THE USE OF SHARED MOBILITY SERVICES IN DISADVANTAGED NEIGHBOURHOODS

A STUDY ON HOW SHARED MOBILITY SERVICES CAN AFFECT URBAN NEIGHBOURHOOD RENEWAL

MASTER THESIS

Meltem Tamer | July 2020 | Delft University of Technology

ADEM IN, ADEM ZUID
HET LEVEN IS EEN ADEMTOCHT

- resp. Feyenoord en Oscar Niemeyer

COLOFON

THE USE OF SHARED MOBILITY SERVICES IN DISADVANTAGED NEIGHBOURHOODS

A study on how shared mobility services can affect urban neighbourhood renewal

PERSONALIA

Name:	Meltem Tamer
Student number:	4161955
E-mail:	m.tamer@student.tudelft.nl
Phone number:	06-43135928

EDUCATION

Institution:	Delft University of Technology
Faculty:	Architecture and the Built Environment
Adress:	Julianalaan 134, 2629 SL Delft
Master track:	Management in the Built Environment
Graduation lab:	Urban Development Management (UDM)
Date:	1 July 2020

THESIS SUPERVISORS

First mentor:	Dr. A. (Aksel) Ersoy
Second mentor:	Dr.ir. B. (Bastiaan) van Loenen
External examiner:	R.J. (Bob) Geldermans

PREFACE

This graduation thesis is the result of a one year during research on the effects of shared mobility services on urban renewal. With this research, I will conclude the master “Management in the Built Environment” at the Faculty of Architecture and the Built Environment at the Delft University of Technology. The research is conducted within the graduation laboratory of Urban Development Management.

Due to my work experience as a concept developer at a development and construction company, my interest in research lied within the area of urban development. Besides, I was also interested in solving rapidly growing mobility issues within cities using smart and modern technology. Since smart mobility and shared mobility are changing the perceptions of transportation worldwide and are influencing individual transportation choices and behaviour. Therefore, this research combines these two research and focuses on the effects of shared mobility services on urban renewal in Rotterdam-South. Hereby, the focus is on the four aspects of urban renewal, which are economical, social, physical and environmental renewal. This research provides insights on how shared mobility services work and how they may be applied and implemented, to change the disadvantaged transportation context of Rotterdam-South.

Acknowledgements
Throughout the graduation process, I could rely on the help of several people. I would like to take this opportunity to sincerely thank everybody that contributed to the process of writing this research. Firstly, I want to thank my mentors Aksel Ersoy and Bastiaan van Loenen for their guidance and support. Secondly, I would like to thank Iris Ruysch from the Future Mobility Network for her guidance. The personal feedback and brainstorm sessions were very valuable to this research. Besides, I would like to thank all interviewees for their informative input. After all, no shared knowledge means no new insights and results. Therefore, I am very thankful that you were willing to help with my graduation research.

On a personal note, I would like to thank my dear parents and family for their unconditional love and support during this process. Furthermore, I would like to thank Fleur for being my graduation buddy and for sharing this master experience with me. And last but not least, I would like to express my greatest gratitude for my husband Mehmet, for his loving support and simply for always being there for me.

I have enjoyed thoroughly and learned a lot during my research process. Therefore, I am glad to share my thesis with people in the field and people who find this topic interesting. Please, enjoy reading!

Yours sincerely,

Meltem Tamer

Delft, July 2020

ABSTRACT

Due to the urbanization, it is expected the world's population will increasingly live in urban areas. Therefore, there is a growing concern about diverse urban problems, such as climate change, emissions, congestion and the quality of life in cities. Hereby, urban mobility systems can be an important factor to solve these problems. Besides, new developments in ICT, the adaptation of smartphones, the increasing availability of data and are changing current mobility systems in cities by creating new possibilities for the application of smart solutions. An example of these new smart solutions is new shared mobility services. New shared mobility services (.e.g. car sharing, ride-hailing and bike-sharing, etc) are technology-based, on-demand and provide alternatives to traditional transport models. These services are seen as an opportunity for more sustainable transport in the city and to address equity in transportation. But without thoughtful planning, there is no guarantee this will happen. Moreover, giving the fact that virtual mobility is growing by the enhancement of ICT and will potentially be a replacement for physical mobility these shared mobility services can bring new equity barriers and opportunities for disadvantaged neighbourhoods. This research will focus on shared mobility services in the context of Rotterdam-South. The area of Rotterdam-South is an urban renewal area, which is struggling with large concentration socio-economic problems. Besides, studies have shown that the inhabitants of Rotterdam-South are the least mobile and suffer from transportation poverty, causing them to come across more barriers to the accessibility of various services and opportunities. Based on the defined problem, the following main research question is formulated for this research: *"In what way can public parties use shared mobility services to stimulate urban neighbourhood renewal in Rotterdam-South?"*. To answer the main research question it was decided that a qualitative approach would be appropriate. The qualitative method includes the review of literature, interviews with advisors, the municipality and providers of shared mobility service in combination with a case study of the neighbourhood Tarwewijk, which is located in Rotterdam-South. From the results, it can be concluded that by the implementation of shared mobility services in a disadvantaged neighbourhood, public parties can positively affect and stimulate two aspects of urban renewal. These are the social and environmental conditions of a neighbourhood. Although the implementation of shared mobilities can offer opportunities for urban renewal areas, it can also bring several barriers and challenges. So, before implementing shared mobility services to stimulate urban renewal, public parties must consider how to implement policies/strategies. This to ensure that the barriers to using these shared mobilities are eliminated. Hereby, this research has suggested several policies and strategies for public parties.

KEYWORDS:
smart mobility, shared mobility services, urban renewal, public parties, service providers, disadvantaged neighbourhoods, Rotterdam-South

EXECUTIVE SUMMARY

INTRODUCTION

Due to the urbanization, it is expected that 68% per cent of the world's population is living in urban areas by 2050 (United Nations, 2018; Carneiro et al., 2019). This can lead to new problems and challenges for cities, such as climate change, emissions, congestion and the quality of life in cities. Hereby, urban mobility systems can be an important factor to solve these problems. In addition, new developments in ICT, the adaptation of smartphones, the increasing availability of data and the increasing connectivity of vehicles and users through the Internet-of-Things (IoT) are changing mobility users' and providers' expectations and opportunities. These developments are changing current mobility systems in cities by creating new possibilities for the application of smart solutions (Borsboom-van Beurden, Kallaos, Gindroz, Costa, & Riegler, 2019). These changed conditions can be placed under the common term "Smart Mobility" (Papa & Lauwers, 2015). An example of these new smart solutions is new shared mobility services, such as car sharing, ride-hailing and bike-sharing. The services are technology-based, on-demand and provide alternatives to traditional transport models. These shared mobility services are seen as an opportunity for more sustainable transport. (Yan & Howe, 2019).

PROBLEM STATEMENT

Studies have shown that inhabits of low-income, minority and socially disadvantaged neighbourhoods are mostly concentrated away from economic opportunities and public resources (Wang, Philips, Small, & Sampson, 2018). These neighbourhoods also encounter injustice of daily transportation (transportation poverty), which can increase social exclusion and other barriers to access services (Litman, 2018; Shaheen, Bell, Cohen, & Yelchuru, 2017). Therefore, it is important to improve the transportation conditions and equity issues in and around disadvantaged neighbourhoods by providing an extensive multi-modal transportation network (Shaheen et al., 2017). This research will focus on the area of Rotterdam-South, which an urban renewal area struggling with a large concentration of socio-economic problems.

Moreover, the inhabitants of Rotterdam-South are the least mobile and suffer from transportation poverty, causing them to come across more barriers to the accessibility of various services and opportunities. Shared mobility services are seen as an opportunity to address equity in transportation and transportation poverty (Yan & Howe, 2019). But without thoughtful planning, there is no guarantee this will happen. Moreover, giving the fact that virtual mobility and potentially be a replacement for physical mobility these shared mobility services can bring new equity barriers and opportunities for disadvantaged neighbourhoods. So, this research will focus on the effects of shared mobility services on urban renewal areas and how they may improve the quality of a disadvantaged neighbourhood.

RESEARCH QUESTIONS

Based on the defined problem statement, the following main research question is addressed for this research:

"In what way can public parties use shared mobility services to stimulate urban neighbourhood renewal in Rotterdam-South?"

To provide an answer to the main question, the following subquestions are formulated:

Urban renewal:
- What is urban renewal?

Shared mobility services in general:
- Which smart mobility services and business models are available?
- Who are the users of shared mobility services?
- What are potential barriers for using smart mobility services in disadvantaged neighbourhoods?

Shared mobility services in Rotterdam-South:
- What is the main motivation of the municipality of Rotterdam when selecting a specific neighbourhood for implementing a shared mobility pilot project?
- Which shared mobility services are used in Rotterdam?
- In which areas of Rotterdam are these services distributed?

- Why are service providers providing services in Rotterdam-South or why are they not?
- What policy does the municipality of Rotterdam have for the implementation of shared mobility services?

Synthesis:

- Which potential solutions show the most promise in overcoming barriers in disadvantaged neighbourhoods in Rotterdam-South?

RESEARCH GOALS

The main goal of this research was to get a better understanding of how shared mobility services affect and can stimulate urban neighbourhood renewal. This goal is also be divided into four sub-goals:

1. To understand how these mobility services are distributed within the city of Rotterdam;
2. To understand what the motivation or role of service providers and local governments is within these shared mobility services;
3. To understand which equity concerns and barriers smart mobility services can bring in disadvantaged neighbourhoods;
4. To understand the key aspects of urban renewal.

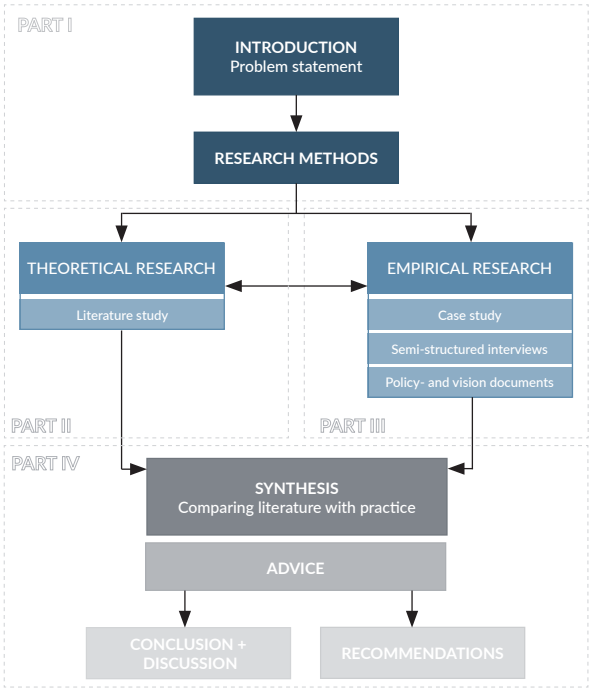


Figure I: Research design (own illustration)

METHODOLOGY

According to Bryman (2012, p. 35), research strategy is something of "a broad orientation to social research". Hereby, the researcher can choose to either conduct qualitative or quantitive research. To answer the proposed research question it was decided that a qualitative approach would be appropriate. The qualitative method is executed by conducting a literature study and empirical research, which are in the end combined in the synthesis. So, this research consisted of three different parts: (1) Literature review, (2) Empirical research and (3) Synthesis. **Figure I** shows the research design for this research.

The first part of this research consisted of a literature study. This to determine what is known about the main research topics of this research. Hereby, the three research topics studied were urban renewal, smart mobility and shared mobility services. This to create a theoretical framework, whereby the insightful information served as the base for the empirical part of this research.

In the empirical part, an exploratory case study is conducted. The case is used to assess the effects of shared mobility services on urban renewal in disadvantaged neighbourhoods. The case that is studied, is the neighbourhood Tarwewijk, which is located in the area of Rotterdam-South. Since studies have shown that Rotterdam-South is struggling with large concentration socio-economic problems and is the least mobile part of Rotterdam. Within the case study, several research methods are used. These mainly involved document studies about the area and semi-structured interviews with the municipality of Rotterdam, service providers and various mobility advisors. Moreover, the policy and vision documents written by the municipality of Rotterdam are used as additional information.

In the final part of this research, the synthesis, the results from the case study and theory were compared to find similarities and differences. These results were then used to come with possible solutions and policy opportunities that can contribute to the implementation and usage of shared mobility services in Rotterdam-South.

RESULTS FROM THE LITERATURE STUDY

In the literature study, four of the research sub-questions are answered. This is done by reviewing the literature. The results of the sub-questions are summarized in this part.

What is urban renewal?

Urban areas are no static entities since they can change and age over time when used by its residents, visitors and businesses. While some areas can continue performing well, others can be confronted with a decline and various urban problems (e.g. deterioration of streets, disappearing facilities, an increase of crime and vandalism, etc). Eventually, these urban areas need maintenance and renewal. Herewith, the concept of urban renewal can be explained as an integrated vision and strategy to solve urban problems in areas that are in a state of decay by improving and upgrading the economic, social, physical and environmental conditions. Figure II summarises the main elements of the four aspects of urban renewal.

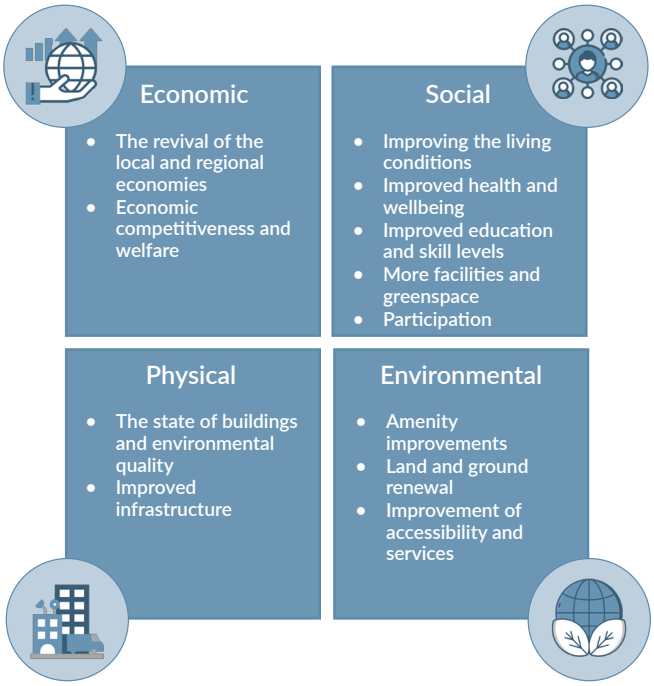


Figure II: The four aspects of urban renewal

Which smart mobility services and business models are available?

New mobility services are one of the four key components of the concept of smart mobility. These are among others, shared (micro-) mobility services (e.g. car sharing, ride sharing, bike sharing and scooter sharing), on-demand riding services and Mobility as a Service.

- *Car sharing:* is provided by mobility providers and offers its users turn-key services. This means, that users only pay for the time they use the vehicle or the distance they drive with the vehicle. Two types of car sharing services can be distinguished. These are the Business-to-Consumer (B2C) and Peer-to-Peer (P2P) model.
- *Ride sharing:* allows more than one person to travel in a vehicle. This ensures that multiple people do not have to drive to a location themselves. This concept of ride sharing is not new and is already used for a long time. Carpooling and vanpooling are examples of this. However, rapid new developments in ICT has led to the emergence of new businesses models, namely on-demand riding services. These services are application-based, whereby it can in real-time match the geo-located demand and supply.
- *Bike-sharing:* the growing concerns about urban problems have led to the increase of sustainable transport modes, such as bike-sharing. Bike-sharing services offer users hourly access to the use of bicycles within the services areas of a city. Bike-sharing systems can be distinguished in three type of systems, station-based bike-sharing systems, dockless bike-sharing systems and hybrid bike-sharing systems. Within these systems, various bike-sharing business models have evolved. These are among others: street furniture bike-sharing, sponsorship based bike-sharing, non-profit bike-sharing, for-profit bike-sharing, public transport agency bike-sharing and publicly owned bike-sharing.
- *Scooter sharing:* like bike-sharing, these services allow users hourly access to the use of scooters within the services areas of a city. A distinction can be made into two types of scooters, namely moped-style scooters and standing electric scoters. The second type is also known as a step.
- *Mobility as a Service (MaaS):* can be described as a digital platform, where different mobility services (e.g. bike- and car sharing, etc.) and traditional transport modes are combined. This digital platform is operated by one single provider which distributes the services to its users.

Who are the users of shared mobility services?

The concept of shared mobility has experienced growth and is nowadays becoming more and more mainstream. When looking at the users of this concept. In general, there is no clear profile for the users of shared mobility services. This because the number of studies on the users are limited or based on small samples. Yet, the typical users of shared mobility services appear to have some key generalities. The users are in general well educated, young and digital experienced adults living in urban areas of the city. Also, the users often belong to higher-income households, who do not have children (yet) and own fewer cars per household.

What are potential barriers for using smart mobility services in disadvantaged neighbourhoods?

Shared mobility services are seen as an opportunity for inhabitants in disadvantaged neighbourhoods since it can bring improvement of equity and accessibility to transport. However, due to several challenges and barriers, these shared mobility services do not reach this group and therefore the usage of the services is lower. These can be classified into the following areas:

- *Social:* when offering shared mobility services for certain groups, such as elderly, people with limited mobility, people with disabilities, various barriers can arise. This, if no accessible shared mobility service or an equivalent alternative is offered for this group.
- *Economic:* for this area, multiple barriers can occur for users. Firstly, shared mobility services work on a pay-as-go pricing method. This means that users pay for the amount of time or distance they use these services. The costs for these services are often more expensive than for instance the use of public transit, walking, cycling. Besides, the usage of these services can bring additional costs, like membership fees and application costs. Secondly, most mobility services require users to have a bank/credit card for the payment of their services. So, people who do not own these cards can not make use of shared mobility services.
- *Digital approach:* besides a bank/credit card, service providers also require that users have a smartphone with access to internet data. Since most shared mobility services are used through a mobile application. This can be a barrier for certain groups, who have limited smartphone ownership.
- *Spatial & Geographic:* shared mobility systems and stations should have easy and safe access, for users to actually use it. However, shared mobility systems and stations are rarely located within walking or at an acceptable distance from disadvantaged neighbourhoods. So, if shared mobility services do not serve a disadvantaged neighbourhood for different reasons than this can be a physical barrier for users.
- *Culture & Education:* barriers that can influence the usage of shared mobility services are potential cultural values of certain groups. Hereby, factors as lack of trust, discomfort with the shared mobility systems and preference to other vehicles can play a role. Besides, the lack of information and education of shared mobility services in a disadvantaged neighbourhood can influence the usage as well. When people do not know how to use systems or understand their potential benefits, they will be likely not to use it.

RESULTS FROM THE EMPIRICAL RESEARCH

In the empirical part of this research, five of the sub-questions are answered. The results of the sub-questions are summarized in this part.

What is the main motivation of the municipality of Rotterdam when selecting a specific neighbourhood for implementing a shared mobility pilot project?

The municipality of Rotterdam wants to conduct a shared mobility pilot in the neighbourhood of Tarwewijk. This in response to a successfully conducted pilot with shared mobility services elsewhere in Rotterdam. Hereby, the municipality wants to examine the impact of shared mobility services on the liveability of the neighbourhood and possibly the addition of more green in the public areas. This since the neighbourhood of Tarwewijk has a major parking task and deals with high parking pressure. The previous pilot was executed in a neighbourhood within the city centre and the municipality has not conducted such a pilot before in a disadvantaged neighbourhood, which is dealing with various socio-economical problems. Furthermore, which is also experiencing problems as transport poverty. Therefore, the municipality of Rotterdam has decided to conduct a pilot in the neighbourhood of Tarwewijk to see what the potential is of shared mobility services.

Which shared mobility services are used in Rotterdam?

Since begin 2020, the municipality of Rotterdam works with a permit system for shared mobility services. Currently, six shared mobility services are granted with a permit with which they are allowed to operate in the city. Hereby, the service providers Mobike, Donkey Republic and JUMP provide for bike-sharing services. All three systems are fourth-generation bike-sharing systems and use smart lock systems with GPS. Moreover, all services are available by a smartphone application. Two out of the three services (Mobike and JUMP) are dockless bike-sharing services, also known as free-floating systems. On the contrary, Donkey Republic is a dockless bike-sharing system, however not free-floating. The service providers Felyx, GO Sharing and Check provide for scooter sharing services. Like the bike-sharing systems, the scooter sharing systems also work on smartphone application-only base.

In which areas of Rotterdam are these services distributed?

All services providers determine their specific services areas within the city based on certain factors. From the interviews the following factors have emerged: 1) Density & Usage, 2) Target groups, 3) Income & Vandalism, 4) Interest areas and 5) The use of the applications. In Rotterdam, the service providers are mainly active within the city centre. Besides they are also operating the East and North parts of Rotterdam. When looking for shared mobility services in Rotterdam-South only two out of the six service providers do operate in the area. These are the bike-sharing service of Donkey Republic and GO Sharing. However, these providers also do not operate in all neighbourhoods of Rotterdam-South.

Why are service providers providing services in Rotterdam-South or why are they not?

Three main factors play a role in why service providers do or do not operate in Rotterdam-South. These are providing a regional solution, usage and vandalism.

- *Providing a regional solution:* one of the reasons that some service providers do operate in Rotterdam-South is that they want to offer a regional solution. Hereby, the need for mobility does not only exist in the dense city centre but also in rural areas of the city.
- *The usage of services:* when the service providers operated in the neighbourhoods of Rotterdam-South, the usage of the services were lower compared to the rest of the city. Because of this low usage, the vehicles were often left at loose places. So, service providers needed to redistribute their vehicles to more popular places within the city which led to high redistribution costs.
- *Vandalism:* the shared mobility services that have operated in the past in Rotterdam-South have experienced high numbers of vandalism. Herewith, bikes and scooters were often demolished or stolen. So, for service providers, the costs of operating in Rotterdam-South were higher than the revenues. This because of the experienced vandalism and the low usage of services. Hereby, the economic risks that Rotterdam-South entailed were too high and therefore service providers decided to reduce their services areas and not include parts of Rotterdam-South anymore.

What policy does the municipality of Rotterdam have for the implementation of shared mobility services?

Since 2020, the municipality has introduced a permit system for shared mobility services that operate in Rotterdam. This permit applies to (electric) bicycles, electric scooters, steps, cargo bikes, etc. Before, the introduction of the permit system, the collaboration between the municipality of Rotterdam and service providers was based on verbal and written agreements. With this new permit system, the municipality wants to improve the quality of shared systems and hereby ensure that users do not experience any inconvenience. This means that service providers are obligated to identify and manage the risks of their services and vehicles. Before issuing a permit, these aspects are assessed by the municipality. With the introduction of this permit, also a maximum number of vehicles active within the city is established. This to ensure that the supply of shared vehicles matches with the demand in the city. For 2020, the municipality has decided for a maximum number of 6.500 permits for the city of Rotterdam. Hereby, a distinction is made into different vehicles. For the number of maximum permits, this means the following: 3.000 (electric) bicycles, 2.000 electric scooters, 1.000 electric steps and 500 car bikes and other forms of shared mobility. Since there are only a number permits, the municipality has decided to issue the permits for 5 years. This to ensure a fair playing field for all service providers.

RESULTS FROM THE SYNTHESIS

Which potential solutions show the most promise in overcoming barriers in disadvantaged neighbourhoods in Rotterdam-South?

From the cross-case analysis of Tarwewijk in comparison to the five criteria of service providers, opportunities and potential barriers have become visible. These were among other the low usage of services, income and vandalism. The following potential solutions are found from the literature that can help to overcome barriers to use shared mobility services in disadvantaged neighbourhoods, more specific for Tarwewijk.

- Granting governmental subsidies to service providers, which can serve as an incentive so they can provide for services in disadvantaged neighbourhoods. Hereby, these subsidies can address the risk of reduced financial viability for service providers is these areas.
- Provide shared mobility services in the form of mobility hubs at strategic and main locations within the neighbourhood. Herewith, the risk of vandalism to the systems can possibly be reduced. Moreover, it can contribute to the digital divide of shared mobility services.
- Introduction of dynamic pricing for all shared mobility services by service providers, whereby discount can be given to specific areas or neighbourhoods.
- Not only granting subsidies to service providers, but also for low-income persons could be a potential solution to overcome financial barriers. Hereby, public parties should reflect on which groups can be eligible for these subsidies.
- Public parties should reach disadvantaged neighbourhoods in a tailored way. Since not all shared mobility systems will suit all residents. Furthermore, specific outreach programmes should be implemented in collaboration with a local community organization.

CONCLUSION

The answers on the sub-questions lead to the answer to the main research question: ***"In what way can public parties use shared mobility services to stimulate urban neighbourhood renewal in Rotterdam-South?"***

Urban renewal is about improving and upgrading the economic, economic, social, physical and environmental conditions of a neighbourhood. By implementation of shared mobility services in disadvantaged neighbourhoods public parties can positively affect and stimulate two urban renewal aspects. These are the social and environmental conditions of a neighbourhood.

With the implementation of shared mobility services in neighbourhoods in Rotterdam-South, the mobility options for users can be expanded. Hereby, this can contribute to the accessibility for users to various services and opportunities, like health services, work, education etc. On top of this, this can positively affect not only their happiness in life but also improve transport poverty. So, shared mobility can contribute to the social aspects of urban renewal. Moreover, the implementation of shared mobility services can potentially contribute to the decrease of car-ownership. Hereby, these car-oriented streets can be transformed to low-traffic streets and people-oriented streets. As a result, more space will be available for green and social/community activities. Furthermore, the implementation of shared mobility can improve the environmental climate and quality of a neighbourhood. Since, shared mobility will provide for less congestion and particulates, which will lead to cleaner and quieter neighbourhoods. So, shared mobility can contribute to the environmental aspects of urban renewal.

However, it must be stated that although the implementation of shared mobilities can offer opportunities for urban renewal areas. It can also bring several barriers and challenges. It is known that these shared mobility services often do not reach residents of disadvantaged neighbourhoods and therefore the usage of the services is lower. So, before implementing shared mobility services to stimulate urban renewal, public parties must consider how to implement policies/strategies. This to ensure that the barriers to using these shared mobilities are eliminated.

DISCUSSION

The given conclusions must, however, be nuanced, since there are several limitations to consider alongside this research.

This research aimed to identify how shared mobility services can affect urban renewal areas and how this can improve the neighbourhoods in Rotterdam-South. Currently, there are limited services active in Rotterdam-South. So, the conclusion of this research is based on the assumption that service providers will operate again in Rotterdam-South in the future. This might not be the case in practice.

Moreover, urban renewal consists of four aspects, namely economic, social, physical and environmental. The four aspects have been described as stand-alone terms. Nonetheless, the four aspects of urban renewal also have mutual relationships. For instance, when an area is economically performing well, this can influence the other aspects of an area positively. However, the opposite is also possible. So, these relationships can cause either a positive effect on urban renewal or a negative effect. The mutual relationships can also ensure that the implementation of shared mobility services has an indirect effect on the other aspects of urban renewal. These interrelationships were disregarded in the study, thus a limitation of this research.

