of carsharing. Frequency is expressed in (almost) never, 1-5 days per year, 6-11 days per year, 1-3 days per month, 1-3 days per week and 4 days per week or more. This indicator is the only collected variable describing carsharing with a ratio level. Besides, as can be seen in the descriptive, it became clear that people with a membership do not always use a shared car. Therefore, the variable membership will not describe the use of carsharing well. For these reasons, the indicator frequency will be used to describe the endogenous factor.

Change of Car Ownership as endogenous variable
The second model will describe the endogenous variable car ownership, and the binary variable dispose of the car is used to describe this factor. This variable indicates if a household has disposed of a car since the relocation.

Based on conceptual reasoning and evidence from the literature review, a system of four equations is developed to represent the endogenous variables, see Figure M.1.

1. Use of Carsharing (frequency of use of carsharing categorization by "(almost) never", 2 = "1-5 days a year", 3 = "6-11 days a year", 4 ="1-3 days a month", 5 = "1-3 days a week", 6 = "4 days a week or more")
2. Change of Car Ownership (dispose of a car after relocation categorziation by 0 = no, 1 = yes)
3. Sum of Built Environment (distance to train, number of shops, population density, number of big supermarkets)
4. Socio-Demographic (age, income, number of household members)
5. Number of Cars (categorization by 0 , 1 car, 2 cars, 3 cars or more)
6. Parking requirement + Providing carsharing (categorization by yes or no)

M.2.1. SEM best fit model: Use of Carsharing

As stated before, all the paths in the final model are not significant. The model fit of the final model is presented in Table M.2. The only indicator that is not sufficient is the PCFI; this indicates that the model could be more parsimonious. Causing in that paths should be removed. However, this is already known by the author and discussed above. The final model and its standardised estimated is presented in Figure M.2. The arrows symbolise direct effects between two factors. The AMOS model is presented in Figure M.4.

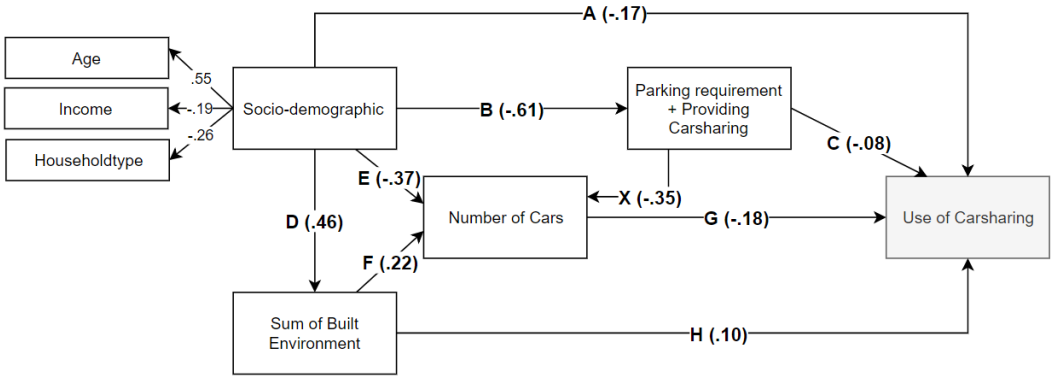


Figure M.2: Standardized estimates - Use of Carsharing

Table M.2: Model fit of final model - Use of Carsharing

Indicator	X^2	p-value	df	cmin/df	CFI	RMSEA	PCLOSE	PCFI
Recommended	As low as possible	>0.05	-	<2	>0.9	<0.1	>0.05	>0.8
Model	6.143	.407	6	1.024	.994	.017	.539	.284

In Table M.3 the direct, indirect and total effects of one variable on the dependent variable are presented. Examining only direct effects can be misleading, indirect effects between factors can be different and stronger than direct effects. Therefore, the total effect must be analysed. The total effect is the sum of the direct and indirect effects. Table M.3 indicates greater importance of car ownership compared to the other variables. Other variables have a shallow effect on the use of carsharing according to this model. However, the effects might be measured differently with the use of other data; these results cannot be used for conclusions.

To see whether the *combination of a low parking requirement with shared cars* has a mediating effect, the associations of B*C and B*X*G should be calculated. The mediating indirect effects are in this model as follow: B * C is -0.0858 and B * X * G is -0.0384 on disposing of the car (total 0.0104). This shows that there is a small mediating effect. However, these relations are not significant; the significance of the indirect effect could not be tested in the AMOS model.

Table M.3: Standardised total effects - Use of Carsharing

Variable	Direct effect	Indirect effect	Total effect
Built Environment	0.10	-0.0396	-0.0604
Parking Requirement + Shared cars	-0.08	-0.063	0.0017
Socio-demographic	-0.17	0.1045	0.0653
Car Ownership	-0.18	N/A	-0.18

M.2.2. SEM best fit model: Change of Car Ownership

As stated before, all the paths in the final model are not significant. The model fit of the final model is presented in Table M.4. The only indicator that is not sufficient is the PCFI, and this indicates that the model could be more parsimonious. Causing in that paths should be removed. However, this is already known by the author and discussed above. The final model and its standardised estimated is presented in Figure M.3. The arrows symbolise direct effects between two factors. The AMOS model is presented in Figure M.5.