Furthermore, several interviews were held with advisors, the municipality of Rotterdam and service providers. However, due to circumstances of COVID-19, the perspective of the inhabitants of disadvantaged neighbourhoods could not be obtained. So, this is a limitation of this research since the potential barriers and challenges for use of shared mobility services from derived literature could not be compared to the practice.

RECOMMENDATIONS

Recommendations for practice

Based on the findings in this research, the following recommendations and points of advice are presented in this research:

- Approach the implementation of shared mobility services in disadvantaged neighbourhoods in a more tailored way.
- Explore the possibility of subsidies for service providers and users.
- Explore the potential of mobility hubs in disadvantaged neighbourhoods.
- Test the system of dynamic pricing.

Recommendations for further research

The presented research can be extended in many directions. The following suggestions are given for further research:

- Broaden the research by adding the perspective of users and non-users is necessary to understand their perceptions of shared mobilities.
- Conduct research in practice (pilot) to examine the impact of subsidies on the actual usage of services by low-income people.
- Conduct research on how mobility hubs should be organised and where they should be placed within a disadvantaged neighbourhood.

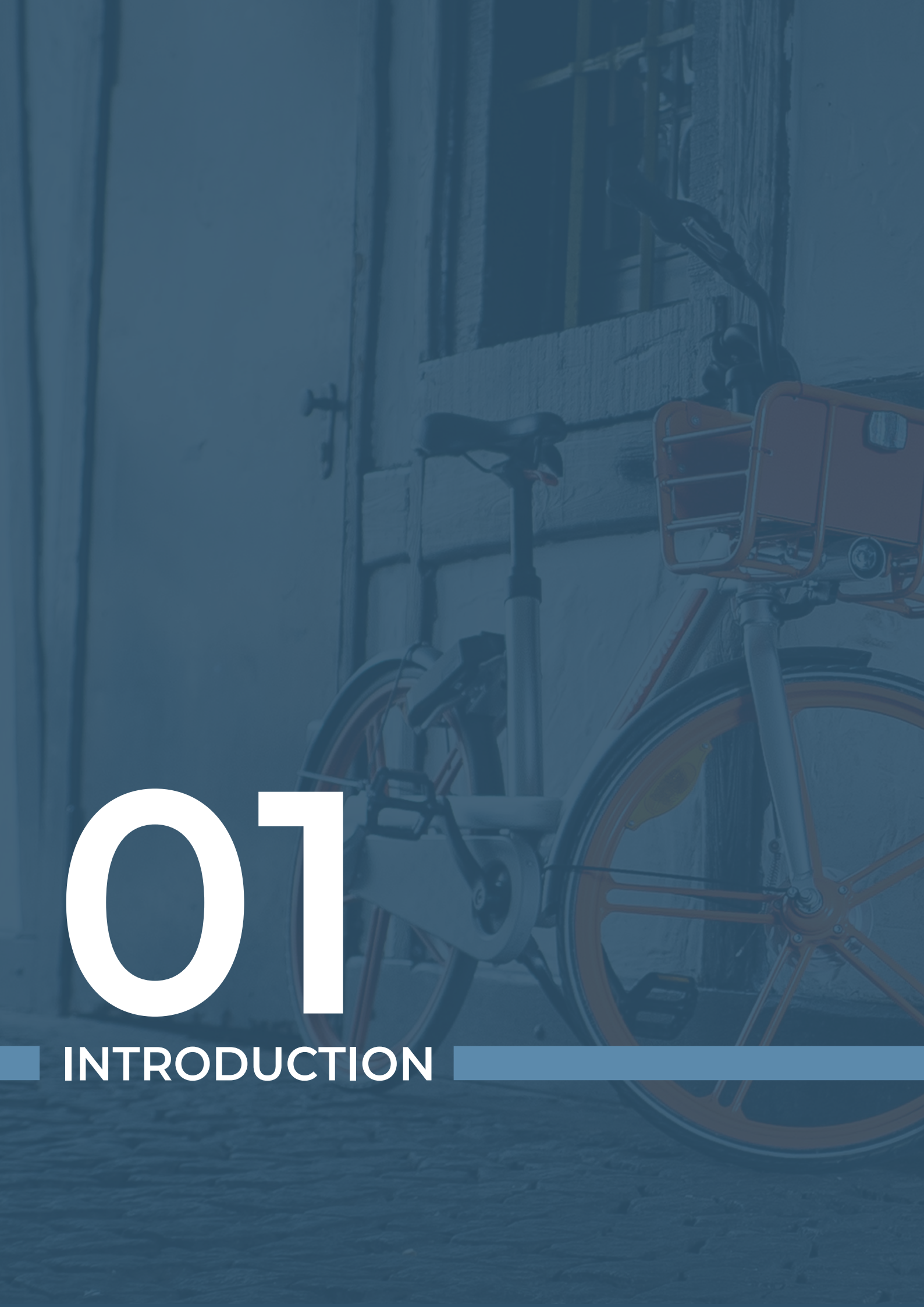
TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

.

.



01 INTRODUCTION

01 INTRODUCTION

This chapter introduces the main concepts that will serve as a starting point for this research. This is done by briefly presenting the concepts of "Smart Mobility" and "Sharing Mobility". Thereafter, the problem analysis is discussed which has formulated the problem statement. Subsequently, the research objectives & goals, research questions and deliverables are presented. Finally, the societal and scientific relevance of this topic is discussed.

1.1 BACKGROUND

Due to the urbanization, it is expected that 68% per cent of the world's population is living in urban areas by 2050 (United Nations, 2018; Carneiro et al., 2019). It is important to be able to predict the dynamic urban activities in a city, such as air pollution, energy consumption, safety, traffic flows, etc. to secure and improve the quality of human life (Flüchter & Wortmann, 2014). Hereby, urban mobility can be an important factor to solve these problems and is, therefore, a major determinant of quality of life, public transit, employment, education and health care (Shafrin Sullivan, Goldman, & Gill, 2017).

In addition, new developments in ICT, the adaptation of smartphones, the increasing availability of data and the increasing connectivity of vehicles and users through the Internet-of-Things (IoT) are changing mobility users' and providers' expectations and opportunities. These developments are changing current mobility systems in cities by creating new possibilities for the application of smart solutions (Borsboom-van Beurden, Kallaos, Gindroz, Costa, & Riegler, 2019). These changed conditions can be placed under the common term "Smart Mobility" (Papa & Lauwers, 2015).

According to Allwinkle & Cruickshank (2011), the term smart mobility can be defined in line with the following developments: the rise of the sharing economy (connecting shared mobility), access over ownership, mobility-on-demand, autonomous vehicles (AV) technologies, the convergence of transport modes and vehicles, the changing boundaries between public and private transport and new entrants challenging the transportation market. These developments impact both the transport demand and supply side, which eventually is reshaping the transport systems and changes the user's expectations.

For the demand side, a trend is emerging where there is a shift from fixed mobility patterns (e.g. car ownership) toward the provision of access to mobility opportunities and the concept of sharing economy (Papa & Lauwers, 2015). In the transportation sector, numerous new shared mobility services have emerged with or without local government support. These services are technology-based, on-demand and provide alternatives to traditional transport models. In addition, the services are addressing the gap in the supply and demand for sustainable transport in the cities. Examples of shared mobility services are car sharing services, peer-to-peer car-sharing services, ridesharing services, However, shared mobility services are not limited to only cars. Shared mobility services also include various lighter transport modes, namely micro-mobility services, which are bike-sharing services and scooter-sharing services, etc. (Eckhardt, Aapaoja, Nykänen, Sochor, & Karlsson, 2017). The concept of sharing within society is not new. However, the evolution of the digital world and IoT has enabled sharing to spread beyond the local interaction and facilitated between multiple individuals (Belk, 2014; Botsman & Rogers, 2010; Hamari, Sjöklint, & Ukkonen, 2016).

1.2 PROBLEM STATEMENT

Studies have shown that inhabits of low-income, minority and socially disadvantaged neighbourhoods are mostly concentrated away from economic opportunities and public resources (Wang, Philips, Small, & Sampson, 2018). These neighbourhoods also encounter injustice of daily transportation (transportation poverty), which can increase social exclusion and other barriers to access services (Litman, 2018; Shaheen, Bell, Cohen, & Yelchuru, 2017). Since the availability and quality of transportation impacts an inhabitants accessibility and opportunities in life. Pyrialakou, Gkritza and Fricker (2016) state that is important to improve the transportation conditions in and around disadvantaged neighbourhoods. Hereby, mobility and accessibility can be promoted against urban settings. As a result, to address transportation equity issues extensive multi-model transportation networks needs to be provided (Shaheen et al., 2017).

New shared mobility services, such as car sharing, ride-hailing and bike-sharing, are seen as emerging modes (Goldman & Gorham, 2006). These services are technology-based, on-demand and provide alternatives to traditional transport models. The shared mobility services are seen as an opportunity for more sustainable transport in the city and to address equity in transportation (Yan & Howe, 2019). But without thoughtful planning, there is no guarantee this will happen (Transportation for America, 2020). Moreover, Golub, Satterfield, Serritell, Singh, and Philips (2019) state that there is an ongoing discussion in the literature about the challenges and benefits of these new shared mobility services. In addition, giving the fact that virtual mobility is growing by the enhancement of ICT and will potentially be a replacement for physical mobility. It should be considered that inequalities of users to access or use ICT resources, can lead to inequalities in mobility in the physical world (Golub et al., 2019).

Case

When looking at the four biggest cities in the Netherlands, studies have shown that in Rotterdam transportation disadvantages and transportation poverty seriously hinder the development opportunities of its citizens. Especially, due to an accumulation of factors, Rotterdam-South, in particular, has a serious problem (Van den Ende, 2018). Rotterdam-South has almost 240.165 (annual level: 2017) inhabitants. Rotterdam-South is an urban renewal area since the area is struggling with a large concentration of socio-economic problems.

In the past, the cheap housing stock has attracted many low-skilled workers to work in the city ports. However, due to the automation and competition from low-wage countries jobs have slowly disappeared (Bastiaanssen, Martens, & Polhuijs, 2013). This has resulted in a high rate of unemployment and due to the limited number of jobs in Rotterdam-South (only one-fifth of all jobs in Rotterdam), low-skilled job seekers, in particular, will have to look for work outside South-Rotterdam (Van den Ende, 2018).

However, the accessibility of the neighbourhoods in Rotterdam-South is less accessible compared to the rest of the city. This is not only the case only internal urban connections but also the connection with the region and beyond. Hereby, the travel times are often longer and there are fewer options for different transport modes. (Programmabureau Nationaal Programma Rotterdam Zuid, 2019).The choice of different transport modes is also limited by budgetary priorities and possibilities. Thereafter the behaviour of many inhabitants also plays a big role (e.g. some inhabitants are not used to cycling). These various factors can be seen as a part of transport poverty.

According to Lucas, Bates, Moore & Carrasco (2016) transport poverty is an umbrella term, in which the following concepts can be distinguished:

- *Mobility poverty*: a systematic lack of means of transport and access to public transport. This makes it difficult for persons to travel to other places.
- *Accessibility poverty*: the effort to reach basic services, such as work, school, hospital, sports accommodation or shop within an acceptable period of time and effort.
- *Affordability of transport*: the lack of options for individuals and households to pay for transport. Income plays an important role here, but so do the costs of transportation.

Studies of Van der Bijl & van der Steenhoven (2019) on transportation poverty in the Netherlands have shown that in Rotterdam-South (Afrikaanderwijk and Bloemhof) approximately 20 per cent of the population is struggling with transport poverty. This is hindering the mobility of inhabitants in Rotterdam-South, thus access to work, education, health and social contacts.

To summarize the problem statement:
The area of Rotterdam-South is an urban renewal area, which is struggling with large concentration socio-economic problems. In addition, studies have shown that the inhabitants of Rotterdam-South are the least mobile and suffer from transportation poverty, causing them to come across more barriers to the accessibility of various services and opportunities. Shared mobility services are seen as an opportunity to address equity in transportation and transportation poverty. However, giving the fact that virtual mobility is growing by the enhancement of ICT and will potentially be a replacement for physical mobility. Shared mobility services can bring new equity concerns and opportunities. This research will focus on the effect of shared mobility services on urban renewal areas.

1.3 RESEARCH QUESTIONS

1.3.1 Main research question

Based on the defined problem statement for this research, the following main research question is formulated:

> **"In what way can public parties use shared mobility services to stimulate urban neighbourhood renewal in Rotterdam-South?"**

1.4.2 Research sub-questions

The research will investigate the main research question through the following sub-questions:

Urban renewal:

- What is urban renewal?

Shared mobility services in general:

- Which smart mobility services and business models are available?
- Who are the users of shared mobility services?
- What are potential barriers for using smart mobility services in disadvantaged neighbourhoods?

Shared mobility services in Rotterdam-South:

- What is the main motivation of the municipality of Rotterdam when selecting a specific neighbourhood for implementing a shared mobility pilot project?
- Which shared mobility services are used in Rotterdam?
- In which areas of Rotterdam are these services distributed?
- Why are service providers providing services in Rotterdam-South or why are they not?
- What policy does the municipality of Rotterdam have for the implementation of shared mobility services?

Synthesis:

- Which potential solutions show the most promise in overcoming barriers in disadvantaged neighbourhoods in Rotterdam-South?

To answer the different sub-questions for this research a suitable research method is chosen. This method will be discussed in chapter 3.

1.4 RESEARCH GOALS & OBJECTIVES

The main goal of this research is to get a better understanding of how shared mobility services affect and can stimulate urban neighbourhood renewal. This goal is also be divided into four sub-goals:

1. To understand how these mobility services are distributed within the city of Rotterdam;
2. To understand what the motivation or role of service providers and local governments is within these shared mobility services;
3. To understand which equity concerns and barriers smart mobility services can bring in disadvantaged neighbourhoods;
4. To understand the key aspects of urban renewal.

1.5 CONCEPTUAL MODEL

Figure 1 presents the conceptual model for this research. This research aims to understand how shared mobility services affect and can stimulate urban neighbourhood renewal. The conceptual model is developed based on the information conducted from the current literature. This will provide a framework for the entire research, connecting the literature with the main aim of this research. Firstly, the research explores the concept of urban renewal. Whereby, the four main aspects of urban renewal will be analysed, which are economic renewal, social renewal physical renewal and environmental renewal. Secondly, the research will focus on smart mobility and more specific on shared mobility services in general and their usage in a disadvantaged neighbourhood. Finally, the two concepts of shared mobility services and the four aspects of urban renewal will be compared. This to see where shard mobility services can effect urban renewal.

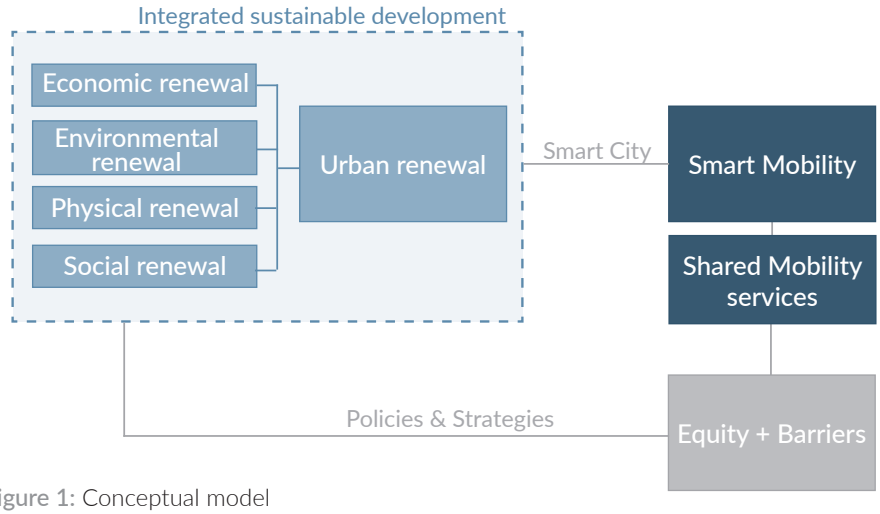


Figure 1: Conceptual model

1.6 DELIVERABLES AND DISSEMINATION

This research will result in an answer to the main research question and advice on the use of shared mobility services in the disadvantaged neighbourhood in Rotterdam-South. This may help parties gaining insides on how shared mobility services work and how they may be applied and implemented, to change the disadvantaged transportation context of Rotterdam-South. Eventually, this advice might be generalized and can be used in a different city context.

This research and advice are addressed to the municipality of Rotterdam, since the outcome of this research can contribute to their strategy for mobility in the city, more specifically for disadvantaged neighbourhoods as Rotterdam-South. Also, this advice will be addressed to the Traffic company (Dutch: de Verkeersonderneming). De Verkeersonderneming is a public-private partnership established between the municipality of Rotterdam, the Rotterdam The Hague Metropolitan Area, the Directorate-General for Public Works and Water Management (Dutch: Rijkswaterstaat), the Ministry of Infrastructure and Water Management, and the Port of Rotterdam (De Verkeersonderneming, n.d). The traffic company is established to provide a joint approach to mobility and accessibility issues. Therefore this advice and can contribute to their strategy.

1.7 RELEVANCE

The relevance of this research can be distinguished in the scientific relevance and societal relevance. In this section, both of them will be briefly discussed.

1.7.1 Scientific relevance & gap in the literature

Shared mobility services consist of several services and systems, among others micro-mobility. Shared micro-mobility can be seen as a new and expanding subfield of urban transportation research (McKenzie, 2020). Shared micro-mobility includes the use of a bicycle, scooter and other low speeds modes. With this type of mobility, users can have short-term access to a transportation mode on an as-needed basis. According to Shaheen & Cohen (2019), the before-after-studies documenting the impacts of shared micro-mobility are limited. Especially since studies on dockless (free-floating) bike-sharing and scooter-sharing are limited (Shaheen & Cohen, 2019). Yan & Howe (2019) adds that free-floating sharing systems are fairly new and therefore their potential impact on the usage and equity in a disadvantaged neighbourhood is unclear. Previous studies have shown that micro-mobility has attributable impacts to offer environmental and social gains (Machado, De Salles Hue, Berssaneti, & Quintanilha, 2018). However, more research is needed. Especially, since there is little academic research on the impacts of shared micro-mobility on urban renewal. This research will examine the effect of shared micro-mobility on urban renewal. Urban renewal does not only exist of environmental and social aspects but also economic and physical aspects. Therefore, this research will contribute to missing knowledge about the effect of shared-micro mobility on urban renewal areas thus fill in the knowledge gap.

1.7.2 Societal relevance

Writing advice on how shared mobility services which might improve the neighbourhood will be useful since there are many cities which already have a social and transportation disadvantage in the Netherlands. The local government, service providers and the end-users might take advantage of this advice. The local government and service providers might be able to respond better to the needs and wishes of the users (inhabitants). Hereby, the transportation disadvantaged in the area might be improved. These changes in transportation disadvantaged might also impact the social disadvantage of the neighbourhood positively.

02

THEORETICAL FRAMEWORK

02 LITERATURE REVIEW

This chapter will present the theoretical framework used for this research. Therefore, this chapter aims to give an overview and better understanding of the concepts of urban renewal, smart mobility and shared mobility services. Firstly, an introduction will be given on the concept of urban renewal and how the focus of urban renewal approaches and policies have changed over time. Secondly, the concept of smart mobility is introduced, thereafter focusing on different shared mobility services. Subsequently, the users of shared mobility will be explained. Finally, potential equity concerns and barriers that shared mobility can raise will be elaborated on.

2.1 URBAN RENEWAL

2.1.1 The concept of urban renewal

Neighbourhoods are not statically. In contrast, they can change and age over time, when they are used by residents, visitors and local businesses. Eventually, these neighbourhoods need maintenance and renewal. While some neighbourhoods are continuously performing well, other neighbourhoods are confronted with decline and problems. These areas get branded as problematic and disadvantaged, low-income neighbourhoods and poverty districts (Wassenberg, 2010). This bad image of the city will cause a new set of problems. Since people who can afford it will move to more prosperous neighbourhoods, making a place for people from lower socio-economic classes. This change in residents leads to new problems, such as the deterioration of dwellings and streets in the neighbourhood, the increase of crime and vandalism, the increase non-social behaviour of residents and disappearing facilities in the neighbourhood (Wassenberg, 2010). To tackle these problems, states have set up different policies and strategies to renew cities and neighbourhoods.

Besides the term “urban renewal” literature shows different terms to describe the renewal of a city or neighbourhood, such as urban redevelopment, urban revival, urban regeneration, etc. In addition, different countries, use specific terms to describe this concept (Wassenberg, 2010). So, it can be said that there is no single agreed-upon definition and its interpretation changes often (Stouten, 2010). In this study, the following (mainly used) definition defined by Roberts and Sykes (2018) is accepted for “urban renewal”. Urban renewal can be seen “a comprehensive integrated vision and action which leads to the resolution of urban problems and which seeks to bring about lasting change in the economic, social, physical and environmental condition of an area that has been the subject to change” (Roberts and Sykes 2008, p.17). To understand this definition of urban renewal better, the four aspects of urban renewal should be studied further.

Economic renewal

Economic renewal plays an important role in the case of urban renewal since it is crucial to counteract any economic decline (Roberts & Sykes, 2008). Economic renewal can be explained as the revival of the local and regional economies of a city and the improvement of the economic competitiveness and welfare (Audit Commission, 2006). Within urban renewal, it aims to attract and stimulate among others, investments, businesses and start-ups, employment opportunities and skills development (Roberts and Sykes, 2008).

Social renewal

Social renewal refers to social interventions and approaches and the empowerment of local communities, within urban renewal strategies (GCPH, 2016). Comparing social renewal to the other aspects of urban renewal, it appears that this is a less tangible process. However, from the literature, it can be reviewed that social renewal focuses on certain aspects. These are the following: the health and wellbeing of the inhabitants, the education and skill levels of the inhabitants, facilities and greenspace in the neighbourhood and culture (Ginsburg, 1999). When social renewal is implemented effectively, it will enable citizens beneficially contributing and participating in the community and society (Ginsburg, 1999).

Physical renewal

Cities are highly investing in their physical appearance, the state of their buildings and environmental quality since these aspects resemble the quality of life, the prosperity and the trust of business and citizens in the city. Roberts and Sykes (2008) state that eventually inefficient infrastructure and obsolescent/vacant buildings can lead to decline and problems within the city. So, physical renewal can be seen as a necessary condition for urban renewal. Moreover, in many cases, physical renewal can be seen as to be the main engine of renewal, since it shows a commitment to change and improvement (Roberts & Sykes, 2008).

Environmental renewal

Roberts and Sykes (2008) argue that physical renewal implies some form of environmental improvements. When a city is deteriorating, it is likely to encounter problems like vacant and obsolescent buildings and land, and even the risks of contamination. These can be seen as aesthetically and physically environmental problems. These problems will impact and influence the perception of (potential) private investors about the city and its image. So, to counter any possible bad images of the city, many urban renewal initiatives have included elements of environmental improvements within their plans. These initiatives are among others: amenity improvements, land and ground treatment, improvement of accessibility and services, more green and open spaces and the quality of the urban design. Moreover, these environmental improvements, not only are beneficial for private investors and business, but also the local community (Roberts, 1995).

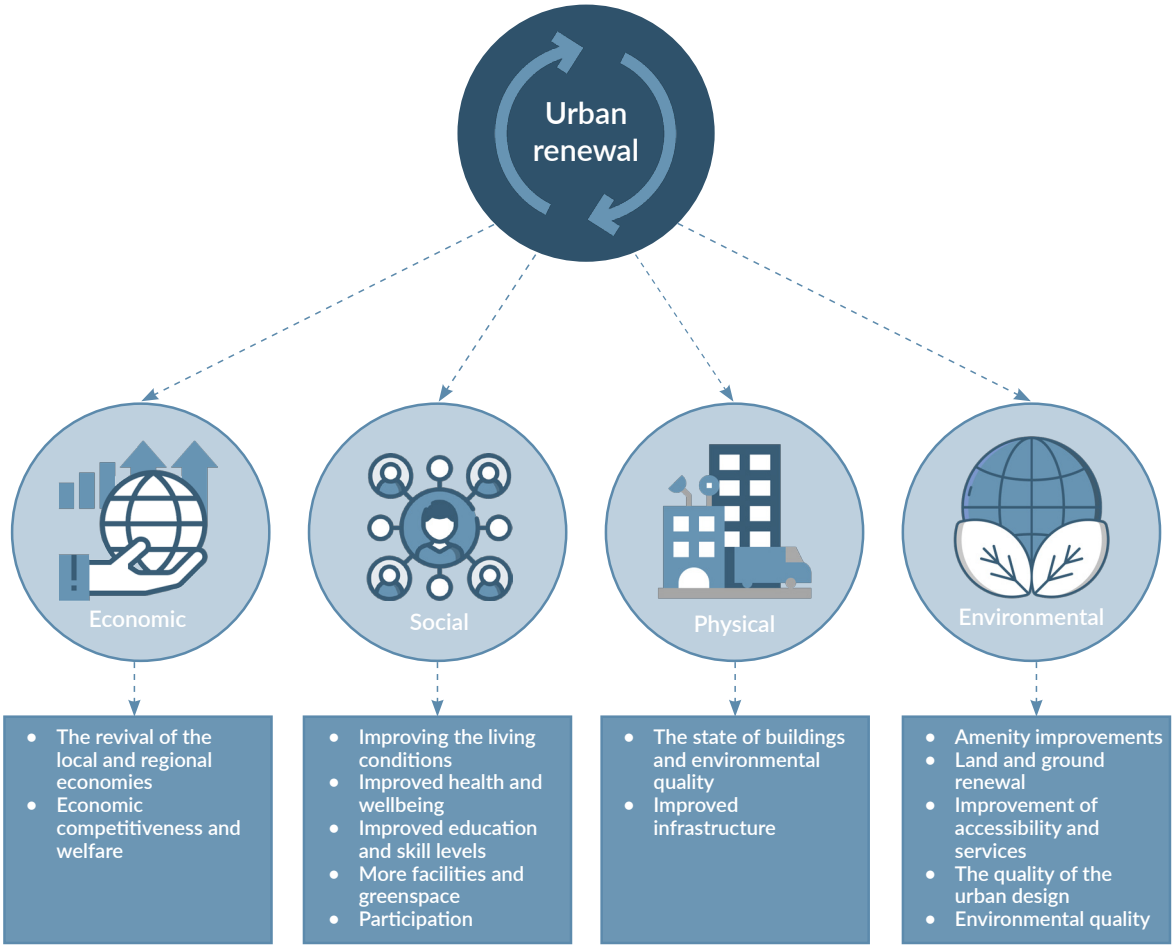


Figure 2: The four aspects of urban renewal (own illustration)

2.1.2 Urban renewal policies through the years

Over the last 50 years in Europe, countries have set up various urban renewal policies to renew their cities. Due to various urban problems, such as poverty, crime, migration, social exclusion, unemployment, bad housing, etc. urban renewal policies have become more complex (Kleinhans, 2004). Hereby, the direction of these policies has changed several times, giving priority to different aims and objectives (Roberts and Sykes, 2008) In the literature, different periods of policies can be distinguished in the urban renewal processes in European countries (Droste, Lelevrier & Wassenberg, 2008). This study focuses on the urban renewal policies since World War II.

In Europe, the first period of urban renewal started immediately after World War II. After suffering and overcoming from the war, the important centres of the cities were reconstructed. In contrast to the old areas of the cities (slums), which were cleared and demolished to make a place for future developments. To provide housing for the inhabitants who were forced to move from the slums near the city centre new dwellings had to be built. These were built in the so-called suburbs (Wassenberg, 2010). The reconstruction of the cities was from national importance level. Hereby, national governments played an important and leading role in providing a political framework and subsidies (Wassenberg, 2010). To summarize, the urban renewal policies in the 1950s and early 1960's emphasised on the reconstruction and replacement of the physical problems of the war. The situation changed from a market-driven situation (which was characteristic until the 1940s) to a situation where the government had a leading role. Hereby the government got support from the private sector and local authorities.

During the 1960s, housing and population pressures continued to be a problem, despite the post-war solutions. While there was growth in the suburban areas, little attempts were made to rehabilitate the inner cities. In the 1970s, an economic decline was starting to spread worldwide, causing unemployment and urban deprivation in the city (Couch, 2003). In this period, urban policies regain focus on the inner-cities and aimed to renew and revitalize the old city centres (Roberts & Sykes, 2008). Thus focusing on improving the rising poverty, housing needs and unemployment. Within these policies, the leading role of the local government changed to a more participatory and decentralised approach. Forming partnerships with private investors to seek for solutions.

From the 1980s onwards, the idea of only the national government providing for resources and subsidies to support urban renewal changed (Roberts and Sykes, 2000). This changed the approach for urban renewal to a more market-oriented one (Stouten, 2010). This approach emphasized more on the collaboration and possible partnership between different sectors, such as private sectors, public authorities, non-profit organisations, community (Tsenkova, 2002).

Urban renewal policies at that time were mostly about generating economic profit. Cities started developing flagship projects, which aimed to improve their image and their economic competitiveness. Policies in the previous decades, focused mainly on one aspect of urban renewal. However, the urban renewal policies of the 1990s and 2000s are characterised by an integrated approach. Since, it became clear that urban problems could not be solved with only the focus on physical improvements or economical improvements (Wassenberg, 2010). Therefore, a more comprehensive form of policy is enhanced emphasising on the integration of all physical, social, economic and environmental objectives.

Based on the brief history of urban renewal, it can be concluded that urban renewal policies mainly focus and reacts to the current trends. When looking at the current trends nowadays, we see the emerging trend of the concept of the "Smart City". The development of the smart city can be seen as the results of the new technological and intelligent developments, such as ICT, Internet of Things, etc. Cities are linking technological policies and their developments plan to achieve integrated sustainable developments to serve socio-economic, environmental objectives and improving the quality of life (Hameed, 2019). Smart City projects consist of six different clusters known as Mobility, Environment, Government, Economy, People and Living. This research will focus on one of the axes, namely mobility.

2.1.3 Mobility and urban renewal

It is important to understand where mobility fits in and can influence the different aspects of urban renewal and sustainable development. According to Vinci and Di Dio (2016), transport and mobility can be seen as important factors in the adaptation of existing urban areas to a more integrated sustainable development. Moreover, mobility can increase the possibilities for inhabitants and businesses, since it will promote economic competitiveness and can be seen as a driver for social cohesion. Therefore efficient and affordable mobility options and public transport must be available for all citizens to meet their transport needs, as it can play a crucial role in the isolation disadvantaged and deprived neighbourhoods (Skayannisa, Goudasb & Rodakiniasc, 2017). , So, the challenge is to meet the transport needs of citizens. This not only in an effective way, but this should also be in a sustainable way. Whereby, the movement of people and goods in an environmentally, economically, socially sustainable way (Skayannisa, Goudasb & Rodakiniasc, 2017).

Economical

Mobility can be seen as a vital part of a thriving urban economy (Ellen MacArthur Foundation, 2019). Thereafter, cities play a key role in attracting investments which support their sustainability objectives. When the public sector, invests in the key infrastructure of a city, this can attract the private sectors and businesses. (Czischke, Moloney & Turcu, 2014).

Social

Inhabitants of disadvantaged neighbourhoods mainly rely on walking and public transport for their daily mobility needs. However, when there is a lack of public transport and other limited mobility options this can hinder the participation of inhabitants in social and economics. Eventually, this can lead to social exclusion and exclusion from the labour market (Noack, 2011). Chan & Lee (2008) add that accessibility is essential to improve social sustainability. Moreover, people do not want to travel too far from their living environment to work, to participate in daily activities, etc. (Smith, 2000). Another additional aspect of limited public transport in disadvantaged urban neighbourhoods is that inhabitants are like to make use of the car. Since a car is necessary to search for jobs in other areas (Curl, Clark and Kearns, 2017).

Physical

When looking at the impact of mobility and transport, it shows that the physical forms and density of neighbourhoods are impacted by these factors. Not only by mobility and transport, but also land ownership regulations and communication methods (Haywood, 1997). Roberts and Sykes (2008) add that an inefficient infrastructure can lead to decline and problems within the city.

Environmental

The main driver of carbon emissions in a city is energy use. Looking at the sectors that are the main drivers, it is clear that these are construction and transport sectors (Czischke, Moloney & Turcu, 2014). To reduce and optimise energy use in the transport sector, new approaches should be considered
For instance through the model shift towards public transport, walking and cycling, developments in vehicle efficiency, compact city planning, etc. (Czischke, Moloney & Turcu, 2014).

2.2 SMART MOBILITY

2.2.1 The concept of Smart Mobility

One of the important domains that support and impacts the Smart City's concept and vision is Smart Mobility. What makes the concept of "Smart Mobility" interesting is first of all the difficulty in defining it. Within the transportation literature, the "smart city" studies and governmental reports, this concept is defined in many different ways. Each of them trying to grasp the full scale of this rapidly evolving "Smart Mobility" ecosystem (Noy & Givon, 2018).

Firstly, it is important to define what is considered the scope of smart mobility. Docherty, Marsden & Anable (2018) have distinguished key components for the concept of smart mobility. These are the following:

- *Data:* the mobility-sector becomes increasingly data-intensive. Data be seen as one of the key element in smart mobility technologies and applications. Since developments, in-vehicle technology, (digital) infrastructure and Mobility as a service (MaaS) all need available, qualitative and safe data.
- *New mobility services:* there is a transition in mobility towards the concept of MaaS. Hereby, individual ownership is changing to the concept of "usership" of vehicles and applications. With this mobility concepts, users can purchase access to various mobility services, such as cars, public transports, bike share, etc. Through a single integrated platform, provided by one private provider, users can plan their trip with the different means of transport and also pay for this (Thakuriah, Tilahun & Zellner, 2017).
- *Increasingly "Intelligent transportation system" (ITS) and infrastructure:* ITS is a system, which uses leading-edge information and communication technologies for transportation and traffic management systems, such as traffic signals, connected vehicles, smart ticketing and cooperative systems. Hereby, this system fosters to improve the transportation networks (increase, safety, efficiency and sustainability), reduce traffic congestions, optimize system performance and enhance users' experience (Alam, Feirrera & Fonseca, 2016).
- *Vehicle technology:* technology is developing and the possibilities for vehicles are growing. For example, an increasing number of vehicles are now powered by electric batteries, hybrid systems and other alternative fuels. Other important focus points of vehicle technologies are autonomous vehicles, car safety, vehicle efficiency, and build in smart systems to support users (Jeekel, 2017).

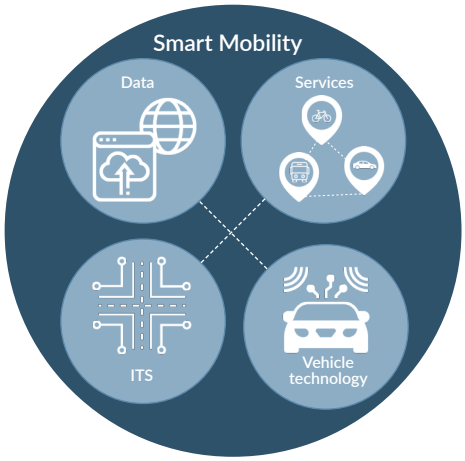


Figure 3: The scope of smart mobility (own illustration)

Now the components of smart mobility are clear, a more specific definition can be given about the concept of smart mobility. According to (Papa & Lauwers, 2015, p.6) smart mobility is mostly defined "as a way of thinking about how to connect people, places and goods across all transport modes. It is about the utilization of a combination of systems thinking, technology and data across the transport network to inform decision-making and enable behavioural change". However, the impact of these technologies and innovations, depending on how they are embedded by the users in their daily lives (Noy & Givon, 2018).

2.2.2 The governance of Smart Mobility

As described, in the previous chapter, smart mobility is about the use of technology, innovation, data, also known as ICT. However, what the impact of these mobility technologies and services will be, is depending on how the users will embed these in their daily lives. This shows that there are two different approaches to smart mobility. Papa & Lauwers (2015) distinguish these approaches in smart mobility, as the "techno-centric" approach and "consumer-centric" approach.

Techno-centric smart mobility

Techno-centric side of smart mobility is mainly focused on the "hard" side of the concept. Whereby the emphasis is on the idea, that ICT infrastructure is the main element to Smart Mobility. Specifically, it refers to the implementation of information technology in the field of road transport, which includes among others the physical infrastructure, vehicles, traffic and mobility management. With the expanded role of ICT in smart mobility, new actors have entered the mobility systems, These actors are small companies, but also large players as multinational firms in the ICT sector (Papa & Lauwers, 2015).

Consumer-centric smart mobility

So, techno-centric smart mobility focuses on the "hard" side. However, consumer-centric is the opposite. The consumer-centric side of smart mobility is focused on the soft side and is emphasizing on the human aspect of mobility. Hereby, it is putting the user of the services in a "consumer role" and sees it as the most important aspect of mobility. Whereby it offers an integrated service with all transport opportunities into one single system (Papa & Lauwers, 2015)

The changing role of mobility users into "consumers" and the increasing part of the ICT industry brings a new set of issues and challenges in a way that mobility systems will be organised, operated and governance by private and public parties. For the techno-centric model, this means that new actors are entering the mobility systems, which can be seen as businesses. These actors are mainly large multinational firms in the ICT sector, which are engaged in urban mobility initiatives (Papa & Lauwers, 2015). In addition, the systems have also seen an entrance from startups and corporations (Cohen & Kietzmann, 2014). Hereby, the risks occur that these new entrants can lose communication and contact with public parties and mobility planners. For the consumer-centric model, the risks occur that the personals goals of the consumers will be more important, than the collective goals for mobility planning (Papa & Lauwers, 2015).

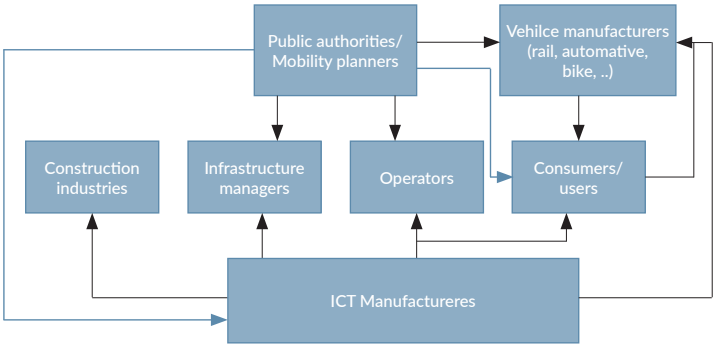


Figure 4: Actors in smart mobility systems. (Papa & Lauwers, 2015)

Figure 4 shows the main actors active in smart mobility system. To achieve common goals, links and connections between the various actors are important. Especially, connections between public authorities and the ICT companies and the connection between public authorities and users. With these connections, it will be assured that there will be some type of regulation (Papa & Lauwers, 2015). Docherty et al. (2018) also note the importance of governance of ICT manufacturers and service providers, while smart mobility can negatively affect transport problems if these providers remain unregulated. So, to achieve an effective functioning, integrated and shared smart mobility network for transportation, new type governance is needed. Public authorities are seen as the key player to realise this. Davis (2018) argues that shaping and governing the transition to smart mobility can not only be achieved by traditional reactive regulation. Public authorities should adopt long-term thinking within their governance and have overarching goals, which will preserve public value, sustainability and quality of life (Docherty et al., 2018).

2.3 MOBILITY SERVICES

Numerous new mobility services have emerged, which range from shared mobility, (car sharing and ride sharing), shared micro-mobility (bike-sharing and scooter services), to on-demand riding services and Mobility as a Service (MaaS). These new mobility services are developed to complement existing public transport and provide citizens with multimodal and on-demand mobility solutions (Firnkorn & Mueller, 2011). These services have changed and are still changing the way people travel in the city between urban centres. Although these mobility services have existed for already a long time, recent enhancements and innovations in the ICT have made new mobility services possible at a larger scale (Orsatto & Clegg, 1999). The following section will elaborate on the various shared mobility, shared micro-mobility services and MaaS. Thereafter, the users of shared (micro)-mobility services will be described. Finally, policies and strategies to address equity barriers will be explained.

2.3.1 Shared mobility

Carsharing

Car sharing has become more and more popular in recent year. Studies have shown that there are approximately 600 different car-sharing providers in the world (Cohen & Kietzmann, 2014). The business provided by mobility providers (Car2go, DriveNow, ZipCar, etc.) is often based on turn-key solutions. Whereby, the users pay for the time they use the car, for the distance they drive, or a combination of these two. The drivers do not have to pay for gasoline, insurance, maintenance, etc.

A distinction can be made in different types of car sharing business models, namely the Business-to-Consumer (B2C) and Peer-to-Peer (P2P) model. In the first case, B2C, a car-sharing provider acquires cars and supplies them within the limits of a city or at important transport nodes. This means, that users can use their smart mobile to find the nearest vehicle available on the map, use their membership to unlock the vehicle and drive the car for the time they need it. This model can also be further categorized into two other models. First, a roundtrip model, whereby the user has to bring the vehicle back, where they picked it up. Secondly, a point-two-point model, whereby the user can leave the vehicle near their destination (Cohen & Kietzmann, 2014). The second model, P2P, is based on the principle that private individuals rent their vehicles to users. To make this possible, different types of intermediation are needed, such as websites and mobile apps to connect the owners with potential drivers.

Car sharing not only provides its users with value but also contributes to changes in the local transportation sector. It reduces emissions and congestion and in addition, studies have shown that members of car-sharing eventually reduce their average vehicle ownership from 0.47 to 0.24 vehicles per household (Martin & Shaheen, 2011). Shaheen, Cohen & Zohdy (2016) state that the reduction of vehicle ownership also can be linked to an increase in the use of public transit, slow-traffic (walking and cycling), and reduction in parking demand.

Ride sharing

Ride sharing is not a new concept, while this type of transportation has been used since after World War II. However, in meanwhile technology has changed and new business models have been developed. As with carpooling, ridesharing can be also categorized in different types: carpooling, vanpooling and on-demand service. Firstly, carpooling means that a vehicle owner allows other passengers to ride in the same vehicle to the same destination. The same principle applies to the way back. Secondly, vanpooling involves a larger number of passengers sharing a van. Finally, on-demand riding services is based on application-based ride-sharing, such as Uber and Lyft. This type of ride-sharing is relying on the new Internet and mobile technologies, to match the geo-located demand and supply and enable real-time ridesharing (Cohen & Kietzmann, 2014).

When looking at the potential benefits of ride sharing. Empirical studies have shown that it can provide for infrastructure, environmental, and transportation benefits. Ride sharing can also have benefits for its participants. Among other fewer travel costs since these are shared, reduced commute stress, etc. (Shaheen, Cohen & Zohdy, 2016).

2.3.2 Shared micro-mobility

Micro-mobility can be seen as a new subfield of urban transportation research (McKenzie, 2020). In recent years, the concept of micro-mobility has gained more attention, due to new developments in technology, equipment, and batteries. With this type of mobility, users can use a vehicle for a short-term on an as-needed basis. To meet the diverse need of the users, shared micro-mobility includes various service models and transportation modes. Common shared micro-mobility modes are station-based bike-sharing, dockless bike-sharing, scooter sharing and other forms of low speeds modes, etc. (Shaheen & Cohen, 2019). The use of shared micro-mobility can have various positive social and environmental impacts, such as increased mobility, health benefits for its users, reduced emissions, reduction of car use and economic developments (Shaheen & Cohen, 2019).

Bike-sharing

There is a growing concern about diverse urban problems, such as climate change, emissions, congestion and the quality of life. This has led to the increase of sustainable transportation modes, such as bike-sharing. As a form of micro-mobility, bike-sharing has various potential environmental, social, health and transport benefits. Like car sharing, bike-sharing also involves providing hourly access to stationed, dockless and hybrid bikes programmes within the limits of a city. The following section will briefly introduce the history of bike-sharing systems, the types of bike-sharing systems, different business models and finally lessons learned from previous bike-sharing cases.

History of bike-sharing

The first generation of bike-sharing was invented in Europa, more specifically in Amsterdam. In 1965, the program called “The White Bike” (in Dutch: de Witte Fietsen) started to offer painted bikes to its community to share. They could use the bike to ride to any locations and could leave them at any other locations to be used by the next user. However, this program did not succeed, because of the numerous thefts and vandalism (Cohen & Kietzmann, 2014).

The second generation was developed in 1991 in Denmark. This program was slightly different than the one in the Netherlands since it had a docking station with locks and operated as a coin deposit system. Even with these changes, this program also encountered thefts because of poor user accountability (DeMaio, 2009).

The third generation was launched in 1996 at England’s Portsmouth University. With this program, users could rent bikes by using a magnetic stripe card. With this new system, the program could track who was renting and charge people who were misusing the bikes. So, comparing to the first two generations. The third generation started to utilize more advanced technologies, such as the mobile phones, magnetic stripe cards and GPS-trackers to facilitate their users more on their reservations, location and access to the bikes (Cohen & Kietzmann, 2014).

The fourth generation of bike-sharing started with the introduction of the dockless bike. With this model new opportunities for users have arisen, significantly changing their transport behaviour. With the addition of smart and innovative technologies to the system, such as GPS tracking and mobile payment via smartphone apps, these programs have become easier to manage and operate. In addition, these technologies have contributed to the accessibility of this service (Shi et al., 2018). Important and the largest operators of these systems are two Chinese bike-sharing companies, Mobike and Ofo, which have entered the European bike market (Bieliński & Ważna, 2019).

Bike-sharing systems

When looking at the history of bike-sharing and current bike-sharing systems, a distinction can be made in three common models. These are the following:

1. Station-based bike-sharing systems: with this system users have access to bicycles from unattended bike stations, who provide for a one-way-station based service. After using bikes, users can return their bike to any station (Shaheen & Cohen, 2019).

2. Dockless bike-sharing systems: which also known as a free-floating system: with this system a user can check out a bicycle with an app with a smartphone and finally return the bike to any location within a service area. These service areas are predefined geographic regions by a service provider (Shaheen & Cohen, 2019).

3. Hybrid bike-sharing systems: with this system a user can check out a bicycle from a station and return their bike to a station or any other non-station location. However, it is also possible that a user can check out a dockless bicycle and return it to a station or a non-station location within a service area (Shaheen & Cohen, 2019).

Bike-sharing business models

With the success of the third-generation and fourth-generation bike-sharing programmes, different bike-sharing business models have evolved. In addition, it has increased the number of bike-sharing providers. A distinction can be made in different types of bike-sharing business models, namely: street furniture bike-sharing, sponsorship based bike-sharing, non-profit bike-sharing, for-profit bike-sharing, Public transport agency bike-sharing and publicly owned bike-sharing.

Street furniture bike-sharing

With this bike-sharing model, an advertisement company provides bike-sharing services in return for the rights to advertise (Shaheen, Guzman, & Zhang, 2010). The first and largest third-generation bike-sharing program was launched in France - Lyon. The program of 1.500 bikes was developed by a global outdoor advertising company. They located their bikes and docking stations in the city like a piece of furniture. Hereby, the cities did not incur direct financial costs by this bike service. On the contrary, it helped the city to promote bike-sharing as a complement to the existing public transportation (Cohen & Kietzmann, 2014).

Sponsorship based bike-sharing

Instead of generating income by the advertisement of using the bikes and their stations, like with street furniture bike-sharing. Sponsors of the bike-sharing systems, which are mostly private parties, use it to promote their image and brand. In many of those cases, the bikes sharing system is owned by the public party and is managed by a private agency. However, it can also be the case that a private party owns the bike-sharing system and gains support and subsidy by the local party for implementing a local bike-sharing project (Cohen & Kietzmann, 2014).

Non-profit bike-sharing

The previous bike-sharing sharing model relied on advertising or sponsorship. However, with a non-profit bike-sharing, a provider is working under the support of public parties or councils. So, the providers mainly rely on subsidies they receive from the public authorities and fees of their users (Cohen & Kietzmann, 2014).

For-profit bike-sharing

With this bike-sharing model, a provider provides for profitable bike-sharing services. With this business model, there is minimal government involvement (Shaheen, Guzman, & Zhang, 2010).

Public transport agency bike-sharing
With this model, a public transport agency provides bike-sharing services, mostly under the lead of public authorities. Their goal is to support and enhance the public transport system with their bike-sharing (Shaheen, Guzman, & Zhang, 2010). An example in the Netherlands is the OV-fiets provided by Dutch Railways company (Dutch: Nederlandse Spoorwegen NS).

Publicly owned bike-sharing
Sometimes, cities decide to operate and fun bike-sharing themselves. Another variant of this model is that the public authority chooses to have publicly owned models, but operated by private agencies (Cohen & Kietzmann, 2014).

Lessons learned from bike-sharing
The evolution of bike-sharing technologies has led to a range of business models and options for the implementation of bike-sharing programs. This section will present examples of good practices of bike-sharing programmes. Firstly, these are selected on the availability of extensive information in the literature. Secondly, these are programmes with a significant percentage of citizens and are implemented in non-renewal areas of the city. Thirdly, these programmes should have improved third or fourth-generation bike-sharing. After the cases, an overview will be given of the lessons learned and of key conditions which should be considered during the implementation of bike-sharing programmes.

Vélib, Paris
When looking at the most famous smart bike-sharing system in the literature of bike-sharing, then systems of Vélib appears. This system has been launched in 2007 in Paris, France (city population 2.15 million) with 10.000 bicycles and 750 automated rental stations. After two years, these numbers have increased and even be doubled to 20.600 bikes and 1.451 stations (Midgley, 2009). The aim of this bike-sharing program was among others: improve air quality and public health, improve mobility, encourage economy, and improve the quality of life (Curran, 2008).
The system of Vélib is highly accessible since bike stations are placed every 300 meters within the city. Moreover, the city has 370 km of cycling lanes. The system of Vélib works as follow: First, the users need to subscribe to the system to use the bike. When using the bike, the first half-hour of usage is for free. After this first half-hour, the user is will be for 30-minute. The system aims to encourage turnover of bikes (Midgley, 2009). Like the bike-sharing program in Lyon, this program is also developed and operated by a global outdoor advertising company. From the turn-overs, the city of France receives a fee each year, In return, the company get exclusive rights to advertise on city-owned billboards (Anderson, 2007).

Good practice:
An improvement of Vélib to the current bike-sharing system is the way the bicycles are distributed within the city. The company uses specially designed vehicles for their bicycle relocation. The vehicles are using natural gas to transport the bikes back to demand locations (Shaheen, Guzman, & Zhang, 2010).

BIXI, Montreal
The first large-scale bike-sharing systems in North-America was with the introduction of BIXI in Montreal, Canada (Faghih-Imani, Eluru, El-Geneidy, Rabbat, & Haq, 2014). The system has been launched in 2009, with 3.000 bikes and 300 stations. Since, the bike-sharing system was a real success the BIXI organization expanded the service up to 5.050 bikes and 405 stations throughout central neighbourhoods of Montreal (Bachand-Marleau, Lee, & El-Geneidy, 2012). Because of its success in Montreal, the system is also been introduced in other large cities in Canada, Australia and the United States. The system of BIXI works as follows: there are three types of membership users can choose from. The 24-hour pass, a monthly or yearly membership. The BIXI service is designed for the use of short trips. Which is also reflected in the costs. Users can use the BIXI free for the first half-hour thereafter the system charges for the additional time (Bachand-Marleau, Lee, & El-Geneidy, 2012).

Good practice:
BIXI is a third-generation bike-sharing system, this means it uses stations for their bikes. An improvement of BIXI to the current bike-sharing system is their docking stations. BIXI uses cleaner technologies for their docking stations. This means that their stations are solar-powered, which is likely to be standard in future systems (Shaheen & Guzman, 2011). Thereafter, the docking stations are mobile, so they can be removed and placed at different locations. This allows service providers to relocate bicycle stations according to usage patterns and user demands (Shaheen, Guzman, & Zhang, 2010). Finally, BIXI is promoting sustainable bicycle redistribution. They do this by giving users price reductions of extra time to leave their bicycle at an empty station instead of a full docking station. Hereby, they can reduce the need for trucks redistribute bicycles (Shaheen & Guzman, 2011).

Yellow Bikes, La Rochelle
The bike-sharing programme called Yellow Bikes is initiated in La Rochelle, France. In 2005, this system had 120 bikes in use. In 2008, the system was converted to a smart bike system, with 300 bikes and 50 stations. In addition, the city has added 150 new bike lanes to promote the system (Midgley, 2009). The aim of this bike-sharing program was among others: creating a sustainable transport system, reducing pollution, emission and traffic congestion, etc. (Curran, 2008) The bike-sharing system of the yellow bike uses a smart card system. The user can use this card also for electric car-sharing, parking and public transit. The aim of this card is to enhance the integration with the public transport system (Midgley, 2009).

Good practice:
A good practice of the Yellow Bikes is the use of the smart card. With this smart card, the programme aims to a seamless integration of the bikes-sharing system with public transport and other transport modes, like carsharing and ridesharing. So, providing a more multi-modal transportation package for users could lead to de reduction of the use and ownership of a car. Since there are more alternative modes for users to support their daily trips (Shaheen, Guzman, & Zhang, 2010).

So, from the bike-sharing cases and literature about bike-sharing plannings and business models lessons learned can be addressed. These are the following:

- *Commitment from the city:* to promote bike-sharing, the city should have a strong commitment to sustainable mobility. Hereby, it is important that cities develop comprehensive bike-sharing strategies, which include safety campaigns, the integration with public transit and cycling policies. Thereafter, as shown in the cases, the city should support bike-sharing programmes with the addition of new bike lanes (Midgley, 2009).
- *Information Systems:* the third-generation of bike-sharing programmes started to utilize real-time information systems. Nowadays, the majority of the bike-sharing systems provide its users with real-lifetime information about their availability and location. When a new bike-sharing program is implemented, such technologies should be included to facilitate the users in a more efficient way (Shaheen & Guzman, 2011).
- *Redistribution:* cities should think about how they will deal with the redistribution of their bicycles. Since bicycles must be redistributed to the main demand locations frequently after they have been used. For instance, 'Vélib', in France manages the redistribution of their bicycles by using natural gas vehicles to transport the bikes back to demand locations (Shaheen & Guzman, 2011).
- *Theft and vandalism:* bicycles in the past occurred high rates of theft and vandalism. Therefore, despite the technological advances (e.g. GPS-tracker, membership), the third and fourth- generation of bike-sharing programmes still should think about how they will approach theft and vandalism. For instance, these programs can consider robust bicycles that require less maintenance and have a better lock system (Shaheen & Guzman, 2011).