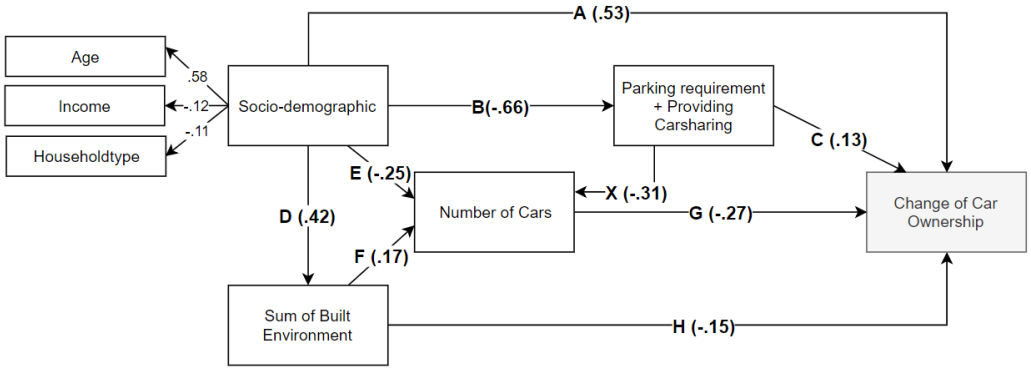


Figure M.3: Standardized estimates - Dispose of the car

Table M.4: Model fit of final model - Dispose of the car

Indicator	X^2	p-value	df	cmin/df	CFI	RMSEA	PCLOSE	PCFI
Recommended	As low as possible	>0.05	-	<2	>0.9	<0.1	>0.05	>0.8
Model	9.294	.158	6	1.549	.919	.080	.264	.265

In Table M.5 the direct, indirect and total effects of one variable on the dependent variable are presented. Examining only direct effects can be misleading, indirect effects between factors can be different and stronger than direct effects. Therefore, the total effect must be analysed. The total effect is the sum of the direct and indirect effects. Table M.5 indicates greater importance of socio-demographic characteristics compared to the other variables. Besides, car ownership also has a high total effect. However, the effects will certainly be measured differently with the use of other data. These results cannot be used for conclusions.

To calculate if the *combination of a low parking requirement with shared cars* has a mediating effect, the associations of B*C and B*X*G should be calculated. The mediating indirect effects are in this model as follow: B * C is -0.858 and B * X * G is 0.0552 on disposing of the car (total -0.0306). This indicates that there is, although small, mediating effect. However, these relations are not significant; the significance of the indirect effect could not be tested in the AMOS model.

Table M.5: Standardised total effects - Dispose of the car

Variable	Direct effect	Indirect effect	Total effect
Built Environment	-0,15	-0,0459	-0,1959
Parking Requirement + Shared cars	0.13	-0.0837	0.0463
Socio-demographic	0.53	0.3841	0.9141
Car Ownership	-0.27	N/A	-0.2700

M.2.3. Conclusion

In conclusion, Structural Equation Modeling is used to analyse the collected data. SEM can find direct and indirect relations between all the factors that are described in the conceptual model. In this way, it is possible to give an explanation in general between the exogenous factors (socio-demographic, built environment, car ownership) and the endogenous factors (use of carsharing & car ownership). Besides, it is possible to test the following hypotheses:

- The relationship Socio-Demographic characteristics and Change of Car Ownership is stronger for residents living in a residential building with carsharing and low parking requirement.
- The relationship Socio-Demographic Characteristics and Use of Carsharing is stronger for residents living in a residential building with carsharing and low parking requirement.

Despite the model had fit was overall good for the build model, it did not succeed to test the hypotheses with the use of multi-group analysis. This is devoted to the sample size, as described above. As an attempt to overcome this problem, new hypotheses are conducted:

- Socio-demographic characteristics affects the change of car ownership indirectly through a residential building with carsharing and low parking requirement.
- Socio-demographic characteristics affects the use of carsharing indirectly through a residential building with carsharing and low parking requirement.