Scooter sharing & E-Step sharing

Another form of micro-mobility is the use of scooter sharing. Scooter sharing allows users to use (electric) by joining service providers that provide scooters at service locations. The scooter-sharing services typically consist of motorized and non-motorized scooters. A distinction can be made in two types of services: Firstly, a moped-style scooter sharing which are scooters with a seated-design. This type can be electric or gas-powered. Secondly, a standing electric scooter, which is a scooter with a standing design with a handlebar (Shaheen & Cohen, 2019). This type is also known as a shared step, whereby the wheels are propelled by an electric motor. This type is not yet allowed in the Netherlands.

2.3.3 Mobility as a Service (MaaS)

Kamargianni, Li, Matyas and Schäfer (2016) defines the concept of Mobility as a Service as the following: a smart mobility distribution model in which all mobility services (e.g. bike- and car sharing, etc.) and other traditional transport modes (e.g. bus, tram, etc.) are combined by a single service provider and distrusted to their users by a digital platform. The concept of MaaS gives us insights on how mobility services can be organized in the future. However, it has to be noticed that while the individual services of MaaS are already available to users, their integration to a single platform is still in a pilot phase (Jittrapirom et al., 2017; Kamargianni et al., 2016).

2.3.4 Scope research

Shared mobility services can be distinguished in two types, namely regular shared mobility services (car sharing and ride sharing) and shared micro-mobility services (bike-sharing, scooter sharing and e-step sharing). These shared mobility services are seen as an opportunity for more sustainable transport (Yan & Howe, 2019). Sustainable transport can be seen as any type of transport which is fuel-efficient, space-saving and supports a healthy lifestyle for its users (Han, 2010; Richardson, 2005). Compared to the regular shared mobility services, shared micro-mobility services can have a bigger role in these three aspects of sustainable transport. Therefore, the following parts of this research will focus on shared micro-mobility services, more specific on bike-sharing and scooter sharing. However, since bike-sharing and scooter sharing are still a part of the broader concept “shared mobility” this general term will be used to refer to services.

2.4 Users of shared mobility

Shared mobility can bring various potential benefits for its users, among others: increased mobility options, improve the accessibility of public transport for the 'first' and 'last' mile gaps, create environmental awareness, increasing travel reliability, reduce the number of cars, reduce emission, etc (Shaheen & Cohen, 2019). Currently, shared mobility is becoming more and more mainstream. Yet, Shaheen & Cohen (2018) state that the demographics of its users often deviate from the general population. There is no clear profile of the type of user for mobility services (Machado, de Salles, Berssaneti, Quintanilha, 2018). However, previous studies have found that shared mobility users are generally young and digitally experienced adults within an age group of 21-45 years old with high education levels. Besides, the users are commonly middle to upper-income households without children. These users commonly live in urban areas of the city, where there is often limited vehicle and car access (e.g. zero to one car households) and therefore use more different types of transport modes, such as public transit, cycling etc. Shaheen & Cohen, 2019). It is also likely that the users are less diverse than the general population (Shaheen & Cohen, 2018).

Looking at other groups in the general population, such as older adults, low-income households, rural communities, and minority communities, etc. Many authors in the literature state that these minorities and low-income communities are more likely to face transportation challenges in their daily lives. This is due to a combination of important factors. Because of their lower incomes, they can not afford a private car. This makes them more dependent on public transportation. In addition, in many cities, jobs and housing spatial do not match, leading to a higher rate of employment (Golub et al., 2019). Studies have shown that shared mobility systems can bring several opportunities and benefits, such as the improvement of equity and access to transport and vehicles (Golub et al., 2019). However, shared mobility often does not reach these groups and therefore the usage remains lower than the general population (Kodransky & Lewenstein, 2014; Shaheen & Cohen, 2018). Hereby, policymakers have to consider to implement policies that discourage current shared mobility services that facilitate users who already have access to transportation and pass underserved and low-income communities. This means that policymakers should ensure that barriers to access shared mobility must be reduced or eliminated (Fleming, 2018).

2.5 Policies and strategies to address equity barriers

The following section will explain the potential equity concerns and barriers that shared mobility can raise. Thereafter, potential policies and strategies that policymakers/public parties and service providers can use to address these barriers will be elaborated on.

Alongside, the previously mentioned benefits of shared mobility services, there are also many challenges and barriers for user's to access and use these services. Hereby, public parties and service providers must work together to address these challenges and barriers to realize benefits from shared mobility services (Di Bartolo, Bosetti, de Stasio & Malgieri, 2016). In general, these equity concerns can be categorized into five common areas, namely Social, Economic, Digital approach, Spatial & Geographic and Culture & Education.

Social

Various challenges can arise while delivering shared mobility services to older adults and people with limited mobility opportunities (disabled). Barriers can occur if there is no accessible shared mobility service or equivalent accessible alternatives for people with limited mobility. According to Shaheen et al., 2017 age can create barriers and affect transportation equity. This due to technological illiteracy, language barriers, ownership of mobile phone and potential other access barriers. In addition, other barriers occur if there is no accessible services or alternative services for people with limited mobility. Snellen and Hollander (2016) also mention that the accessibility to new mobility services is determined by the degree to which people have the technological skills and psychological flexibility to coupe with all changes in the transport sector.

Policy and strategy opportunities

Policymakers must ensure that an equivalent level of shared mobility services is provided for older adults and users with special needs. This can be people with low-incomes, disabilities, minorities, etc. This means that the level of service should be equal to the level of service to non-special users (Shaheen & Cohen, 2019).

Economic

Accessibility for every social group can become an issue if the mobility systems increasingly rely on private platforms and agencies. To make sure that inhabits of all groups are socially integrated, affordable and accessible transportations systems need to be provided (Snellen and Hollander, 2016). Shared mobility services mainly work on a pay-as-you-go pricing method, whereby users pay per minute for service. The costs for these services can be a barrier for accessing these services. Since these costs can be more expensive, than the use of public transport and other slow traffic modes, such as walking and private cycling (Shaheen & Cohen, 2019). Besides, these services charge also other recurring and one-time costs, such as application costs and membership fees (Kodransky & Lewenstein, 2014).

Another barrier to using certain mobility services can be the "banking divide" of particular groups. Since shared mobility services are mainly working with banking and credit systems. This means that persons who do not have access to one of these cards, can not sign for these services. An example of this situation is illustrated by McNeil et al. (2017). They noticed that people low income and people of colour are facing several barriers by using bike-sharing services. Since these services do not accept different payment methods than a bank- and credit cards and they also rely on private data of the user.

Policy and strategy opportunities

In comparison to car ownership, shared mobility services may be more affordable. However, there can still be a financial burden for low-income groups to use these services. To decrease these burdens, service providers could choose to reduce their fees and taxes or lower the users costs for low-income users that can not afford market prices (Kodransky & Lewenstein, 2014; Shaheen et al., 2017). For instance, this can be executed in the form of discounts or subsidies by public parties. When implementing such a discount or subsidy programme, it is important to think about which groups will be eligible and how the process will work. Kodransky & Lewenstein (2014) notes that a frequent option is that people that gain social assistance or live in social housing can be eligibly for discounts and subsidies since this information can be verified.

A second barrier to use shared mobility services is the banking divide. To address this barrier, service providers could choose to provide for alternative payment options. This can be in the form of pre-paid cars of public transit cards (Kodransky & Lewenstein, 2014).

Digital approach

Shared mobility providers mostly require that users have a smartphone and access to internet data, to make use of their services. These requirements can potentially hinder the use of services for minority, low-income, young and older persons. Since these groups can have limited smartphone ownership or are not able to afford data coverage access the services (Shaheen & Cohen, 2019). So, whereas shared mobility services require specific things of users, public transit modes do not.

Policies and strategy opportunities

To address the digital divide barrier, many public sector experts argue the potential role of neighbourhood mobility hubs. These hubs are mostly smaller mobility hubs, which provide for a few services like bike-sharing, scooter sharing, way findings etc (Los Angeles Department of City Planning, 2016). If these mobility hubs are placed strategically, that could allow persons without a smartphone or access to the internet to use a variety of shared mobility services (Shaheen et al., 2017).

Spatial & Geographic

Shaheen et al. (2017) emphasize on spatial dimensions and time-of-day availability as potential barriers. Kodransky & Lewenstein (2014) states that the main barrier to the low-income usage of shared mobility is the absence of stations in disadvantaged and low-income neighbourhoods. Moreover, there must be easy, safe and near access to shared mobility systems, since this will determine the actual use of shared mobility systems. However, according to Bergman (2013), these systems are rarely located within walking or at an acceptable distance from the places where minority and low-income households live. So, if not all neighbourhood is accessible and served by shared mobility services, this can hinder the physical accessibility. Eventually, this can lead to transportation inequity (Snellen & Hollander, 2016).

To determine their operation and service areas, service providers mainly look at two aspects, namely to the potential profits and risks. For service providers it important that their business case is financially viable. Many business cases rely on gained profits from user fees. So, any form of low demand and usage can affect the business negatively. To avoid this, many shared mobility providers start their services in areas that support the highest usages. These are mainly mixed high-density areas. When service providers expand their service areas to more low-income and minority neighbourhoods, they can perceive the risk of reduced financial viability (Kodransky & Lewenstein, 2014). Another factor, that service providers may encounter is a higher level of risk in low-income and disadvantaged neighbourhoods. This is the form of vandalism or theft to their systems. There is no specific evidence that shows that there will be an increased level of risk. However, the perception of the higher level of risk can limit the expansion of the service area to these specific neighbourhoods (Kodransky & Lewenstein, 2014). So based on these two factors, providers mainly want to operate in neighbourhoods that have the potential for a successful implementation of shared mobility services. Since minority and low-income households mostly do not live in this neighbourhood, service providers may often leave out these groups (Kodransky & Lewenstein, 2014).

Policy and strategy opportunities

Addressing the lack of services in low-income and disadvantaged neighbourhoods can be by setting a policy that requires service providers to also locate their services in these underserved areas. This policy can be sufficient, if service providers have enough market potential and profits in the more dense areas, to cross-subsidy the less profitable services in the other areas (Shaheen et al., 2017).

Another approach to address the risk of reduced financial viability for service providers is to provide for governmental subsidies. These subsidies can help and give incentives to provide for more affordable services into areas where the demand and profits may be lower (Kodransky & Lewenstein, 2014; Shaheen et al., 2017; Arnd, Drews, Hertel, Langer & Wiedenhöft, 2019).

Culture & Education

Other barriers that can influence the use and receptiveness of certain mobility services are cultural factors and values. More specifically, the lack of trust about financial, privacy and security, discomfort with shared mobility services or preference to other culturally congruent vehicles, can influence the usage of shared mobility systems among minority and low-income groups (Kodransky & Lewenstein, 2014). Moreover, it is still unclear to what extent ownership of a vehicle is a status symbol, across these groups. Since, this status may outweigh the benefits of shared mobility systems (Kodransky & Lewenstein, 2014).

Moreover, factors that can contribute to the low usages of shared mobility services among minority and low-income groups is the absence of proper information and education about shared mobility services. If these groups do not how to use certain shared mobility systems or do not understand their potential benefits, they are less likely to take advantage of these services (Kodransky & Lewenstein, 2014).

Policy and strategy opportunities

To address cultural barriers it is important to navigate around the lack of trust and understand this. Secondly, these groups should be made more comfortable with using these shared mobility services. Not all services will suit a specific group or work in every neighbourhood. So, service providers and public parties should reach a group or neighbourhood in a more tailored way (Kodransky & Lewenstein, 2014).

Specific community outreach programmes can help to reduce the barriers of absent information and education. These programmes should focus on the reason why certain groups do not want to take part in shared mobility services. In that way, the programmes may help to expand the access and use of these services. In addition, partnering with local community organizations can help to guide and implement these programmes (Shared-Use Mobility Center, 2019; Shaheen & Cohen, 2019). Examples of community outreach programmes are among others: education and training programmes for cycling, demonstrations on the use of services, etc.

03

METHODOLOGY

03 METHODOLOGY

The following chapter aims to present and underpin the used research method to answer the proposed research question. Firstly, this chapter discusses the complete methodological structure of this research and the methods and techniques to be used. Thereafter, an elaboration will be given on the data and data collection. Finally, this chapter will end with a reflection on the ethical considerations.

3.1 TYPE OF STUDY

According to Bryman (2012, p. 35), a research strategy is something of "a broad orientation to social research". Hereby, the researcher can choose to either conduct qualitative or quantitive research. To answer the proposed research question: "In what way can public parties use smart mobility services to stimulate urban neighbourhood renewal in Rotterdam-South?" it was decided that a qualitative approach would be appropriate. The qualitative method is done by conducting literature reviews and empirical research, which are in the end combined in the synthesis.

3.2 RESEARCH DESIGN

The answer to the main research questions, the research can be divided into three parts: (1) Literature review, (2) Empirical research and (3) Synthesis. Figure 5 shows the research design for this research.

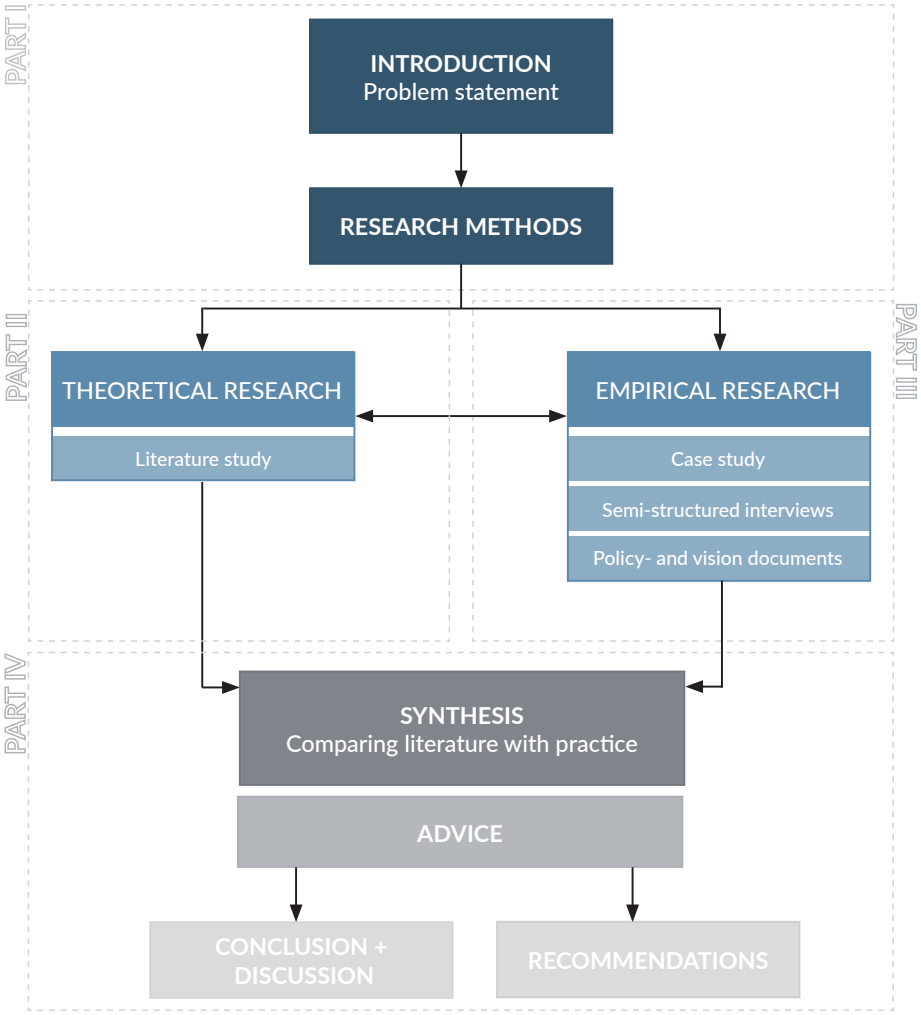


Figure 5: Research design (own illustration)

3.3 RESEARCH METHODS

The methodology is divided into three parts, namely the literature review, the empirical research and the synthesis.

3.3.1 Phase 1: Theoretical research

Literature study

The first part of this research consists of a literature study. This study aims to get a better overview and understanding of the concepts, knowledge and theories that have already been used in related research topics (Bryman, 2015). The three main research topics studied are urban renewal, smart mobility and shared mobility services. These research topics are linked to sub-questions. Based on the information gathered from the literature study, the first sub-questions can be answered. This will create a theoretical framework, whereby this information will serve as the base for the empirical part of this research (Groat & Wang, 2013). Next to the theoretical framework, the literature study helps to explore a possible research gap (Bryman, 2015).

3.3.2 Phase 2: Empirical research

The second part of this research is based on the gathered knowledge from the literature study. This consists of empirical research at which an exploratory case study is conducted. This research opts to solve real-life problems. Therefore, it is important to add a case study as a part of the research process.

Case study

A case study can be seen as an empirical research method, that examines a phenomenon within its real-life context (Yin, 2009). This method is chosen since this research aims to understand a phenomenon by learning something about the case itself or by using it to gain a general understanding (Stake, 1995; Yin, 2009). In this context, the phenomenon that is being investigated is the effect of shared mobility services on urban renewal in disadvantaged neighbourhoods. So, for this thesis, a single case study is used which will take place in a neighbourhood in Rotterdam-South. Since studies have shown that this area is struggling with large concentration socio-economic problems and is the least mobile part of Rotterdam. The case study will consist of semi-structured interviews and desk-research on policy documents and the case studies' database. So, to collect data different methods are used (triangulation). This will minimize biases and assures the validity of the research (Bryman, 2015).

Case study: Rotterdam-South

Studies have shown that in the City of Rotterdam, one of the four biggest cities in the Netherlands, that transportation disadvantages and transportation poverty seriously hinder the development opportunities of its citizens. Especially, due to an accumulation of factors, Rotterdam-South, in particular, has a serious problem (Van den Ende, 2018). Rotterdam-South has almost 240.165 (annual level: 2017) inhabitants and the area is struggling with a large concentration of socio-economic problems. In the past, the cheap housing stock has attracted many low-skilled workers to work in the city ports. However, due to the automation and competition from low-wage countries jobs have slowly disappeared (Bastiaanssen, Martens, & Polhuijs, 2013). This has resulted in a high rate of unemployment and due to the limited number of jobs in Rotterdam-South (only one-fifth of all jobs in Rotterdam), low-skilled job seekers, in particular, will have to look for work outside South-Rotterdam (Van den Ende, 2018).

Semi-structured interviews

A more in-depth view will be obtained through semi-structured interviews. This will allow the interview to ask predefined questions, while considering an elaboration during the conversation (May 2003). The interviews will be carried out with the municipality of Rotterdam, particular service provides and various advisors. The goal of the interviews is to get a better understanding of the roles and the collaboration of the municipality and service providers within the implementation of shared mobility in the city and besides understand what the effect can be of these services on urban renewal.

Table 1. List for semi-structured interviews

Name	Profession	Company
	City Manager Rotterdam	Service provider Scooter sharing
	Government Affairs & PR Manager	Service provider Bike-sharing
	Region Manager	Service provider Scooter sharing
	Strategist Mobility and Environment	Province of South-Holland
	Advisor Mobility, specialised in transport poverty	Municipality of Rotterdam / De Verkeersonderneming
	Advisor and coordinator Smart Mobility	Municipality of Rotterdam
	Senior advisor Mobility	Municipality of Rotterdam
	Advisor Living environment, Data, and Mobility	Overmorgen
	Advisor Sustainable Mobility	Overmorgen

Policy and vision documents

The policy and vision documents written by the municipality of Rotterdam will be used as additional information. Mainly focusing on their policies and visions for transport, smart mobility and urban renewal.

3.3.3. Synthesis

The final part of this research will focus on the conclusions, which will consist of a synthesis between findings in the literature and the empirical findings from the case study. With this information, the sub-question "Which potential solutions show the most promise in overcoming barriers in disadvantaged neighbourhoods in Rotterdam-South?" can be answered. Finally, this will result in advice for the city of Rotterdam.

3.4 DATA COLLECTION

Table 2 shows the research methods and how the data will be collected to answer each sub-question.

Table 2. Data collection (own illustration)

Part	Type	Sub questions	Research method	Data collection
1	Literature review	• What is urban renewal? • Which smart mobility services and business models are available? • Who are the users of shared mobility services? • What are potential barriers for using smart mobility services in disadvantaged neighbourhoods?	Literature study	TU Delft Repository, Google Scholar, Scopus, Internet, Library
2	Empirical research	• What is the main motivation of the municipality of Rotterdam when selecting a specific neighbourhood for implementing a shared mobility pilot project? • Which shared mobility services are used in Rotterdam? • In which areas of Rotterdam are these services distributed? • Why are service providers providing services in Rotterdam-South or why are they not? • What policy does the municipality of Rotterdam have for the implementation of shared mobility services?	Case study Rotterdam-South	In-depth interviews with advisors, the municipality of Rotterdam and service providers. Policy and vision documents
3	Synthesis	• Which potential solutions show the most promise in overcoming barriers in disadvantaged neighbourhoods in Rotterdam-South?	Comparison of literature study and case study	Input from phase 1 + 2

3.5 DATA PLAN

Wilkinson et al. (2016) have described four FAIR guiding principles that aim to support research by the value gained through digital publishing. According to these guiding principles, data should be Findable, Accessible, Interoperable, and Reusable (Wilkinson et al., 2016). To make this thesis findable, clear and explicit keywords will be used, which define the written subject accurately. Accessible means that the data is open, free and retrievable. More specific, for this research that means that it will be published and stored on access websites, like the TU Delft Repository. Therefore, the used and generated data by this thesis will be accessible at any time. Finally, to make the data interoperable and reusable, the main language of the thesis is formal English and written according to the APA 6th style guidelines.

3.6 ETHICAL CONSIDERATIONS

While conducting qualitative research, the interaction between the researcher and participants can lead to various an ethical challenges (Sanjari, Bahramnezhad, Fomani, Shoghi & Cheraghi, 2014) Besides, a researcher should ensure the interests of those participating in the research at any time. Therefore, it is important to take into account specific ethical guidelines. For this thesis, the following ethical guidelines are respected:

- *Informed and voluntary consents:* in advance, participants should be made aware of the aim of the research and how the data and findings from the research will be used and stored. To ensure this, a consent form is provided for the participants explaining the purpose of the research. Hereby, the participants can make an informed decision if they want to participate in the research. In addition, it will be made clear that this voluntary participation. Thus, participants are free to withdraw from their participation in the research at any time.
- *Privacy and confidentiality:* private and confidential details of the participants should be respected. Therefore, personal information about the participants will not be used and the answers given will be processed privately and anonymously. However, to ensure confidentiality in some cases, participants will be asked if their function and the organisation they work for can be published.
- *Data storage:* raw research data, consent forms and transcriptions will be stored for one year after the graduation. After this year, all data will be deleted in a safe and confidentially way.
- *Data integration and writing:* when writing the findings and results, misinterpretations by the researcher should be avoided. Therefore, the interviews will be recorded and transcripts will be sent to the participants for confirmation.

04

CASE STUDY

04 CASE STUDY

This chapter contains the empirical part of this research, which is a case study in Rotterdam, more specific a neighbourhood Rotterdam-South. This chapter will start with an elaboration on the two concepts of "shared mobility" and "urban renewal" in Rotterdam and Rotterdam-South. Thereafter, this chapter will focus on the research area of Tarwewijk. Whereby, first the motives for the selection of the research area is provided. Secondly, a brief introduction and history are given of the research area. Thereafter, the current condition of the area is elaborated on from different dimensions. Finally, new area developments in Rotterdam-South are presented.

4.1 (SHARED) MOBILITY IN ROTTERDAM

4.1.1 Mobility vision

The city of Rotterdam is like other cities growing, the economy is changing and with climate changes, the city is required to make different choices. The city of Rotterdam has the vision to make Rotterdam a healthier, inclusive and accessible city (Gemeente Rotterdam, 2020). Hereby, transport and mobility plays an integrated role and should offer opportunities for all its inhabitants to live, work, learn, recreate and play. Moreover, the city of Rotterdam should be a place where everyone can participate in daily social life and whereby eventually the transport poverty of the city can be improved (Gemeente Rotterdam, 2020).

To ensure that this vision is the guiding line for the things build, developed and implemented in the city, the municipality has set up an approach called The Rotterdam Mobility Approach (RMA). With this approach, the municipality wants to improve the accessibility of the growing city. Moreover, this approach combines and gives substance to the various mobility visions and policies for the city of Rotterdam. The RMA approach emphasizes four key principles for the future of the city, which are the following (Gemeente Rotterdam, 2020):

1. *More space for pedestrians, cyclist and public transport:*

With this principle, the municipality wants to improve and increase the residential areas in the city. Hereby, the residential areas should offer more and better quality space for pedestrians and bicycles. Car traffic that does not have to be in these areas, should be distributed to the main routes. So, this principle should eventually lead to better road safety in the neighbourhoods, air quality, quality of life and more space for living and residential environments.

2. *Safe and healthy connections:*

With this principle, the municipality wants to change the way the infrastructure in the city is classified. Where it was previously classified by the vehicle type (e.g. a car road or bicycle line). The municipality wants to gradually shift to a distribution of the roads based on speed. So, this type of distribution of traffic should save space by sharing the same infrastructure by multiple mobility modes.

3. *All inhabitants should participate by enriching the mobility choices:*

With this principle, the municipality wants to stimulate the use of the bicycle, public transport and walking and other forms of clean and healthy transport. This, by designing the city in a way that there are more space and accessibility for these mobility choices.

4. *Vital economic traffic, more efficient and clean logistics:*

With this principle, the municipality wants to achieve a Zero Emission Urban Distribution in the city.

4.1.2 Shared mobility vision

To realise the RMA vision of the municipality, a new approach in the various forms of transport is needed. According to the municipality (Gemeente Rotterdam, 2019), all forms of shared mobility transport can contribute to this vision of the municipality of Rotterdam and mobility transition in the city. Since shared mobility strengthens the current mobility system and contributes to public transit in the city. Besides, shared mobility can be a replacement for the use of the car for shorter trips. In addition, shared mobility can contribute to more efficient use of existing bicycle parking facilities, since they are used more frequently by users. So, they drive more often than they are standing still (Gemeente Rotterdam, 2019). Finally, the use of shared mobility could help to reduce transportation poverty in the city. Since with the use of shared mobility different facilities (such as shops, healthcare, education) and work employment are more accessible for inhabitants. Therefore, shared mobility can have social value for the city of Rotterdam and can make its inhabitants more mobile (Gemeente Rotterdam, 2019).

4.1.3 Permit system for shared mobility

From 1 January 2020 onwards, service providers that offer shared mobility vehicles require a permit for their services. Before the permit system, the service providers and municipality of Rotterdam worked according to a so-called gentlemen's agreement (Service provider, personal communication, 23 April 2020). Whereby, the service providers made agreements with the municipality about their services and service areas in a verbal or written form. According to a service provider (Service provider, personal communication, 14 April 2020)., they want to have these written agreements if there is no permit system within a city. This because they want to have good cooperation with the municipality from the start of their service. In this form of corporation between the two parties, the municipality had little to no influence on the service providers.

With the new approach of a permit system, the municipality of Rotterdam aims to improve the quality of shared vehicles, ensuring that users do not experience any inconvenience (Gemeente Rotterdam, 2019). Since the permit systems oblige the service providers to identify and manage the risks of their vehicles and services. In advance, a service provider must think about the quality of their vehicles, the parking places, the place on the road, the way of driving, the number of vehicles in relation to public space, etc (Gemeente Rotterdam, 2019). The municipality will assess this prior to and during the operation period. If these obligations do not go well, the municipality has the influence to stir on the services (Advisor mobility, personal communication, 27 March 2020). This particular permit applies to shared (electric) bicycles, electric scooters, electric steps, cargo bikes and other forms. Forms of shared mobility that use parking permits, such as shared cars and microcars, are not regulated by this permit.

The municipality of Rotterdam wants to ensure that the supply of shared vehicles grows with the demand to minimize the negative impact of the shared vehicles on the public spaces in the city. Therefore, the municipality has decided to set a maximum for the number of shared vehicles in the city. When this maximum number of vehicles is reached, the municipality will stop issue more permits (Gemeente Rotterdam, 2019). Each year the current maximum number will be reviewed again, so it is up-to-date with the current demand in the city. If necessary, this number can be adjusted.

For 2020, the municipality of Rotterdam has set a maximum number of 6.500 shared vehicles for the city. These are 3.000 (electric) bicycles, 2.000 electric scooters, 1.000 electric steps and 500 car bikes and other forms of shared mobility (Gemeente Rotterdam, 2019). The use of the electric step is a relatively new development in the shared micro-mobility world. This new type of vehicle is already in use in 17 other European countries (Het Parool, 2019). However, the electric step is not yet allowed in Rotterdam and the Netherlands by the RDW: Dutch/Netherlands vehicle authority. So, no permits have been issued yet to service providers. However, by adding 1.000 electric steps and 500 other forms of shared micro-mobility to their permit system, the municipality of Rotterdam wants to respond to the possible future developments (Gemeente Rotterdam, 2019).

The municipality of Rotterdam sees the permits for shared vehicles as a scarce permit, since there is a maximum number of permits that are issued. So, to ensure a fair playfield for all service providers, these permits are not issued for an undetermined time. Instead, the municipality has decided to issue the permits for 5 years. This period is based on the time that service providers need to earn their initial investment back. After these 5 years, a service provider needs to request for a new permit. For new service providers, this regulation is different (Gemeente Rotterdam, 2019). In the past, different excesses have occurred with various service providers in the city. To prevent this in the future, the municipality wants to have more influence on the regulations and processes, to guarantee the continuity and manageability of the systems. Therefore, new service providers must first prove their capability in the city of Rotterdam, before placing a larger number of vehicles in public spaces. More specifically, this means that new service providers can only place a maximum of 500 vehicles in the city in their first year (Gemeente Rotterdam, 2019).

4.1.4 Shared mobility services

There are different service providers active in Rotterdam. Currently, the municipality of Rotterdam has granted permits to six service providers that operate in the city. This section will focus on these six service providers who provide bike-sharing and scooter-sharing in Rotterdam and elaborate on their sharing services and service areas. The following service providers operate actively in Rotterdam: Mobike, Donkey Republic, Jump, Felyx, GO Sharing and Check. Table 3 and 4 show more detailed information about the service that is provided by the service providers active in Rotterdam-South.

Mobike

Mobike is the world's and largest first dockless and cashless bike sharing service, founded in 2015 in Beijing, China. Mobike uses a combination of a smart lock system with GPS and a smartphone, this system is also known as the fourth bike-sharing generation. Mobike operates in more than 19 countries, 180 cities with 8 million bikes. Mobike has more than 200 million registered users since it is been launched (Wired, 2017). In November of 2017 Mobike officially launched in Rotterdam.

Donkey Republic

The company of Donkey Republic was founded in 2015 in Denmark. The system is a dockless (not free-floating) bike-sharing system based on a hub-centric model, for the needs of European cities (Donkey Republic, 2020). Donkey Republic is operating 19 different countries with 16.000 bicycles. More than 30.000 people have used a Donkey Bike since its launch (Donkey Republic, 2020).

JUMP

The company of JUMP is a free-floating electric bike-sharing system, founded in 2018 by the American ride-hailing company Uber (Wikipedia, 2020). Users can locate their bikes using the JUMP or their Uber apps. JUMP is operating 10 different countries, 30 cities with 4.000 bicycles. In October of 2019 JUMP officially launched in October of 2019 Rotterdam with 500 electric bikes (Emerce, 2019).

Felyx

Felyx is an innovative scale-up who offers shared electric scooters. Felyx is founded in 2017 in the Netherlands (Felyx, 2020). As with the fourth bike-sharing systems, Felyx also works on an app-only base. This means that a user has to download an app, they can find a scooter by the GPS tracker and then make use of the scooters. Felyx is providing two types of scooters, namely scooters that go up to 25 kilometres per hour and scooters that go up 45 kilometres per hour. Felyx is operating in two different countries and four cities, namely Amsterdam, Rotterdam, The Hague and Brussels (Felyx, 2020).

GO Sharing

GO Sharing is a start-up who offers shared electric scooters. GO Sharing is founded in 2019 in the Netherlands. The company started operating in Eindhoven but is now also operating in the city of Rotterdam. The scooters of GO Sharing go up to 25 kilometres per hour and can be booked via the app (GO Sharing, 2020).

Check

Check is a relatively new market player in scooter-sharing. Since it is only been operating in scooter sharing since February 2020. Currently, Check is only active in Rotterdam with 200 shared scooters (Emerce, 2020) However, up to 400 scooters will be added in the city in phases in the coming months. The scooters of Check go up to 30 kilometres per hour and can be booked via the app.

Table 3: Detailed information bike-sharing service providers (own table based on service providers)

Company	Price	Number of vehicles	Terms for users	Drive outside service area
Bike-sharing				
Mobike Regular bikes	Use costs: €1,50,- per 20 min Use costs: €0,08,-per/min Mobike membership: €12 for 30 days Whereby, all rides shorter than 40 minutes is for free	500	To register a debit card (IDEAL) + credit card that is valid in the Netherlands is accepted. Pay deposit before use	With a Mobike you have to stay within the service zone. It is possible to park your bike at any legal parking spot.
Donkey Republic Regular + Electric bikes	Use costs from: €2,80,-per 15 min Use costs: €0,19,-per/min Donkey Republic membership: €14 for 30 days. Whereby, all rides shorter than an hour is for free.	Unknown	To register a debit card (IDEAL) + credit card that is valid in the Netherlands is accepted.	With a Donkey Republic bike, it is possible to drive outside the service are. However, before your rental period is over, a user needs to return the vehicle to one of the Donkey Republic drop-off location. These are shown as black pins within the map view of the app.
JUMP Electric bikes	Reservation costs: €1,00,- Use costs: €0,20,-per/minute	400	To register a debit card (IDEAL) + credit card that is valid in the Netherlands is accepted. Deductible in case of theft	With a Jump bike, it is possible to drive outside the service are. However, parking your bike has to be at a legal parking spot and within the service area.

Table 4: Detailed information scooter sharing service providers (own table based on service providers)

Company	Price	Number of vehicles	Terms for users	Drive outside service area
Scooter -sharing				
Felyx	Registration costs: €8,00,- Use costs: €0,30,-per/minute Parking costs: €0,10,- per/minute	800	• To register a Dutch bank account is needed. • Minimum age of 18 years • In need of a driving license B (car), driving license A (motorcycle) or driving license AM (moped) • Deductible in case of damage or theft as a result of negligence €500,-	With a Felyx scooter, it is possible to drive outside the service area. However, a user can only check-out within the service area the user started the ride.
GO Sharing	Registration costs: €0,00,- Use costs: from €0,23,- to €0,29,- per/minute Parking costs: €0,05,-per/minute	450	• To register a debit card or credit card that is valid in the Netherlands is accepted. • Minimum age of 16 years • In need of a driving license B (car), driving license A (motorcycle) or driving license AM (moped) • Deductible in case of damage or theft as a result of negligence €500,-	With a GO Sharing scooter, it is possible to drive outside the service area and park it. However, a user can only check-out within the service area.
Check	Registration costs: €0,00,- Use costs: €0,25,- per/minute + start rate €1,00,- Parking costs: €0,10,-per/minute	200	• To register a debit card (IDEAL) + credit card that is valid in the Netherlands is accepted. • In need of a driving license B (car), driving license A (motorcycle) or driving license AM (moped) • Minimum age of 18 years • Deductible in case of damage or theft as a result of negligence €500,-	With a Check scooter, it is possible to drive outside the service area. However, a user can only check-out within the service area.

One of the service providers for scooter sharing, Felyx, has started with a new to pricing method for their scooters, namely dynamic pricing. With this type of pricing, the service providers want to stabilize demand and supply for their scooters. A scooter can only be used by one person at a time. So, therefore scooters should not be placed in a place with little demand for a long time. To prevent this, scooters are made cheaper in places with low demand. The idea is that users then choose a Felyx scooter faster The consequence of the cheaper ride is that the scooter will be placed in a busier place within the city (Felyx, 2020).

4.2 URBAN RENEWAL IN ROTTERDAM-SOUTH

This research focuses on a neighbourhood in Rotterdam-South. Rotterdam-South is including the part of Rotterdam, which is located at the south of the Nieuwe Maas. The area consists of three areas, namely Charlois, Feyenoord and IJsselmonde. Rotterdam-South has a versatile concentration of socio-economic problems. In the past, the cheap housing stock has attracted many low-skilled workers to work in the city ports. However, due to the automation and competition from low-wage countries jobs have slowly disappeared (Bastiaanssen, Martens, & Polhuijs, 2013). This has resulted in a high rate of unemployment and due to the limited number of jobs in Rotterdam-South (only one-fifth of all jobs in Rotterdam), low-skilled job seekers, in particular, will have to look for work outside South-Rotterdam (Van den Ende, 2018). Since this decline, Rotterdam-South is part various urban renewal programs of the government, such as the Vogelaars approach in old Rotterdam-South (Dutch: de Vogelaarsaanpak), the Pact on South (Dutch: Pact op Zuid), and from 2012 onwards the National Program Rotterdam-South (Nationaal Programma Rotterdam-Zuid) (Uyterlinde van der Velden & Bouwman, 2020).

4.2.1 Governmental plans

Vogelaars approach (2007- 2011)

The Vogelaar approach was initiated in 2007 by the former PvdA Minister for Housing, Communities and Integration. The Vogelaars approach consisted of a list of 40 most disadvantaged and deprived neighbourhoods in the Netherlands. Hereby, the government invested more in these neighbourhoods, to overcome their social, physical and economic problems. However, already after four years, this neighbourhood approach ended. Since there were no investments left for the neighbourhoods. Moreover, the effect of this approach turned out to have little effect on deprived neighbourhoods (Trouw, 2014).

Pact on South (2006-2011)

In 2006, the Municipality of Rotterdam, four sub municipalities and four housing associations announced that they would invest an additional 1 billion euro in the qualities of Rotterdam-South. This over ten years (Meeuwisse, 2015). The plans were combined into the 'Pact on South'. The aim of this pact was mainly to counteract selective migration in the areas of South and increase the neighbourhood satisfaction under the residents. Besides, five main pillars were important which had to contribute to the quality of Rotterdam-South. These were economics, physical, social, safety, arts and culture (Meeuwisse, 2015). Despite this pact and approaches, Rotterdam-South still suffered from socio-economical problems. Therefore, At the end of 2010, the then Minister for Housing, Communities and Integration, Eberhard Van der Laan, concluded that the Pact on South should be executed on a national level. Therefore, The Pact on South continued in 2012 under the name National Program Rotterdam South (Notten, 2012).

National Program Rotterdam-South (2012 -present)

The National Program Rotterdam South (NPRZ) is an area-oriented investment program for seven neighbourhoods for 20 years. Tarwewijk is one of them. The NPRZ is an initiative from the government, the municipality of Rotterdam, housing corporations, healthcare institutions, schools, businesses, the police and Public Prosecution Service (Dutch: OM) to work together on a better future for Rotterdam-South. The program aims is to improve the three pillars of "education, work and living" for the inhabitants in Rotterdam-South. In addition, the program also focuses on other focus areas such as care, safety, culture, sport and subversion. So, they can get a stronger position in society (Programmabureau Nationaal Programma Rotterdam Zuid, 2019). Furthermore, Rotterdam-South should be able to rise to the average of the G5 cities in twenty years.

For the pillar of living, the report implementation plan 2019-2022 (Dutch: Uitvoeringsprogramma 2019-2022) states that the NPRZ aims to provide the inhabitants of Rotterdam-South with a better living environment, by improving the housing stock and create more differentiated living environments. Specifically focusing on the living environment, this presents several challenges (Programmabureau Nationaal Programma Rotterdam Zuid, 2019):

1. *Quality of the public area:* a green and attractive living environment stimulates inhabitants to recreate, move and meet. However, this is not sufficient in all areas in the focus neighbourhoods. Hereby the NPRZ has set the following main tasks:
    - The integration of outdoor space and public areas around new construction and renovation projects;
    - More green spaces in the neighbourhoods;
    - Improve the inner-connection between neighbourhoods and the connection between residential areas and recreation areas.

2. *Traffic and transport*: accessibility of the neighbourhoods in Rotterdam-South is less accessible than the rest of the city. This is not only the case only internal urban connections but also the connection with the region and beyond. Hereby the NPRZ has set the following main tasks for projects, studies and pilots:
    - Rapid public transit and passenger transport across the water;
    - Solutions to last and file mile problems to and from tram stops, train and subway stations;
    - Innovative mobility concepts in connection with the parking strategy for the public space;
    - Stimulate bicycle use of inhabitants;
    - Improve station environment Station South;
    - Improve walking and cycling routes.

3. *The quality of private rental:* the dwellings have often deferred maintenance, which can lead to impoverishment.

4. *Regional dwelling stock:* the number of social dwellings is very high in Rotterdam-South. The NPRZ strives for a more balanced spread over the region.

4.3 SELECTION OF THE RESEARCH AREA

The municipality of Rotterdam has set up an approach called The Rotterdam Mobility Approach (RMA). With this approach, the municipality wants to improve the accessibility of the city of Rotterdam. Moreover, support several challenges in Rotterdam from a mobility perspective (Gemeente Rotterdam 2020). One of the approaches of the RMA is executed in the form of pilots. In 2019, the municipality executed a pilot in the form of a mobility challenge at the Hooghkwartier. With this challenge, ninety residents of the neighbourhood Hooghkwartier used forms of shared mobility (car sharing, bike sharing and public transit) for two months. The shared mobility systems were located at a central hub in the neighbourhood, whereby participants could unlock the systems with an application. To realise this, thirty participants had to park their cars in a parking garage outside the neighbourhood. These vacant parking spaces were temporarily converted into other space for the area, namely green areas (Mchoogkwartier, 2020). This challenges aimed to make visible what the impacts of new forms mobility like shared mobility can be for the public space in a neighbourhood like Hooghkwartier. Since, Hooghkwartier is a centrally located neighbourhood, with more square meters of parking space than green areas (Mchoogkwartier, 2020).

For the neighbourhood of Tarwewijk, the municipality wants to conduct a similar pilot for the coming year. Like the neighbourhood Hooghkwartier, Tarwewijk has also a parking task. It is known that there is a demand for more parking spots in the neighbourhood. In addition, there is a greening task. However, there is a motion stating that greening should not be at the expense of parking spaces. Moreover, the municipality does not want to provide more parking spots in the area, since this will affect the living environment and public spaces of the neighbourhood. Therefore, the municipality wants to test the functioning of shared mobility systems in Tarwewijk, since they think that adding shared mobility systems can eventually decrease the number of cars in the future. Hereby, it would not be necessary to add more parking spots and there may be the opportunity to make more green spaces the neighbourhood (Advisor Smart Mobility, personal communication, 30 April 2020).

So, the municipality wants conduct pilot, whereby they provide for shared mobility systems in the neighbourhood of Tarwewijk, to see how this can impact the liveability of the neighbourhood and possible also add more green in the public areas. Moreover, such a pilot is not yet been conducted in a neighbourhood which is dealing with socio-economical problems and transport poverty. Therefore, the impact on these aspects is also unknown. Giving these facts and the fact that the municipality wants to examine the possibilities of shared mobility services in this specific neighbourhood are the motives for this case selection for Rotterdam-South.

4.4 TARWEWIJK

4.4.1 Introduction & history

Tarwewijk is one of the eight neighbourhoods located in the district of Charlois in Rotterdam-South. Tarwewijk is located centrally in the south of the Maashaven, near the city centre, the Zuiderpark and the shopping centre Zuidplein. Tarwewijk has a striking triangle shape since one side of the neighbourhood is formed by the port, the other two by the Pleinweg and the Dordtselaan.

Tarwewijk can be characterised as a working-class district. The emerge of the neighbourhood can be linked to the development of the port of Rotterdam. The increasing economic developments had a great suction effect on labour at the port. These workers came from outside the region and where mainly people from Brabant, Zeeland and Groningen. To accommodate all these new workers in the port, in a rapid time new residential areas with cheap housing needed to be Rotterdam Zuid. So, in the early twentieth century, Tarwewijk was built to house the port workers (Programmabureau NPRZ, 2019). Tarwewijk was mainly known and popular for its industry in grain and flour transport.

Figure 6: Location of Tarwewijk (own illustration)

Moreover, in the area, large grain companies and warehouses, such as Meneba, Quaker and the Maassilo were established. The grain ships of these companies were loaded in the adjacent port of Maashaven (which is named after the river Maas) at the northern side of the neighbourhood (Cultuur Werkplaats Tarwewijk, n.d).

The neighbourhood Tarwewijk has struggled continuously with poverty and was never a rich area, even in the best economic pre-war times of Rotterdam (Lub, 2017). Moreover, from the 60s on the area started to deteriorate more and more. From the 60s and 70s onwards more cheap workers came to the port of Rotterdam. This to execute the work that the local inhabitants did not want to do anymore. These workers were mainly guest workers who came from the Southern countries. In the end, these workers settled in Tarwewijk and other areas in Rotterdam-South. This changed the cultural composition and the population of Tarwewijk. Since, the Dutch inhabitants who first came to live in the Tarwewijk increasingly left the neighbourhood to move to the post-war neighbourhoods on the edges of the city, which led to selective migration (Programmabureau Nationaal Programma Rotterdam Zuid, 2019). Eventually, this has resulted in the fact that 79% of the current population (12.480 inhabitants) has a migration background (BRP – OBI, 2020). In the 80s, the port activities in Tarwewijk and the rest of Rotterdam-South started to shift towards the West. This led to a decline in jobs in Rotterdam-South and the rise of unemployment. The port was no longer the most important employer for the area of Rotterdam-South (Programmabureau Nationaal Programma Rotterdam Zuid, 2019).

Since the change in population and the developments in the port in the 1980s, the image of Tarwewijk started to decline even more. The move from many of the former inhabitants to other areas to look for job opportunities resulted in the neglection of the dwellings in Tarwewijk. In addition, the neighbourhood became known for being highly unsafe and criminal, especially this image was reinforced by 'Millinxbuurt' (Engbersen, Snel & Weltevrede, 2005). Where similar neighbourhoods received a quality impulse, this was not achieved in the Tarwewijk. This resulted in a vicious decline cycle. So, since the end of the last century, the government and the municipality of Rotterdam have been working on improving the situation in Tarwewijk, focusing on the physical, social and safety level (Cultuur Werkplaats Tarwewijk, n.d).

4.4.2 Governmental plans

Since the decline of the neighbourhood, Tarwewijk is like the rest of Rotterdam-South part of different urban renewal programs. Currently, the NPRZ is working on a new perspective for Rotterdam-South Besides the previous described the general challenges for Rotterdam-South, the NPRZ has set up challenges for Tarwewijk to address in their strategy for the neighbourhood. These are in general the following (Programmabureau NPRZ, 2015):

Employment:

- Opportunities for work at Brielselaan in time
- More space for small entrepreneurs in the edges of the neighbourhood
- Concentrate facilities on 3 nodes Dordtselaan
- Probability map Brielselaan in the long term

Dwellings:

- The transformation of the Mijnkintbuurt and Tarwebuurt to a family-friendly living area.
- Agreements about where and how to sell dwellings, social real estate and business premises for the municipality and housing corporations

Public space and accessibility:

- Use green spaces in the neighbourhood as carriers of new living environments
- Create a balance in the use of living areas and traffic areas
- Greening of the neighbourhood
- Improve the isolated location of Tarwewijkby, offering small-scale transport and improving the connections to Zuiderpark and Katendrecht
- Improve the appearance of the Maashaven subway station

People

- Improve social cohesion and participation in society

4.4.3 Neighbourhood profile

The municipality of Rotterdam has developed a tool to measure the different areas and their neighbourhoods. Previously, this was a separate tool that measured the safety and social index of an area. With this new tool, the domain of “physical” is included. The three domains focus on various objective and subjective factors in an area, which are the following:

1. Physical: Living experience, living, public space, services environment, etc.
2. Safety: Safety experience, theft, violence, burglary, vandalism, nuisance, etc.
3. Social: Experience quality of life, self-sustainability, participation, interaction with local inhabitants, etc.

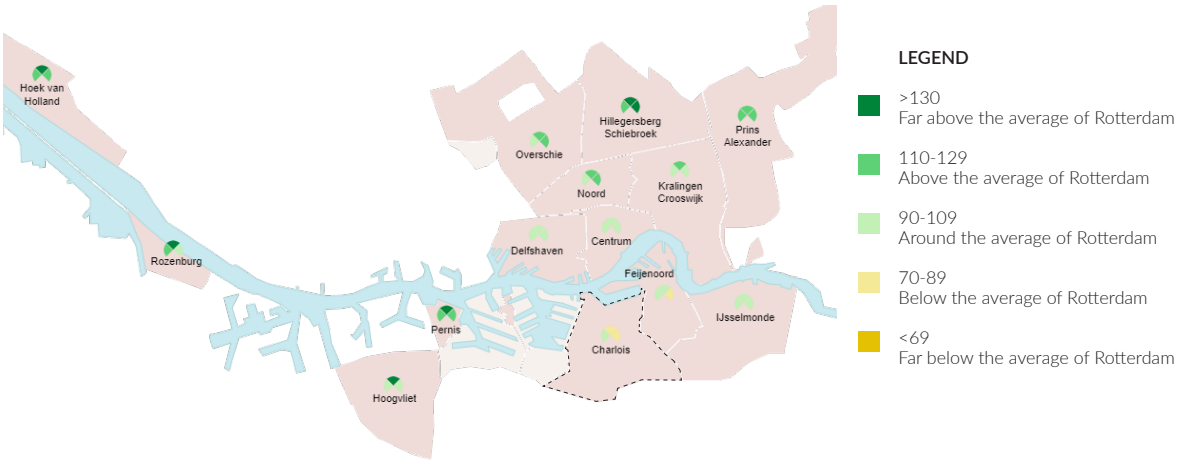


Figure 7: Areas in Rotterdam (Wijkprofiel Rotterdam, 2020)

The colours of the tool indicate how an area or neighbourhood scores in relation to the entire city of Rotterdam. A green domain score is equal to or above the Rotterdam average, a yellow domain means a score below the Rotterdam average. Besides, the tool makes a distinction in an objective and subjective score. The objective score is based on facts and figures, whereas the subjective score is based on inhabitants of the inhabitants (Wijkprofiel Rotterdam, 2020).

When looking at the area profile of Charlois, where Tarwewijk is located. The schematic overview of the three domains shows that the area scores below the average of Rotterdam for two domains. These are the safety and social domain.

Focusing on Tarwewijk. the schematic overview shows that Tarwewijk below the average of Rotterdam for two domain, namely physical and safety. In the physical domain, the biggest problems are with the theme's living and public space. The objective theme "living" gives an impression of the quality of housing and the buildings in the neighbourhood. The subjective theme of living gives an impression of the satisfaction of the inhabitants with their dwellings and the attractiveness of the buildings in their neighbourhood. This shows that the quality of dwellings and the buildings in the neighbourhood is not sufficient and the inhabitants are not satisfied. Another problematic theme is "public space". The objective theme gives an impression of the image of public space and traffic safety in the neighbourhood. This is measured by random inspections in the area. The subjective theme gives an impression of the satisfaction of the inhabitants about the quality of the public space and traffic safety. Hereby, on an objective level the public space and traffic safety scores equal to the rest of Rotterdam, however, on a subjective level, the inhabitants are not satisfied.

In the safety domain, Tarwewijk scores below the average of Rotterdam for all themes. This means that the inhabitants are not satisfied with the safety in the neighbourhood and experience many problems. On an objective level, it even scores far below the average of Rotterdam for the theme "nuisance". This describes the extent to which nuisance occurs in the public space (e.g. drug nuisance, conflicts, etc.).

Tarwewijk scores relatively better on the social domain, than the other two domains. On the objective level, it scores below the average of Rotterdam for the theme "building". This gives an impression of the commitment from the inhabitants to their neighbourhood and city. More specifically, the rate of mutation and the duration of residence in the neighbourhood and city of Rotterdam. On a subjective level, Tarwewijk scores low for the themes "self-sustainability" and "participation". These themes give an overview of how residents value their participation in society and their self-sustainability, focusing on their income, health, language skills, etc.

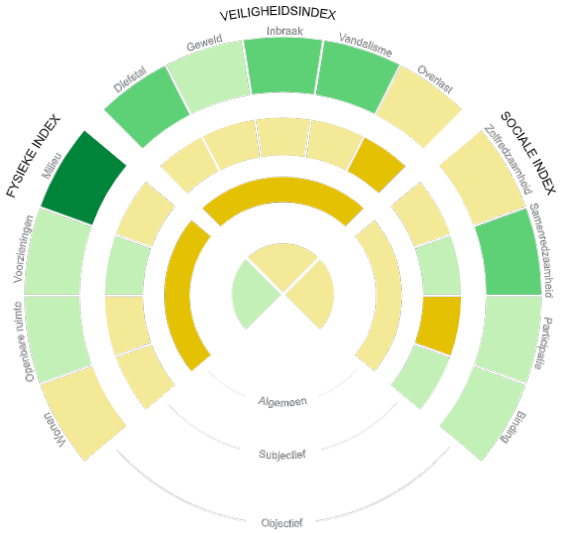


Figure 8: Area profile Charlois (Wijkprofiel Rotterdam, 2020)

Figure 9: Neighbourhood profile Tarwewijk (Wijkprofiel Rotterdam, 2020)

4.4.4 Demographic background of the population

Population by migration background

Rotterdam can be seen a multicultural city since many different inhabitants groups live together. When looking at the neighbourhood of Tarwewijk, in 2020 the majority of the inhabitants identifies as Dutch (20,7%). However, a considerable number (79,3%) of the inhabitants in Tarwewijk are from immigrant origin compared (Surinam, Turkey, Antilles, etc.) to half in all of Rotterdam.