It must be taken into account that the factor *parking requirement and carsharing* has been added to the conceptual model as a new box, although it was found in the literature that it can be used as a built environment factor. In this research, it is used as an additional factor built environment. Since relationships in the SEM model must be built with the use of theory, relationships may be drawn incorrectly. Besides, the effects found with the model were all not significant. Which means that the effects can not be used for the population described. Moreover, no statements based on the weights of relations can be made. Therefore, the effects of the model and the conclusions that are drawn here must be taken very carefully. About the relation of parking requirement and shared cars on the use of car sharing, the following can be said. It might have a positive influence on the use of carsharing. It was expected that a low parking standard would have a positive influence on the use of shared cars. However, the standardised effects show that other effects may have more influence on the use of carsharing. About the relation of parking requirement and shared cars on the change of car ownership, the following can be said. It might have a positive direct influence on disposing of a car. The indirect relationship by car ownership shows that it might have a negative effect. Although the cumulative effect is still positive, it was expected that a low parking standard would have a positive influence on the use of shared cars. However, the standardised effects show that other effects may have more influence on the decrease in car ownership.

M.2.4. SEM models

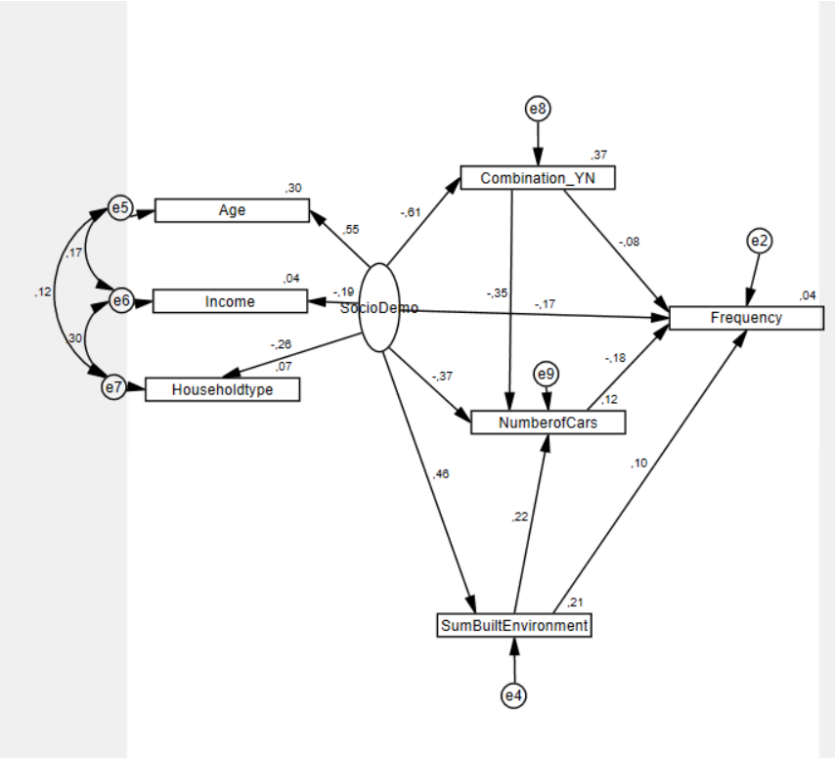


Figure M.4: Standardized estimates - Use of Carsharing

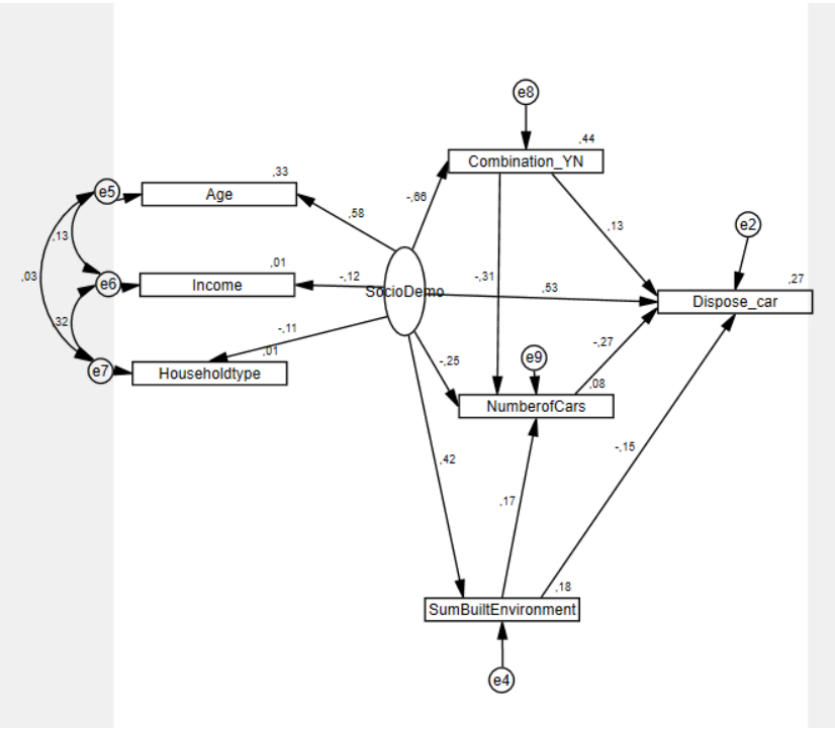


Figure M.5: Standardized estimates - Dispose of the car