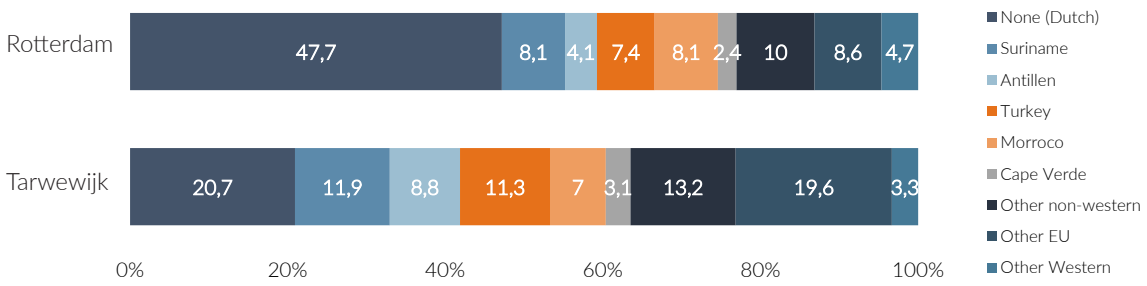


Figure 10: Population by migration (BRP-OBI, 2020)

Population by age and household

Besides the diversity of the neighbourhood, Tarwewijk can also be identified as a young neighbourhood. From the total population, almost 85% is younger than the age of 55. Whereby, the peak of the age demographics is between the age group of 27-39 years. Comparing to the rest of the Rotterdam, Tarwewijk has a smaller percentage of elderly people. In 2020, the neighbourhood of Tarwewijk counted 6.382 households. Whereby the biggest group consists of single-family households with children.

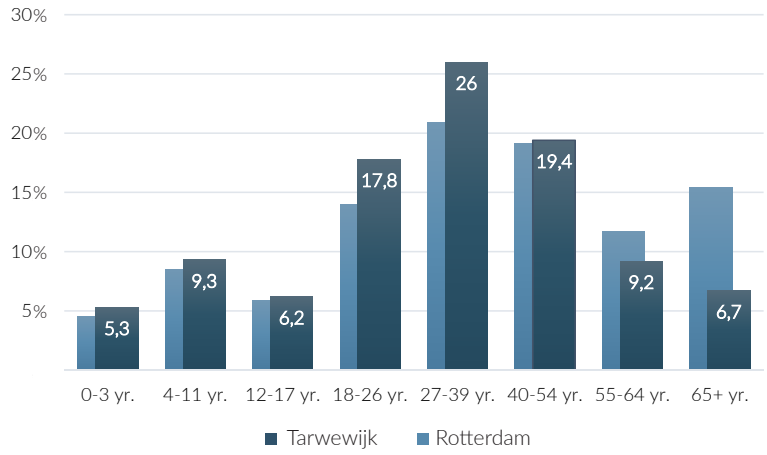


Figure 11: Population by age (BRP-OBI, 2020)

4.4.5 Socio-economic conditions

Income

The incomes of the people in the Tarwewijk are among the lowest in Rotterdam. The average income per inhabitant in the Tarwewijk is € 27,400 (Annual level: 2017). The incomes of the inhabitants can also be divided into three groups. The bottom 40% of the national income is considered as the "low" group, the top 20% as the "high" group and the rest is considered as the "middle" group. In the municipality of Rotterdam, a little more than half of the inhabitants to the group with the lowest income and about a third are in the middle group. In Tarwewijk the percentage of its inhabitants in the lower in the group is higher, about 66%[1] (Gemeente Rotterdam, 2020). The income level (Figure 12) shows that 13% of the inhabitants earn below and up to the minimum wage. Moreover, In Tarwewijk, the percentage of inhabitants that get social security benefits almost two times higher (19,8%) than the average for the whole of Rotterdam (11,2%).

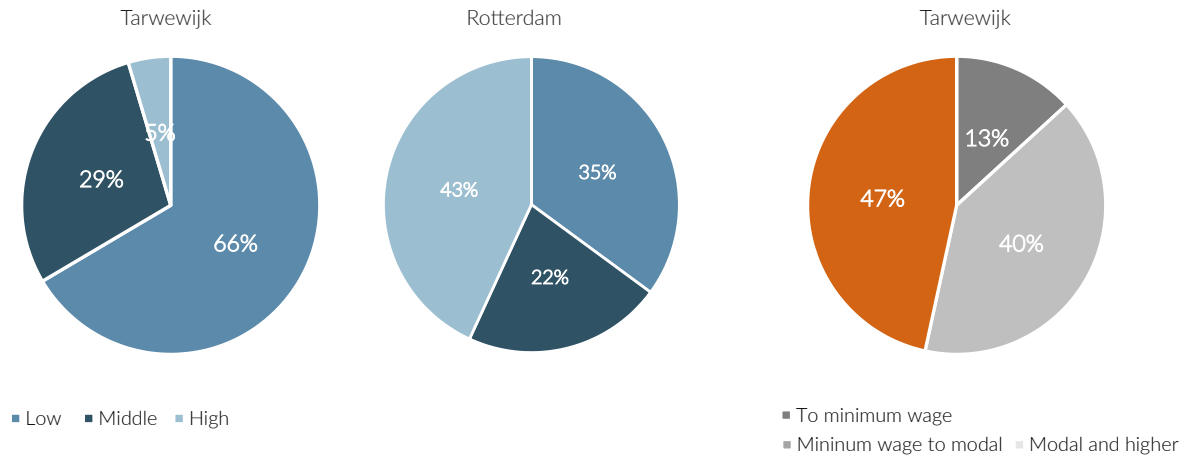


Figure 12: Income group (BRP-OBI, 2017)

Figure 13: Income level (BRP-OBI, 2017)

Education

One of the pillars of the NPRZ is "education". With the programme, the NPRZ wants to improve the competence of children and young people from Rotterdam-South up to the level of the G5 cities (Programabureau NPRZ, 2019). When looking at the education level of the inhabitants from the age group 15-75 years, numbers show that only 13% has a high education level. The majority of the inhabitants has low (41%) and middle (45%) income.

Work

As previously described, the incomes of the inhabitants of Tarwewijk are on average very low. Figure 14 shows the source of income. Hereby, it becomes clear that 13% of the inhabitants are unemployment or is receiving social assistance. For the rest of Rotterdam, this number is only 11%. So, a large number of the inhabitants do not have a job, while having a job provides financial support and resilience of the inhabitants.

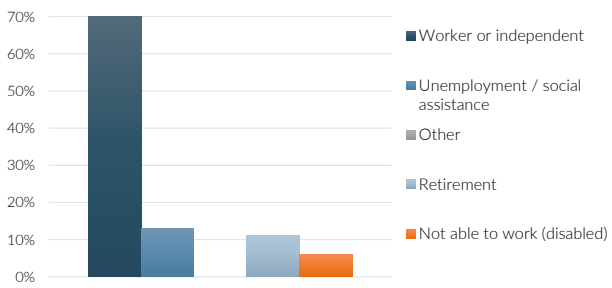


Figure 14: Source of income (CBS-OBI, 2018)

[1] The report dates from 2020, however, the numbers used in the report are from 2017.

Companies and businesses

Companies and businesses in Tarwewijk are mainly concentrated around the de edges of the area, such as the Dortselaan, Pleinweg, Mijnsherenlaan and the Wolphaertsbocht. As a result, there is a clear separation between housing and businesses. Currently, there are 951 companies and small businesses located in the Tarwewijk (OBI, 2019). The task for the Tarwewijk is to create sufficient opportunities for the establishment of business activities that generate employment for its inhabitants (Programmabureau NPRZ, 2019).

Services

The facilities in the Tarwewijk are primarily aimed at the residents of the Tarwewijk. Retail, shops and restaurants are mainly concentrated at the edges of the neighbourhood. They can be found at the Dordselaan and the Pleinweg at the intersection with Wolphaertsbocht and Hellevoetstraat. In addition, the Zuidplein shopping centre is within walking distance of the neighbourhood. Other neighbourhood oriented facilities, such as schools, health centres, churches, etc, are more located in the inner areas.

4.4.6 Living

Structure

Tarwewijk has a triangle shape, whereby one side of the neighbourhood is formed by the port and the companies located at the Maashaven, the other two sides are surrounded by large traffic structures as the Pleinweg and the Dordtselaan. Besides there also other traffic structures that run along with o through the neighbourhood, such as the Brielselaan, Mijnsherenlaan, Wolphaertsbotch and the subway line. Because of this, Tarwewijk is well connected to the city centre. However, this also leads to a highly insulated neighbourhood.

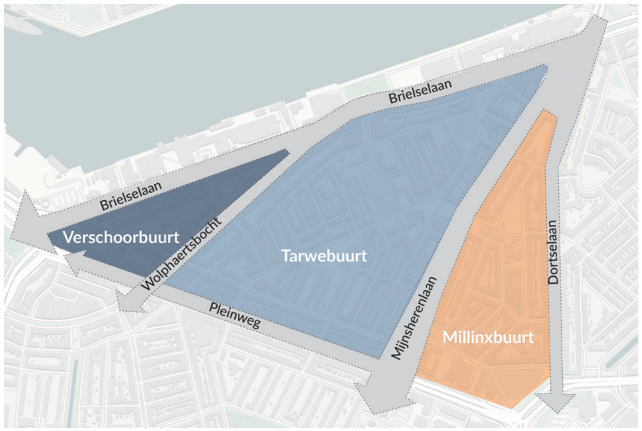


Figure 15: Neighbourhoods Tarwewijk (own illustration)

Further looking at the urban structure of Tarwewijk, the pre-war structure with avenues is clearly visible. Because of the avenues, Tarwewijk can be divided into three smaller neighbourhoods, namely the Verschoorbuurt, the Millinxbuurt and the largest one of three the Tarwebuurt. Both sides of the avenues are accompanied by buildings with higher heights. Because of this structure, Tarwewijk is characterized by its busy traffic structures with facilities and services at the edges of the neighbourhood and quiet inner areas, where people live.

Dwellings

Currently, there are 5.982 dwellings in Tarwewijk. From this number, 92% of the dwellings are occupied. The rest of Rotterdam has an occupancy rate of approximately 95%, so this only a small difference with Tarwewijk. When looking at the dwelling types in the stock, it becomes clear that the majority consists of multi-family stacked dwellings located at the edges of the area. Tarwewijk is known for its families with children. However, this is not showing in the current dwelling stock, since the number of single-family dwellings is only limited to 8% (BAG-OBI, 2020).

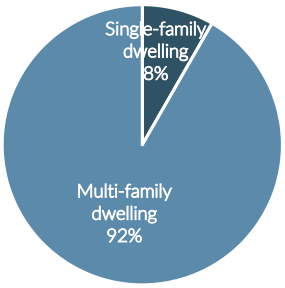


Figure 16: Type of buildings (BAG-OBI, 2020)

Focusing on the construction year of the buildings, the numbers show that the majority (80%) of the dwelling stock is built before the 1945s (BAG-OBI, 2020). This is because Tarwewijk was originally built to accommodate the new workers in the port. So, the dwellings are relatively old and provide cheap housing for its residents. This is also reflecting on property values (Dutch: WOZ-waarde). Namely, 64% of the dwellings has a property value below €100.000,-. Unlike the rest of Rotterdam, where the average property value is between €100.000,-. and €175.000,-.

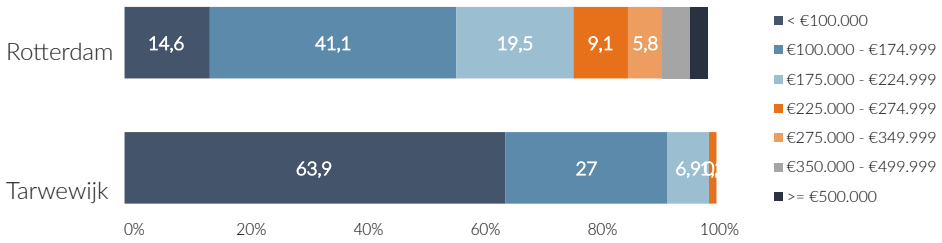


Figure 17: Property values (BAG-OBI, 2020)

Approximately 32% of the dwelling stock in Tarwewijk is owned by housing corporations. About 23% of the dwellings are owner-occupied and a striking percentage of 45% is showing for private rental dwellings. Compared to the number of private dwellings in the rest of Rotterdam, this is only 20%. Since this, a large part of the housing stock in Tarwewijk, the NPRZ wants to stir on good tenant arrangements to guarantee the quality and counteract deterioration. According to the NPRZ also other problems occur because of this type of property ownership. The neighbourhood has a high turn-over rate. Especially, in the Mijnkintbuurt where the private rental is concentrated. In these areas, the inhabitants live relatively short which influences social bonding with the neighbourhood in a negative way (Programmabureau NPRZ, 2013). Therefore, the NPRZ wants to increase the number of owner-occupied dwellings and the property values compared to Rotterdam. They want to achieve this by realizing more other residential environments with more room for middle and higher incomes (Programmabureau NPRZ, 2019).

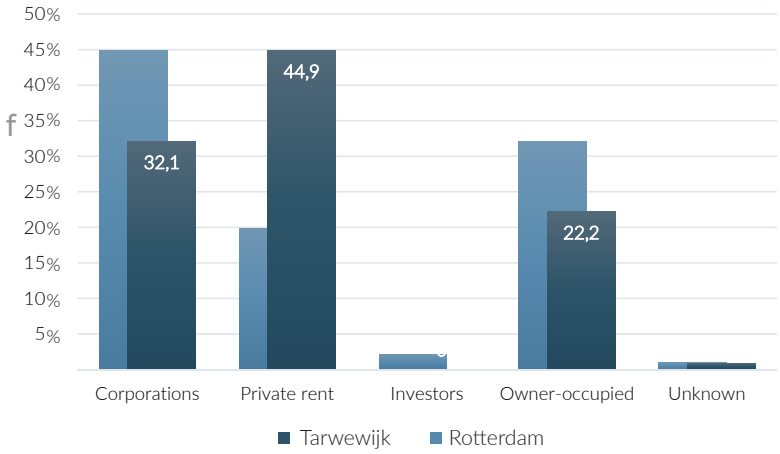


Figure 18: Dwelling stock to property ownership (BRP-OBI, 2020)

Public spaces and green

The public spaces and green of the neighbourhood of Tarwewijk have been applied on different scales. At an urban level, the urban green roads are in particular important, such as the Mijnsherenlaan, Dordtselaan, Brielselaan and the Pleinweg. Hereby, various types of green are applied, such as green roadsides, rows of threes, grass areas, bushes and hedges. Adding more green to these urban areas has to contribute to the viability of the roads. Secondly, on an urban level, there is the dyke, which separates the residential parts and industrial parts of Tarwewijk.

At the neighbourhood, several parks and squares can be distinguished. Figure 19 shows that in principle, every "small" neighbourhood has his own park or square. However, the maps also show there is no coherent interplay of the various public spaces. Whereby, the public spaces are fragmented on a neighbourhood level. Which negatively contributes to this fragmentation is the presence of the many fences around the parks and squares.

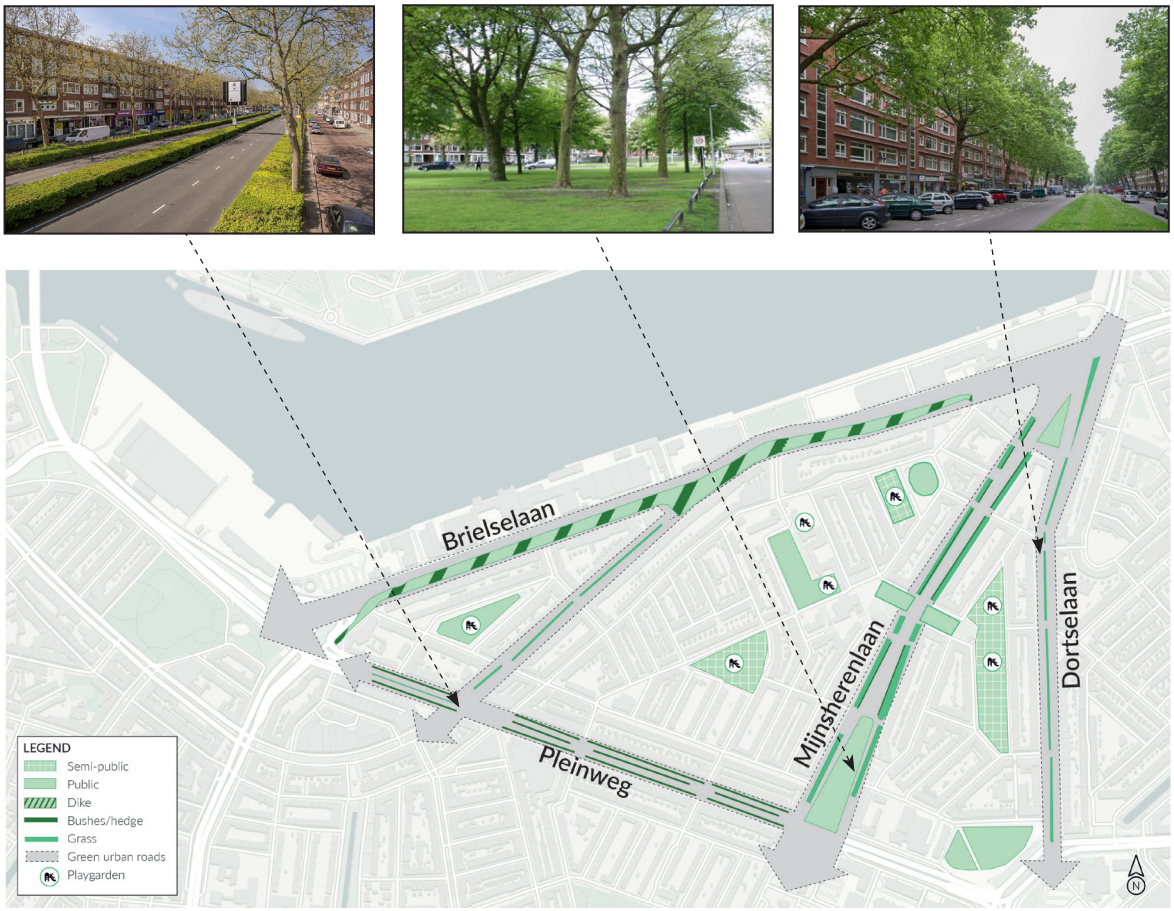


Figure 19: Public spaces and green in Tarwewijk (own illustration)

4.4.7 Connectivity and accessibility

Mobility environment

Cities and neighbourhoods can be categorized in different living environments. Like these living environments, mobility can also be categorized in various general mobility environments These mobility environments contain a qualitative description of the present mobility in a city or neighbourhood (Rebelgroup, 2020). Seven mobility environments can be distinguished, which are: 1) multimodally accessible cities, 2) walkable facilities centres, 3) cyclable city districts, 4) Public transport accessible living/working environments 5) car villages with daily amenities, 6) rural car areas and 7) car-dependent production locations (Springco Cartotool, 2020). Figure 20 shows the mobility environments for Rotterdam and more specific for Tarwewijk. This map shows that the mobility environment " public transport accessible living/working environment" is predominant in the neighbourhood.

Looking at the description and characteristics of this mobility environment, one of the main aspects is the presence of high-quality public transport, such as a subway or slow train within 15 minutes cycling distance. Giving this fact, these neighbourhoods are mostly located near the main subway line or train line, such as the subway of Rotterdam. Besides the subway and train, this environment is easily accessible by bus and tram (Springco Cartotool, 2020). Daily basic facilities are located within 10 minutes of travel time by bicycle. However, other facilities like higher education schools and hospitals are further away. People who live in these mobility environments are expected to choose their car more than average as the primary modality for their living and work traffic. Moreover, it is expected that they use these means of transport also to reach facilities, despite the cycling time being fairly low (Springco Cartotool, 2020).

The following sections will focus on infrastructure and the various means of transport car, slow traffic and public transit) for Tarwewijk on a city and neighbourhood level. Hereby, it can be seen if the previously mentioned mobility environment for Tarwewijk corresponds.

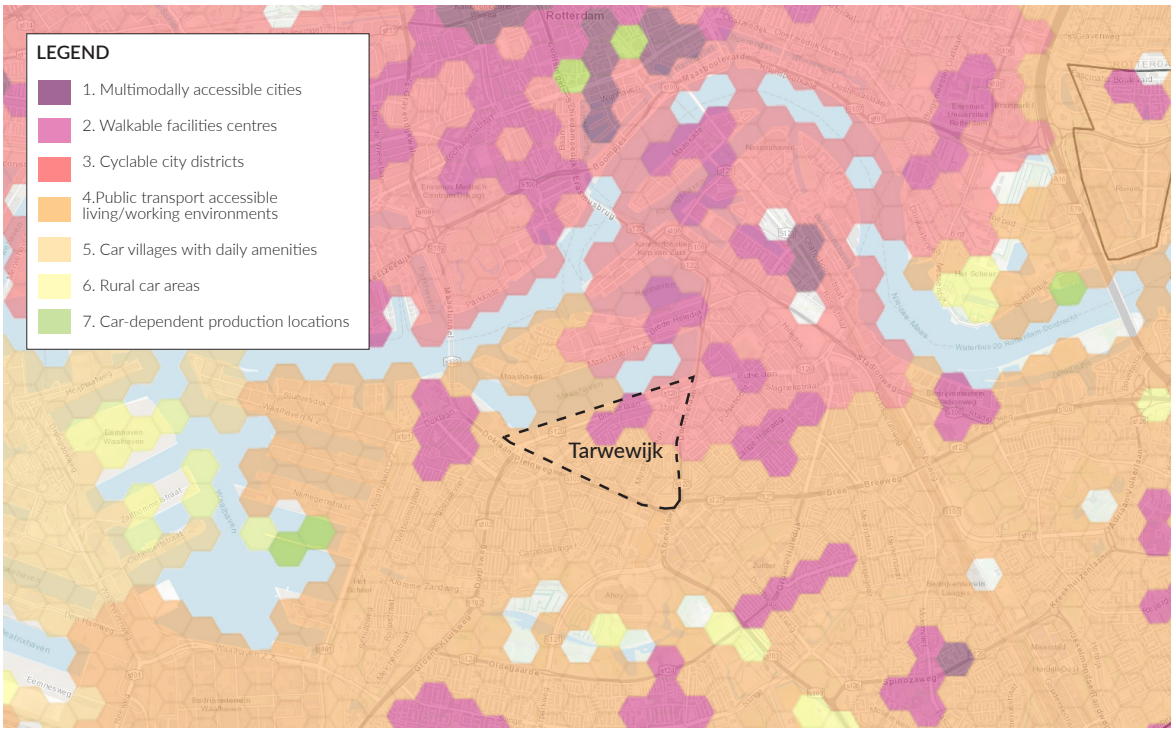


Figure 20: Mobility levels (Springco Cartotool, 2020)

Infrastructure and public transit (city-level)

At the city level, Tarwewijk is easily accessible by car and public transport. Two important main roads in the neighbourhood are the Dordtselaan and Pleinweg. The Dordtselaan is located at the east side of Tarwewijk. This road connects the neighbourhood with the city centre of Rotterdam and an important highway, the A15. The Pleinweg is located on the south of the neighbourhood and connects Tarwewijk with the Maastunnel and Rotterdam-North.

Not only by car but also by public transit Tarwewijk is easily accessible. In the neighbourhood and close area, two subway stations are located, namely the Maashaven station and Zuidplein station. The subway lines D and E cross these stations, connecting Spijkennisse, Rotterdam Central Station and The Hague station. The tram stations within the neighbourhood, connect Tarwewijk with the train station Lombardijen.

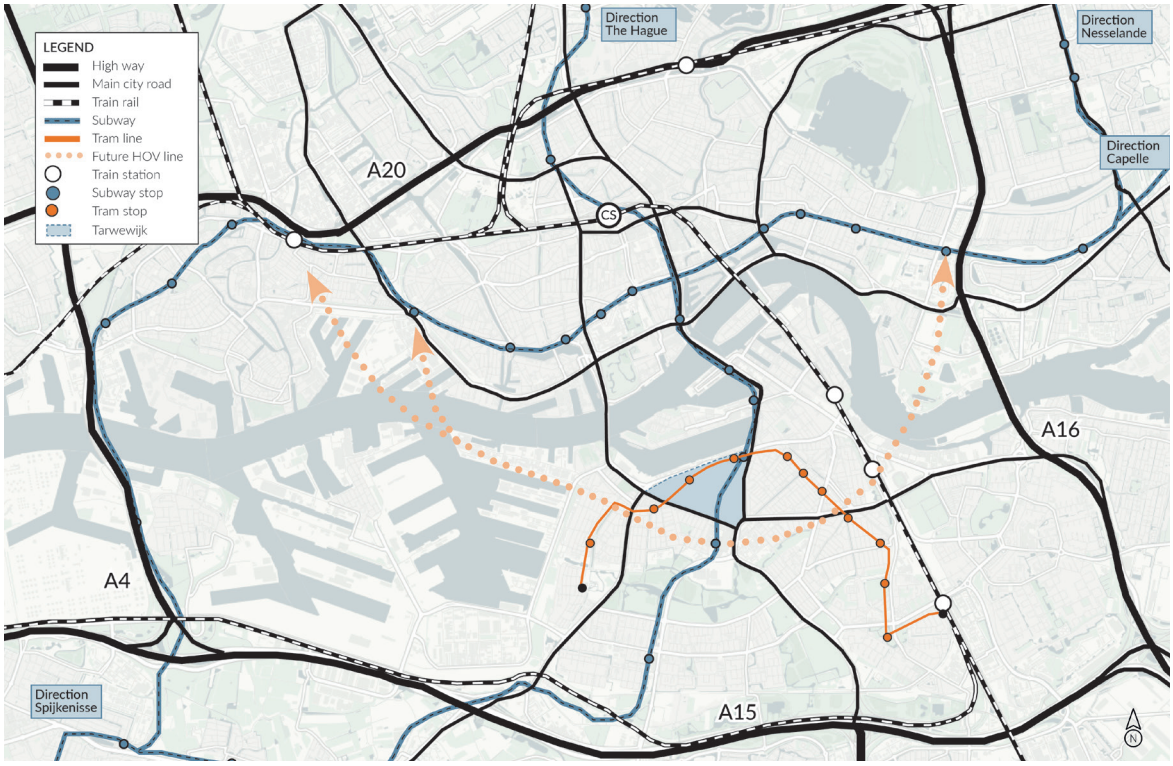


Figure 21: Infrastructure on a city level (own illustration)

Infrastructure car and slow traffic (neighbourhood level)

As described, The Tarwewijk is located between the Dordtselaan, the Brielselaan and the Pleinweg. Currently, the Pleinweg is been designated as the main access from the south to the city centre and is, therefore, the largest traffic barrier in Rotterdam-South. The Dordtselaan and Brielselaan are slightly quieter city roads. Looking at the current traffic system, this consists of main roads at the city level, with parallel roads for access to the neighbourhood. The Pleinweg and the Dordtselaan can be seen as the most important traffic junction at the city level. The Mijnsherenlaan, part of the Wolphaertsbocht and the Brielselaan are more important at a local level.

The entrance to the Tarwewijk from the surrounding neighbourhoods is quite difficult. From the Brielselaan is not possible to access the neighbourhood, because of the dyke. From the Dordtselaan, the neighbourhood only has two entrances. So, the main entrance to the neighbourhood is by the Pleinweg. In Tarwewijk there a couple of regional cycling routes along the Brielselaan, Dordtselaan, Pleinweg and Mijnsherenlaan. There a couple of barriers to slow traffic. The entrance to the neighbourhood by the Brielselaan is like the car entrance also difficult by bicycle because of the dyke. Another barrier for slow traffic is the crossing of the Pleinweg from the neighbourhood towards Zuidplein and the Zuiderpark. Besides, the Maashaven is only accessible on the east side for slow traffic. In the neighbourhood itself, cyclist makes use of the roads.

Figure 22: Car roads and slow traffic in Tarwewijk (own illustration)

Infrastructure public transit (neighbourhood level)

Figure 23 shows the map with different public transit modes in Tarwewijk. Different tram and bus lines run through and around the neighbourhood of Tarwewijk. The CROW (2014) has made an overview of acceptable walking distances for different functions in the Netherlands, such as public transit. For the various public transport modes, these are the following: bus stops: 350 meters, tram stops: 400 to 500 meters and metro stations: 700-1.000 meters. Looking at the walking distance radius on the map. The map shows that in almost all parts in Tarwewijk a public transport node can be found within walking distance. So, due to the existing infrastructure, the Tarwewijk is well accessible by public transport.

Figure 23: Public transit in Tarwewijk (own illustration)

Parking

Figure 24 shows where the parking of the neighbourhood is located. HHereby, it becomes clear that the parking spots and areas are located as sideway parking within the streets, where there is high parking pressure. A total of 3,225 passenger cars were registered in Tarwewijk. Whereby, the number of cars per household is 0.5.

Figure 24: Parking spaces and spots in Tarwewijk (adapted from Springco, 2020)

4.4.8 Urban area developments in Rotterdam-South

Various urban area developments in Rotterdam-South are currently in the execution of are planned for the coming years. This section will focus and elaborate on two large urban area developments in around the neighbourhood of Tarwewijk, namely the realisation of Hart van Zuid and the proposed Masterplan of Rijnhaven.

Hart van Zuid

"Hart van Zuid", the development in the area around the shopping mall Zuidplein and event location Ahoy, can be seen as one of the largest urban area developments of Rotterdam-South. This development has started in 2016 in a joint collaboration between the consortium consisting of Ballast Nedam and Heijmans with the municipality of Rotterdam (Heijmans, 2016).

The ambition of the development van Hart van Zuid, for the coming 20 years, is to create a new vibrant centre for Rotterdam-South. Hereby, the Hart van Zuid should be an inviting place for residents, visitors and entrepreneurs to live, work and relax. Moreover, the development aims to strengthen the cohesion between existing and new facilities, improve the centre appearance and create better quality public spaces. So, eventually giving Rotterdam-South a lasting economical, physical, social and cultural impulse (Hart van Zuid Rotterdam, 2020).

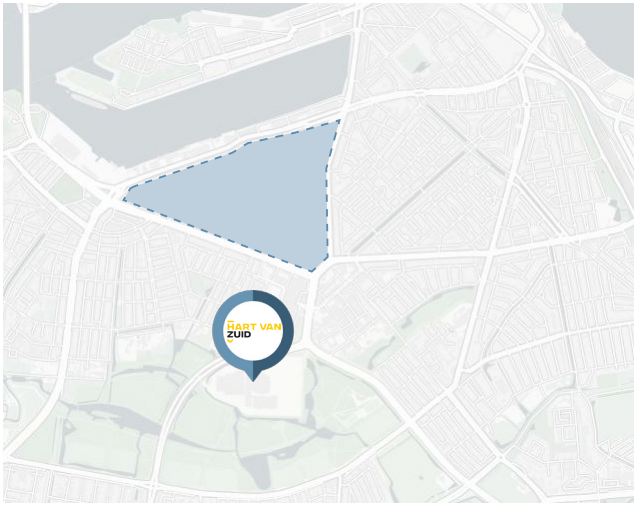


Figure 25: Location Hart van Zuid & Tarwewijk (own illustration)

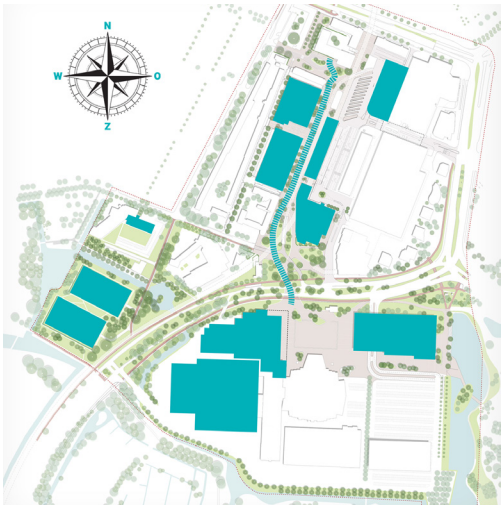


Figure 26: Plan area "Hart van Zuid" (Hart van Zuid, 2020)

Figure 27: Impression new public square "Plein op Zuid" (Hart van Zuid, 2020)

To realise this ambition for Rotterdam-South in the coming years, the development consists of various subprojects, among others (Hart van Zuid Rotterdam, 2020):

- The Gooilandsingel will be converted to a car-free, green promenade, which will serve as a connecting link within the entire area of Hart van Zuid. Hereby, the promenade connects the Zuiderpark to Ahoy and the Pleinweg (Tarwewijk). Located at this promenade are several public squares, such as the Ahoyplein and the new Plein op Zuid.
- Around the new square of Plein of Zuid, several inviting public functions for the residents and visitors will be added. For instance, in 2017, the new swimming pool for the area is realised in the former sub municipal office. Another already realised project is the Theater Zuidplein. Which consists of a theatre, but also a library, a café-restaurant and spaces for art exhibitions.
- The current shopping mall Zuidplein will be expanded and renewed. Whereby the focus to make it lighter, accessible and open for the area.
- The event location Ahoy will be renewed and expanded with more functions and facilities like a conference centre, music hall, hotel and cinema.
- The current public transit node Zuidplein will be improved and expanded. Hereby, the focus is to improve the public transit connects. Moreover, the passenger comfort is going to be improved is by a redesign of the bus and subway station terminal, which will better connect to the renewed shopping mall. Besides, a new bicycle parking garage will be added, which is accessible to everyone.
- In the new neighbourhood “In het Zuiderpark” 84 single-family dwellings will be developed.
- Besides the previously mentioned projects, the development of Hart van Zuid also has a social programme. Whereby, this programme stimulates talent, craftsmanship and entrepreneurship in and to the area. In addition, the programme provides for several internship places and employment for people persons with a distance to the labour market. Besides, the programme provides for several internship places and 750 job opportunities for the inhabitants of Rotterdam-South and persons with a distance to the labour market.

Hart van Zuid and Tarwewijk
Tarwewijk is an adjacent neighbourhood of Zuidplein. The two neighbourhoods are connected through the Mijnsherenlaan/Pleinweg and the Goereesestraat. With the development of Hart van Zuid, this intersection will be adapted. This has mainly two reasons. Firstly, to realise green and inviting public spaces in Zuidplein. Secondly, to realise the central promenade Gooilandsingel with the Tarwewijk to the north of the Pleinweg (Riederwaard C.V., 2018). With this adaption, Tarwewijk will be better connected with the development of Hart van Zuid, Zuidplein and the area around. Hereby, the inhabitants of Tarwewijk can also make use of the new facilities and opportunities that developments of Hart van Zuid deliver.

Masterplan Rijnhaven

In March 2020, the municipality of Rotterdam presented their master plan for the urban area development of the Rijnhaven. The master plan has set out the main principles for the development of the Rijnhaven. Currently, the master plan is developed further and it is expected that the realization of the area will start in 2024 (Architectenweb, 2020).

With the plans of the Rijnhaven, the municipality wants to contribute to the densification of the city of Rotterdam. Whereby, between the Posthumalaan and the waterfront of Rijnhaven, approximately 2.000 to 2.500 new dwellings will be developed in the form of high-rise buildings and city blocks. The plinths of the buildings will be reserved for a mixed program, such as small-scale companies, facilities, catering, offices, etc (Architectenweb, 2020). Besides a new urban and mixed program, one-third of the water will be damped for a largely floating city park and a city beach. The Posthumanlaan will serve as a walking promenade from the Rijnhaven towards the Wilheminapier and Katrendrecht. Whereby the quays along these areas will also get more greenery (Team Rijnhaven, 2020).

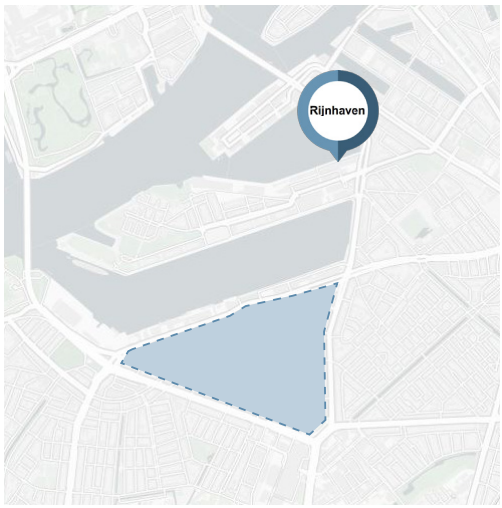


Figure 28: Location Rijnhaven & Tarwewijk (own illustration)

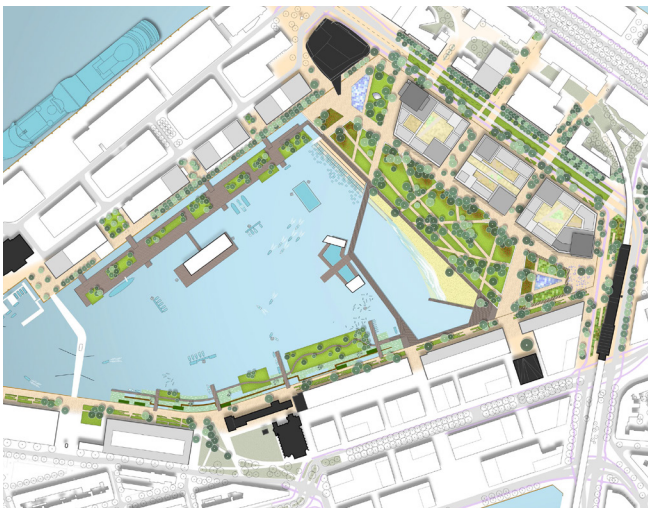


Figure 29: Plan area Rijnhaven (Team Rijnhaven, 2020)

Figure 30: Impression Rijnhaven (Team Rijnhaven, 2020)

With these plans, the municipality wants to develop Rijnhaven the as a vibrant city centre for the Southside of Rotterdam That not only connects the North and South of Rotterdam but also serves as a new destination for the city and especially for the residents of the surrounding neighbourhoods. Moreover, it has the opportunity to connect the surrounding neighbourhoods, so they can benefit more from each other (Team Rijnhaven, 2020).

When looking at the aspect of mobility. The development of the Rijnhaven will focus on sustainable and healthy forms of mobility. There are two subway stations located in the area, which will be upgraded into mobility hubs. These hubs will provide for various shared mobility services (e.g. bike sharing, scooter sharing, etc) for new residents of Rijnhaven, but also for the residents from the surrounding neighbourhoods (Team Rijnhaven, 2020). In addition, a new bicycle network will be developed, to connect the Rijnhavenpark with the surrounded neighbourhoods (Team Rijnhaven, 2020).

Rijnhaven and Tarwewijk

Tarwewijk is not an adjacent neighbourhood of Rijnhaven, however, can be seen as a surrounding neighbourhood. Since the development of Rijnhaven is designed to be a new destination for the city and the surrounding neighbourhoods. These with new functions, facilities, mobility systems, this can also bring new opportunities for Tarwewijk located nearby.

05

EMPIRICAL RESEARCH

05 SHARED MOBILITY SERVICES

This chapter will give an elaboration on how service providers determine their service areas within a city based on the data gathered from different interviews with service providers. Thereafter, more details will be given why a service provider does or does not operate in Rotterdam-South and what should change to enlarge their service area. Finally, a cross-analyse will be presented for the case study of Tarwewijk with the determination criteria of service providers.

5.1 SERVICE AREAS

5.1.1 Determination of the service areas

From the various interviews, different factors have emerged that are important in determining the service area in a city. These are the following:

Density and usage:

Service providers are often more actively operating in the city centre. The reason for this is that more people live in the city centre. Hereby, the density of an area is much higher than the other parts of the city. Due to this higher density, the market potential for shared mobility services is often higher. So, a higher market potential means that more trips with the vehicles can be realized and thus a better business case (Service provider, personal communication, 14 April 2020). When shared vehicles are placed at locations where the density and market potential is lower than there is a chance that bicycles/ scooters will be left at various loose places, where they will not be used again soon. This eventually can lead to high redistribution costs to place the vehicles back to more popular places. In addition, users want fast and easy access to a bike or scooter. This means that service providers need to locate their vehicles in a small circle around the users. So, users only have to walk a short distance to take a vehicle. To be able to achieve this in a city, high-density locations are needed (Strategist mobility and environment, personal communication, 2 April 2020).

Target group:

Another factor which is used to determine a service location is the presence of a target group. Service providers will look if their target group is present in a city. More specifically, they will look in which areas, neighbourhoods and streets they are. Since this determines the market potential that a service provider can deliver (Service provider, personal communication, 14 April 2020). When looking at the target group of service providers, this range of age and kind is large. This is because, service providers do not want to respond specifically to one target group, but want to be accessible to everyone. However, it becomes clear that the main target age of the actual users is mainly between 25-35 years. These are often young professionals or early adopters, so young people who already use their smartphone and train users, who do not want to stick to their own means of transport (Strategist mobility and environment, personal communication, 2 April 2020).

Income and vandalism:

When a service provider starts to determine their service providers the other factor are the income of the inhabitants and the vandalism numbers of an area (Service provider, personal communication, 14 April 2020). Since the risk of shared mobility is that it is capital intensive and a service provider needs to earn his investment back in a certain period. So, when the vandalism numbers of an area are higher, the risk is that vehicles can be damaged or even stolen is higher. This eventually will affect the business case of a service provider, since it has to invest again to repair or buy new vehicles (Service provider, personal communication, 14 April 2020).

Interest areas:

Another for determining a service area is the presence of interest spots in an area. These are for example restaurants and cafes, hotels, event locations, hospitals and stadiums These interest spots do not always have to be located within an existing service area. Service providers can expand their service area with so-called service area islands (Service provider, personal communication, 14 April 2020).

Use of the app

The final factor mentioned by a service provider is the use of their service application (Service provider, personal communication, 8 May 2020). The service provider looks at which locations their service application is opened. In this way, the mobility needs can be identified and the service can be offered in the right service locations.

5.1.2 Services areas in Rotterdam

Figures 31-36 show the areas that the six service providers operate within the city of Rotterdam based on their determination criteria.

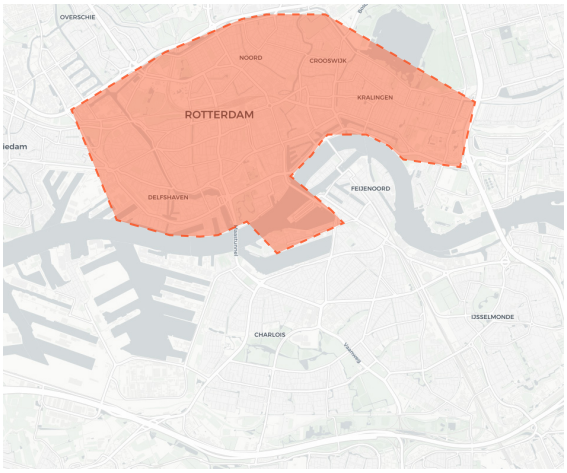


Figure 31: Service area Mobike (own illustration)

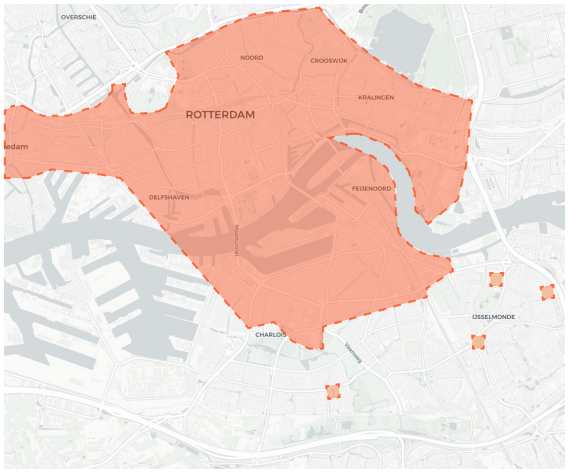


Figure 32: Service area Donkey Republic (own illustration)

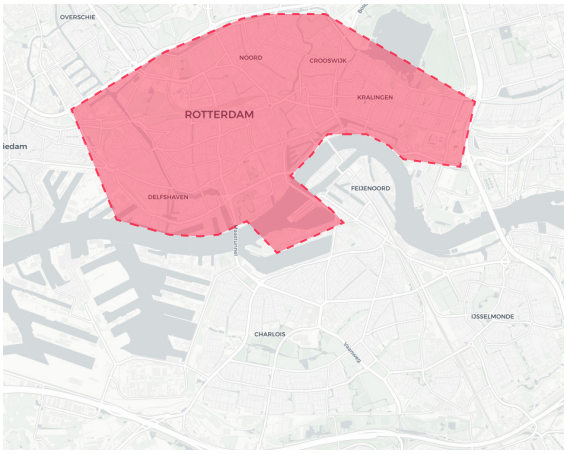


Figure 33: Service area Jump (own illustration)

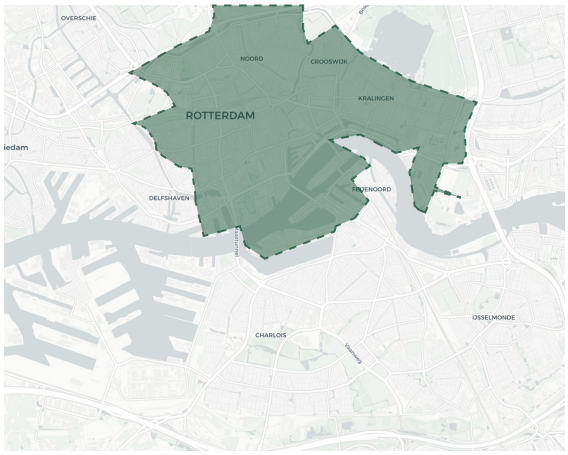


Figure 34: Service area Felyx (own illustration)

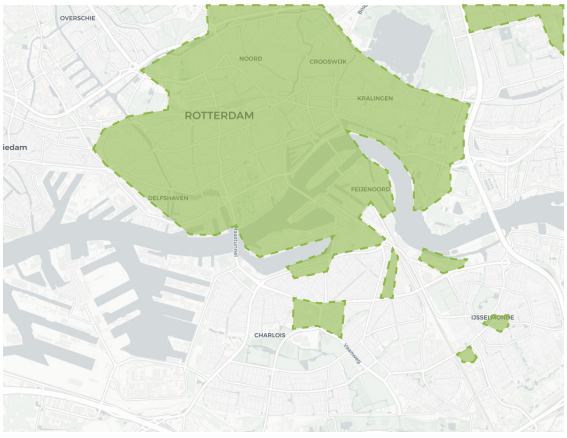


Figure 35: Service area GO Sharing (own illustration)

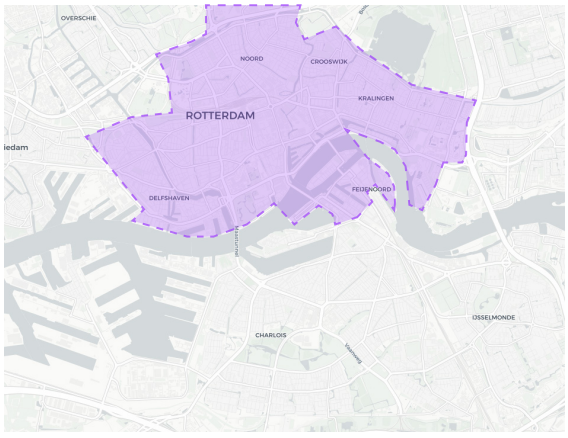


Figure 36: Service area Check (own illustration)

5.2 SERVICES AREAS IN ROTTERDAM-SOUTH

5.2.1 Services areas in Rotterdam-South

Firstly, it is important to state that the municipality has the wish that shared mobility is also offered in the Rotterdam-South. However, no solid agreements have been made about offering mobility services at all locations in the city. Since, they cannot (yet) oblige this as the municipality, because that would interfere with the business operations of the service providers (Advisor mobility, personal communication, 27 March 2020; Advisor smart mobility, personal communication, 30 April 2020). Currently, the municipality works with a maximum number of permits for the shared services. If the municipality sees that this permit system works and the number of complaints about nuisance is kept low. Then the expansion of this maximum number of vehicles can be reconsidered in consultation with the service providers. Whereby they can be stimulated to operate in Rotterdam-South as well (Advisor mobility, personal communication, 27 March 2020).

Looking at the service areas of the different service providers, it is showing that only two of the six provide shared mobility services in Rotterdam-South. These are the bike-sharing service of Donkey Republic and the scooter-sharing service of GO Sharing. However, when looking at these two service providers, they also do not provide shared mobility services for all neighbourhoods in Rotterdam-South. The biggest services area is concentrated in the neighbourhoods of Feijenoord, whereas in the neighbourhoods of Charlois and IJsselmonde do have small or even do not have any services areas. Besides, it is also known that some service providers have operated in Rotterdam-South, but over time have reduced their service area. Given this fact, it is important to understand why service providers do or do not operate in the areas of Rotterdam-South.

Regional solution

One of the service providers who does operate partly in Rotterdam-South state that they are operating South since they want to offer a regional solution. They see that need for mobility does not only exist in the city centre of Rotterdam but residents of rural areas, in particular, can also benefit from this form of mobility (Service provider, personal communication, 8 May 2020).

The use of vehicles

During the time that service providers operated in Rotterdam-South, they saw that the use of vehicles was much lower than other areas within the city of Rotterdam. Since the vehicles were not used that often, the vehicles were left at loose places. This led to high redistribution costs since the service providers needed to redistribute the vehicles to more popular places (Service provider, personal communication, 23 April 2020). Hereby, the business case no longer profitable. Eventually, this has been one of the factors for service providers to no longer operate in all areas of Rotterdam-South.

The maps of the service areas show that most service providers do provide services in the areas beneath the “Maas”, such as Katendrecht and Kop van Zuid. When service providers stopped providing services in all areas they still saw that many vehicles were still used from the city centre to these areas. Therefore, they decided to include these places of Rotterdam-South in their service area (Service provider, personal communication, 23 April 2020).

Vandalism

Not only too few rides on Rotterdam-South were the problem for service providers, but another crucial factor was the high number of vandalism. During their operation time in Rotterdam-South, it was too often that bikes and scooters ware demolished and stolen (Service provider, personal communication, 14 April 2020; Service provider, personal communication, 23 April 2020). In combination with the too few rides, the costs of operating in Rotterdam-South were much higher than the revenues. So, the economic risks that Rotterdam-South entailed, were too high to continue to operate there.

So, the analysis shows that service providers do not operate in Rotterdam-South because the use of vehicles is too low and high number of vandalism, making it economically unprofitable. Nonetheless, the municipality of Rotterdam has the wish that shared mobility services also been provided in Rotterdam-South (Service provider, personal communication, 27 March 2020). However, with the new permit system for shared mobility they can not oblige service providers to operate in Rotterdam-South (Service provider, personal communication, 27 March 2020).

5.2.2 Enlarging the services areas

So, now it is clear why service provides do not operate in Rotterdam-South, it is important what needs to change or which incentives are needed to make more service providers operate in Rotterdam-South. Since the municipality of Rotterdam has the wish that shared mobility services also been provided in Rotterdam-South. Moreover, service providers do state that they have the ambition to operate in Rotterdam-South again, so that everyone can use a shared bicycle or scooter. However, with the current situation of Rotterdam-South, this is not executed yet.

Subsidies

An important factor is that partly due to the low usage of shared mobility vehicles and vandalism, it is not profitable for service providers to operate in Rotterdam-South. From the interviews, it became clear that there was a suggestion, namely, granting subsidies which could be an incentive for a service provider (Strategist Mobility and Environment, personal communication, 2 April 2020; Service provider, personal communication, 23 April 2020). Currently, in the Netherlands, the government grants subsidies for transport authorities to provide for public transport. With these subsidies, transport authorities can provide for urban and regional transport below the cost prices (Wikipedia, 2018). Without this subsidy by the government, the transport would be more expensive for the users or it would be only provided in the larger cities. The strategist mobility and environmental (personal communication, 2 April 2020) mentions that the service providers have to compete with public transport that is subsided by the government. So, he argues that these partial mobility providers should also be subsidized, or that a level playing field should be created. For Rotterdam, the Transport Authority of the Rotterdam The Hague Metropolitan Area grants subsidies for traffic and transport projects (MRDH, 2020). However, at the moment, no municipal or governmental support helps service providers with their operations.

Looking at the approach of the municipality of Rotterdam to support and stimulate service providers to operate on Rotterdam-South. According to the advisor and coordinator smart mobility (personal communication, 30 May 2020), The municipality of Rotterdam is currently working with other large municipalities of the G5 (Amsterdam, The Hague, Utrecht, Eindhoven) to discuss how this problem can be tackled. So, to grant subsidies for not every city but at least for the five big cities can be an idea. However, they see that some service providers do not need any subsidies to operate in Rotterdam-South. So, the municipality wants to do an inventorying on how other cities approach this problem and to see how this can help the municipality of Rotterdam. Moreover, the advisor and coordinator smart mobility states that is important to work with the MRDH, since it is not only about Rotterdam but is also about the entire region. Since the MRDH is the public transport concession provider, this also has to be discussed with them. Perhaps the subsidy should be broadened to a shared mobility concession that service providers can register for (Advisor and coordinator smart mobility, personal communication, 30 May 2020).

Mobility hubs

Currently, all bike and scooter sharing services in Rotterdam are in the form of dockless systems (free-floating), throughout the city. Hereby the users can check out and leave their vehicle at any place within a service area (Shaheen & Cohen, 2019). Another approach to counter vandalism in Rotterdam-South suggestion came from the Strategist Mobility and Environment. The strategist mentioned that service provider may operate in the form of hubs in Rotterdam-South. So, this should not be in the form of a free-floating system, but can be a hybrid system. Whereby, users can return their vehicle to a docking station but also a non-station location. Hereby, it is important to place the hubs strategically within the neighbourhoods. Hubs should not be placed in the small- and/or back streets of the neighbourhood. On the contrary, the should be placed at the main streets of a neighbourhood or near to a subway station. So, the systems should not be placed everywhere, but should be concentrated in one hub. With this, users can walk from their house to the main street to a hub to use shared vehicles (Strategist mobility and environment, personal communication, 2 April 2020).

Since this idea of a "mobility hub" for Rotterdam-South was discussed during one of the first interviews of this thesis. This idea is also probed among the other interviewees.

According to a service provider, (Personal communication, 14 April 2020), a mobility hub at the main street or near a subway station can be a good initiative to start with. If they would expand their service area to Rotterdam-South again in the future, they would choose for a comparable option to test the potential and viability of the services. Hereby, the would choose a secured and insight main street, where the risk of vandalism is low to execute a pilot (Service provider, personal communication, 14 April 2020).

The advisor and coordinator Smart Mobility of the municipality (personal communication, 30 April 2020) add that free-floating is maybe not a good option for Rotterdam-South, since there may be not enough demand for it. Therefore, a stationed system in the form of a hub can be a good idea. Also to counter vandalism in Rotterdam-South since people tend to demolish and steal things if these are placed in the back streets of neighbourhoods. So, therefore hubs at central places in Rotterdam-South can be a good option (Advisor and coordinator Smart Mobility, personal communication, 30 April 2020).

According to the senior advisor mobility (Personal communication, 4 May 2020). the municipality wants to test these kinds of hubs. Since there is a greening challenge for many neighbourhoods in Rotterdam-South. Currently, the available spaces in the neighbourhoods are used for cars and parking spots. So, therefore the municipality has the wish to make these streets and neighbourhoods more green, liveable and attractive for their residents. Hereby, the advisor states that an option is to see if the present cars in the neighbourhood can be located into a central facility, which can be in the form of a central mobility hub in a neighbourhood. So, residents can leave their car there and make use of other shared mobilities modes to travel (Senior advisor mobility, personal communication, 4 May 2020).

5.3 SHARED MOBILITY SERVICES IN TARWEWIJK

As described before, from the various interviews, different factors have emerged that are important in determining the service area in a city. These were the following factors: density and usage, target group, income, vandalism and interest areas. This section will cross check the determination criteria of the service areas with the case study of Tarwewijk. This to see if this neighbourhood has the potential to be integrated as part of the current service areas of the providers.

Density and usage

Most of the service providers operate actively in the city centre because of the density and the number of people living there. Looking at the case of Tarwewijk. Currently, 12.480 inhabitants live in the neighbourhood. Whereby the neighbourhood has a total area of 114 hectares. So, the density of the area is approximately 10.950 inhabitants per km^2. To compare this to the city centre of Rotterdam, where 35.028 inhabitants live in an area of 4,88 km^2. So, the density in the city centre is about approximately 7.180 inhabitants per km^2. This shows that the density of Tarwewijk is not immediately lower than the city centre of Rotterdam.

For the usage of the shared systems, service providers state that the usage in Rotterdam-South was lower compared to the rest of the service areas (Service provider, personal communication, 14 April 2020; Service provider, personal communication, 23 April 2020). Another service provider partly active mentions that there is a demand for mobility in Rotterdam-South, however not much supply yet (Service provider, personal communication, 8 May 2020).

Target group

Service providers want to provide shared mobility services for everyone. However, there is one specific target group who uses these services more than the others. These are mainly young professionals or the early adapters. Who are between the age group of 25-35 years old. Tarwewijk can be characterized as a young neighbourhood compared to the rest of Rotterdam. Since the total population, almost 85% is younger than the age of 55. Moreover, the biggest age group is between 27 and 39 years old. Giving this fact, the target group of the service providers is present in the Tarwewijk.

Income

Besides the density and target group, shared providers look at the income of their market potential. Looking at the income of the inhabitants of Tarwewijk, these are among the lowest in Rotterdam. About 66% of the inhabitants have an income in the lowest group (Gemeente Rotterdam, 2020). According to Golub et al. (2019), low-income households are likely to face transport disadvantages in their daily lives. Di Bartolo, Bosetti, de Stasio & Patrizia Malgieri (2020) adds that shared mobility services have the potential to offer different transport opportunities for the low-income groups. A service provider (personal communication, 14 April 2020) mentions that the low income of the neighbourhood in Rotterdam-South would not be a problem for their business case. Besides, they add that shared mobility may be an opportunity to improve the transport poverty the area of Rotterdam-South is struggling with.

Vandalism

According to the service providers, one of the main aspects why service providers do not operate in Rotterdam-South and Tarwewijk, is the high rate of vandalism. However, one of the service providers (who partly operates in Rotterdam-South) mentions that they consider the risk of vandalism to be greater in Rotterdam-South. However, this has not yet become apparent. When looking at the neighbourhood profile of Tarwewijk for the safety domain, it showed that on a subjective level the neighbourhood scores below the average of Rotterdam. This means that the inhabitants are not satisfied with the safety in their neighbourhood. On an objective level, these numbers are different. Besides these general numbers, the neighbourhood profile also has specific numbers for the number of crimes of the theft of bicycles and scooters and the number of crimes of destruction or damage to properties.

Figure 37 and figure 38 show these numbers for Tarwewijk per thousand inhabitants compared to Rotterdam.For the number of crimes of the theft of bicycles and scooters, in 2020 Tarwewijk scores better than the average of Rotterdam. The number of crimes has also been lower than in previous years. For the numbers o crimes of destruction or damage Tarwewijk scores lower than the average of Rotterdam. However, this number also shows that Tarwewijk scores better on this domain than the previous years.

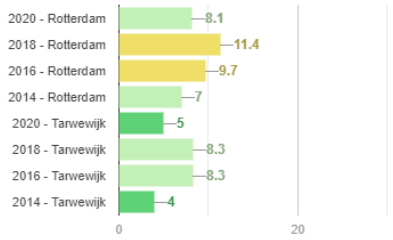


Figure 37: Number of crimes of the theft of bicycles and scooters (Basisvoorziening Handhaving, 2019)

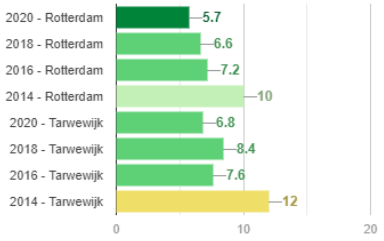


Figure 38: Number of crimes of destruction or damage to properties (Basisvoorziening Handhaving, 2019)

Interest areas

Another factor for determining a service area is the presence of interest spots in an area, like cafes, restaurants, hospitals, etc. When looking for these aspects for the neighbourhood of Tarwewijk, there are no specific interest areas within the neighbourhood like mentioned before. However, there are two large urban area developments planned and in progress for Rotterdam-South. These are the developments of Hart van Zuid and Rijnhaven. Both developments are closely located in the neighbourhood of Tarwewijk. With the development of Hart van Zuid, which is already in execution, a new vibrant centre with various mixed functions will be developed for Rotterdam-South. Hereby, this development can serve as an interesting area for Tarwewijk. Another large urban area development is Rijnhaven. For this development, a masterplan is made by the municipality of Rotterdam and the execution is planned for the coming years. The development of Rijnhaven is designed to be a new destination with new functions and facilities for the city and the surrounding neighbourhoods. Moreover, a mobility hub will be created for various transport modes among others shared mobilities. Hereby, the development of Rijnhaven can also serve as an interesting area for Tarwewijk.

5.5.1 Cross-case analysis

From the previous information about Tarwewijk, a cross-case analysis can be made. Table 5 shows the cross-case analysis for Tarwewijk in comparison with the five criteria of service providers. Hereby, a distinction is made in three categories: present, equal and absent. It can be said that the density and target group needed for shared mobility services is present in Tarwewijk since the density of the neighbourhood is even higher than the city centre. Moreover, the main target group of 25-35 years is also present. When looking at the criteria of vandalism, numbers for theft and destruction/damage do not show a big difference between Tarwewijk and the rest of Rotterdam. However, this is still an important criterion for service providers. For the income of inhabitants of Tarwewijk, it can be said that this is lower than the rest of the Rotterdam. This given fact may influence the use of shared mobilities in the neighbourhood. Since service providers state that the usage of the services in Rotterdam-South was low when they operated there. Finally, there are no specific interest areas in Tarwewijk. However, new large area developments can be an opportunity for the neighbourhood. So, three of the six criteria are absent in Tarwewijk and one criteria can be seen as equal to the rest of Rotterdam. The absence of these criteria in Rotterdam can be a barrier for users and service providers. In the synthesis (chapter 7) a comparison will be made between the findings from literature and empirical research. Hereby, this chapter will elaborated on which potential solutions show the most promise in overcoming barriers in Tarwewijk.

Table 5: Cross-case analysis Tarwewijk (own table)

CRITERIA SERVICE PROVIDERS	TARWEWIJK
Density	✓
Usage	✗
Target group	✓
Income	✗
Vandalism	=
Interest areas	✗

✓ Present = Equal ✗ Absent

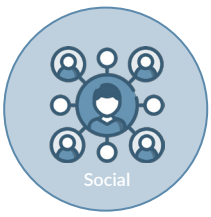
06 URBAN RENEWAL AND SHARED MOBILITY

The previous chapter has analysed the potential of shared mobility systems in Tarwewijk based on the factors determined by service providers. This chapter will describe the findings from the semi-structured interviews. All interviewees were asked about the potential (positive) effect of shared mobility services on urban renewal areas. Whereby, the focus was on the four aspects of urban renewal, namely economic, social, physical and environmental.

6.1 URBAN RENEWAL IN TARWEWIJK

The NPRZ has set up various challenges for the neighbourhoods of Rotterdam-South and also Tarwewijk to address for the coming years. Hereby, it is important to see for which of these challenges shared mobility services can affect positively and contribute to the quality and improvements of the Tarwewijk. Therefore, the challenges of the NPRZ for the Tarwewijk are categorized according to the four aspects of urban renewal. To summarise again, these are the following:

- Opportunities for work at Brielselaan in time;
- More space for small entrepreneurs in the edges of the neighbourhood;
- Concentrate facilities on 3 nodes Dordtselaan;
- Probability map Brielselaan in the long term.



- Improve social cohesion and participation in society
- Improve the isolated location of Tarwewijk by, offering small-scale transport and improving the connections to Zuiderpark and Katendrecht;
- Create a balance in the use of living areas and traffic areas.

- The transformation of the Mijnkintbuurt and Tarwebuurt to a family-friendly living area;
- Improve the isolated location of Tarwewijk by, offering small-scale transport and improving the connections to Zuiderpark and Katendrecht;
- Agreements about where and how to sell dwellings, social real estate and business premises for the municipality and housing corporations.

- Use green spaces in the neighbourhood as carriers of new living environments;
- Greening of the neighbourhood;
- Improve the appearance of the Maashaven subway station.

Hereby, it is important to see for which of these challenges shared mobility services can affect positively and contribute to the quality and improvements of the Tarwewijk. The data is gathered from the literature review, the case study and interviews with diverse parties about the effect of shared mobility services.

6.2 ECONOMIC RENEWAL

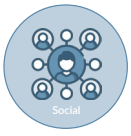
Looking at the impact that mobility can have on the economics of a city, literature states that mobility can increase the possibilities for inhabitants and businesses since it will promote economic competitiveness. Moreover, if public parties invest in the mobility and infrastructure of a city, this can attract sectors and businesses (Czischke, Moloney & Turcu, 2014).

Interviews

The senior mobility advisor of the municipality (personal communication, 4 May 2020) stresses the importance of good accessibility and infrastructure for the macro-economic developments of an area. When public parties invest in new infrastructure, the travel distance and time for residents can be reduced. Hereby, the range in which residents can find work and employment may increase. This same principle applies to businesses. Herewith, the sale market can increase by these new investments. So, if the new infrastructure of new mobility is added to an area, the accessibility can increase which offers new opportunities for the labour market, sales market, the development of new knowledge and the developments of specializations (Senior advisor mobility, personal communication, 4 May 2020). For the micro-economic effect of mobility on urban renewal and urban development, the senior mobility advisor (personal communication, 4 May 2020) thinks that if the accessibility to an area is increased it is likely that is also becoming more attractive for some residents to live there. So, hereby the demand for real estate increases and potentially also its value. However, the senior mobility advisor does not think that shared mobility contributes to this. Moreover, it is stated that shared mobility will not add any economic value for an area or neighbourhood. Service providers can determine their own service areas within a city. Therefore, there is always the risk that they can withdraw from certain neighbourhoods or areas. Which has also happened in the areas of Rotterdam-South (Senior advisor mobility, personal communication, 4 May 2020). Advisors of Overmorgen (personal communication, 28 April 2020) add that if you look at the broader economic picture, shared mobility would not have any influence on for example employment or people's purchasing power. Since shared mobility services are only used by a specific target group, this will remain something for a niche. So, shared mobility is strong when it comes to complementing the missing links in mobility and for instance public transport. However, there will be an upper limit for its use, which will therefore also keep the economic impact of shared mobility minimal. The other interviewees also did not mention any positive impact of shared mobility on urban renewal.

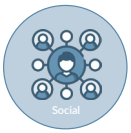
Tarwewijk

So, according to the interviews, the potential effect of shared mobility services on economical renewal in Tarwewijk and other disadvantaged neighbourhoods is minimal. Literature states that mobility in general can affect the economics of a city, moreover on the inhabitants and businesses. However, since shared mobility is only a niche in the transport market, the effect remains low. Therefore, it will not contribute to the economic objectives of the NPRZ.



6.3 SOCIAL RENEWAL

Literature states that social renewal can improve the living conditions, health and wellbeing, education and skill levels for the inhabitants. Moreover, it will increase the facilities and green spaces in an area (Ginsburg, 1999). Moreover, if urban renewal is implemented well, this can help citizens participating in the community and society. When looking at the aspect of mobility on social renewal. It can be said that a lack of public transport or other mobility options for residents of disadvantaged neighbourhoods, can potentially hinder their social participation and lead to social inclusion (Noack, 2011). Another additional aspect of limited public transport in disadvantaged urban neighbourhoods is that inhabitants are like to make use of the car.



Interviews:
The advisors from Overmorgen (personal communication, 28 April) state that potential decrease in car-ownership by shared mobilities can reinforce the trend of low-traffic streets or more people-oriented streets. When mobility modes such as cars are clustered outside the neighbourhood to make a place for active mobility as walking and cycling within the neighbourhood. This can allow residents to reclaim public space and use street space for community activity. Moreover, the advisors mention the increasing trend in urban development, named "Healthy urban living". This concept is about making areas greener, healthier and more liveable. Shared mobility plays a major role in this concept. So, active forms of shared mobility can also have health benefits for users.

Furthermore, it was asked what the positive effect is of shared mobility can be on users. One aspect mentioned in multiple interviews when asking what the positive effect is of shared mobility on users is flexibility (Advisors Overmorgen; Strategist Mobility & Environment; Advisor and coordinator smart mobility, Senior advisor mobility, 2020). With shared mobility inhabitants and users have more flexibility and more freedom of choice for transport modes. Another important aspect obtained from the interviews is the happiness of persons, whereby the term "mobiliteitsgeluk" is mentioned. De Verkeersonderneming (2020) defines "Mobiliteitsgeluk" as the extent to which mobility contributes to people's happiness. As described before, shared mobility can increase the mobility options of users. The interviewees state that this can positively affect the happiness of users since shared mobility will increase and expand their accessibility towards certain places (e.g. work, services, health etc.).

Also, the interviewees were asked about the possible positive effects of shared mobility on transport poverty. Since, studies have shown that a large part of the inhabitants of Rotterdam-South is dealing with transport poverty (Van der Bijl & van der Steenhoven, 2019). Transport poverty can hinder the mobility of inhabitants in their accessibility to work, education, health and social contacts. All interviewees think that the use of shared mobility can contribute to counter transport poverty in the neighbourhoods of Rotterdam. Since it can improve the accessibility of various locations and solve the potential first-mile problem. However, it is also stated that the problem of low usage should be addressed. So, new initiatives should come to understand what the inhabitants need. Moreover, it is crucial to know how the inhabitants of Rotterdam-South can be stimulated to use shared mobility services. The advisor and coordinator smart mobility (personal communication, 30 April 2020) also mentioned that the municipality previously conducted a pilot with the concept of MaaS with 100 different households. Hereby, 100 households were selected who were a good reflection of all inhabitants of Rotterdam So, low-income households also participated within this pilot to test the MaaS for two months. From this pilot, various insights came, such as the affordability of these services for low-income people. So, according to the advisor and coordinator of smart mobility besides the usage of these services, it is also important to look at finance and affordability.

Tarwewijk:
In contrast to the economic effect of shared mobility on urban renewal, there is a social effect. Since shared mobility can increase the mobility options of users it can positively affect the happiness of users. Moreover, it contributes positively to decrease transport poverty since it is likely that shared mobility expand the accessibility of users towards certain places (e.g. work, services, health etc.). Hereby, it will also contribute to the objectives of the NPRZ to improve the social cohesion and participation of the inhabitants into society. Moreover, it can also contribute to improving the isolated location of Tarwewijk. Since it offers the inhabitants with more mobility options and therefore they can also use these shared mobility services to connect and access the nearby neighbourhoods. Another objective of the NPRZ for Tarwewijk is to create a balance in the use of living areas and traffic areas. It is known that the Tarwewijk is known for its high parking pressure. Furthermore, the streets are mostly car-oriented with sideway parking. So, the potential decrease in cars by the use of shared mobilities can take place for more active mobility as walking and cycling within the neighbourhood.

6.4 PHYSICAL RENEWAL

Literature states physical renewal is an important and necessary condition for urban renewal (Roberts & Sykes, 2008). Hereby, it is about the physical appearance, the state of buildings and environmental quality. This aspect, environmental quality, will be assessed in the next section. Moreover, Roberts and Sykes (2008) add that an inefficient infrastructure and obsolescent/ vacant buildings can lead to decline and problems within the city.

Tarwewijk:
From the interviews, not a direct response came about the effects of shared mobility on the aspects of physical aspects of urban renewal. However, when looking at the infrastructure of Tarwewijk described in chapter 5. This analysis shows that the neighbourhood is mainly car-oriented. Moreover, the entrance to Tarwewijk from the surrounding neighbourhoods is also difficult. Since the spatial character of Tarwewijk is determined by the large (traffic) structures that run along or through the neighbourhood. Tarwewijk isolated from the surrounding neighbourhoods. So, as Robert & Sykes (2008) states this inefficient infrastructure can lead to decline. Hereby, shared mobility services can be an option to connect Tarwewijk again to the nearby neighbourhoods. Moreover, shared mobility may be used to improve the accessibility for people from outside to the neighbourhood, by solving the last mile problem (Shaheen & Cohen, 2019).

6.5 ENVIRONMENTAL RENEWAL

According to Roberts and Sykes (2008), environmental improvements can be seen as amenity improvements, land and ground treatment, improvement of accessibility and services, more green and open spaces and the improving the quality of the urban design. When looking at mobility in an environmental context. It shows, that the mobility and transport sectors are the main drivers for carbon emissions in a city. To reduce this and optimise the energy use, new approaches are needed (Czischke, Moloney & Turcu, 2014). Hereby, this can be in the form of a model shift, for instance through shared mobility.

Interviews
Like previously mentioned, the advisors from Overmorgen (personal communication, 28 April) state that potential decrease in car-ownership by shared mobilities can reinforce the trend of low-traffic streets or more people-oriented streets. If mobility modes such as cars are clustered outside the neighbourhood to make a place for active mobility as walking and cycling within the neighbourhood. This can allow residents to reclaim public space back and use the streets for community activities. In that way, a neighbourhood can be made not only more social but also more green and liveable. The senior advisor mobility (personal communication, 4 May 2020) adds that shared mobility can contribute to environmental and spatial quality of a neighbourhood.

Moreover, interviews add that shared mobility is mainly about active and/or electric mobility. If more people make use of this type of clean mobility (walking, cycling or electric mobility than this can also improve the climate by less congestion and particulates. Moreover, it can improve the environment quality of neighbourhoods since shared mobility can lead to more cleaner to be quieter neighbourhoods.

Tarwewijk:
The NPRZ has set various objectives on an environmental level for Tarwewijk. Which are among others to create meer green spaces as carriers of new living environments. Currently, each “small” neighbourhood in Tarwewijk has its own green park or square. However, it is also known that there is no coherent interplay of the various public spaces. So, hereby by implementing shared mobility services can increase the amount of public green spaces, and hereby improve the livability of the neighbourhood.

07

SYNTHESIS

07 SYNTHESIS

The goal of this chapter is to come with possible solutions and policy opportunities from literature, that can contribute to the implementation and usage of shared mobility services in Rotterdam-South. Hereby, this chapter focuses on the possible next steps that public parties and service providers can take. This will provide an answer to the research question of which potential solutions show the most promise in overcoming barriers in disadvantaged neighbourhoods in Rotterdam-South.

7.1 BARRIERS IN TARWEWIJK AND ROTTERDAM-SOUTH

The municipality of Rotterdam wants to conduct a pilot, whereby shared mobility systems are provided. The goal of this pilot is to see how this will affect the liveability of the neighbourhood and possible also add more green into the neighbourhood. Such a pilot is not executed before in a disadvantaged neighbourhood. From the empirical research, it became clear that service providers do not or barely do operate in the neighbourhoods of Rotterdam-South, like Tarwewijk. This for several reasons. Fleming (2018) states that public parties have to consider policies that discourage current service providers to serve users who already have access to transportation and pass underserved and low-income communities. So, public parties should ensure that barriers to access shared mobility must be reduced. Moreover, public parties and service providers must work together to address these challenges and barriers to realize benefits from shared mobility services (Di Bartolo, Bosetti, de Stasio & Malgieri, 2016).

From the cross-case analysis of Tarwewijk in comparison to the five criteria of service providers, opportunities and potential barriers have become visible. These were among other the low usage of services, income and vandalism. Hereby, the next section will show possible solutions and policy opportunities as described in chapter 2.4 from literature to overcome these potential barriers.

7.1.1 Spatial accessibility

As described before, service providers do not or barely do operate in the Tarwewijk and comparable neighbourhoods in Rotterdam-South. Kodransky and Lewenstein (2014) states shared mobility systems and stations should have easy and safe access, for users to use it. However, shared mobility systems and stations are rarely located within walking or at an acceptable distance from disadvantaged neighbourhoods (Bergman, 2013). On top of this, the absence of stations can be seen as the main barrier for low usage of shared mobility services in disadvantaged neighbourhoods.

According to Kodransky and Lewenstein (2014) services providers determine their services areas based on two aspects: potential profits and risks. If the demand for shared mobility services is low, this can impact the business case. Therefore, shared mobility services start their operations mainly in high mixed density areas. Another aspect can be the high level of risks in disadvantaged neighbourhoods. This is the form of vandalism or theft to the systems. In the interviews with service providers, both of these aspects were mentioned as reasons to not operate in certain neighbourhoods of Rotterdam. So, service providers leaving out these neighbourhoods and groups (Kodransky & Lewenstein, 2014) can hinder the physical accessibility. Eventually, leading to transportation inequity (Snellen & Hollander, 2016).

Policy and strategy opportunities

From literature, two policy opportunities can be found to potentially improve the spatial accessibilities of shared mobility services. Shaheen et al. (2017) mention that public parties can set policy requirements for service providers to also operate in disadvantaged underserved areas. This policy can work if the service providers have enough market potential in the more dense areas, to cross-subsidy the other areas. Another possible solution can be granting governmental subsidies to service providers, as an incentive to provide for these services in disadvantaged neighbourhoods.

Comparison

With the new permit system, the municipality can not oblige the service providers to operate in the neighbourhoods of Rotterdam. Moreover, they do not want to interfere with the business of service providers. However, the municipality does still have the wish for service providers to also operate in Rotterdam-South. Literature suggests granting subsidies as a potential solution to encourage service providers to operate in underserved neighbourhoods. This potential solution was also mentioned in several interviews (Strategist Mobility and Environment, personal communication, 2 April 2020; Service provider, personal communication, 23 April 2020).

Another suggestion came from the interviews is the use of mobility hubs instead of a free-floating system in disadvantaged/underserved neighbourhoods. This can counter possible vandalism to systems in disadvantaged neighbourhoods. Hereby, hubs should be placed at main streets and/or near to a subway station. In literature, the use of mobility hubs to counter vandalism is not discussed directly. However, it is mentioned that mobility hubs can be an option to also address the digital divide barrier in disadvantaged neighbourhoods. Shaheen et al. (2017) mention that if mobility hubs are placed strategically in a neighbourhood, this can help persons without a smartphone or access to the internet to use a variety of shared mobility service.

7.1.1. Low usage of services

Studies have shown that shared mobility systems can provide new opportunities and benefits for the people in disadvantaged neighbourhoods, like Tarwewijk. However, it is also mentioned that these services often do not reach these groups and their usages remain lower than other areas within the city (Kodransky & Lewenstein, 2014; Shaheen & Cohen, 2018). This fact is also mentioned in the interviews with service providers. During the time that service providers operated in the neighbourhoods of Rotterdam-South. they saw that the usage of their services was lower. From the cross-case analysis, it shows that the density and target group are present in the neighbourhood of Tarwewijk. So, other potential barriers can play a role in the low usage of this neighbourhood.

Economic

In comparison to the use of public transport and other slow traffic modes, such as walking and private cycling, shared mobility services can be more expensive for users. This, because service providers do work on a pay-as-you-go pricing method (Shaheen & Cohen, 2019). Moreover, these services also charge for other extra costs (Kodransky & Lewenstein, 2014). However, in comparison to car ownership, shared mobility services may be more affordable. So, if shared mobility services do not provide services that are affordable for low-income groups, this can be an issue and impact the use. When looking at the income levels of the neighbourhood of Tarwewijk, numbers show that 66% of the inhabitants have an income in the lowest group (Gemeente Rotterdam, 2020). Moreover, 13% of the inhabitants are unemployment or are receiving social assistance. Currently, the service providers in Rotterdam do not make any distinction in areas or neighbourhoods when it comes to their fares and service prices. Except, the shared scooter provider Felyx. This service provider has started with so-called dynamic pricing. With dynamic pricing, Felyx wants to match and stabilize the demand and supply of their scooters. So, more scooters should be placed in the demand areas instead of the low-demand areas. Therefore, Felyx has decided to make their services cheaper in low-demand areas. The idea of this is that the services will be used faster and users will transport the scooters again back to busier and more demand areas (Felyx, 2020).

Policy and strategy opportunities

From literature, policy opportunities can be derived to decrease these financial burdens for low-income groups. A potential to decrease these burdens can be done by reducing the fees and taxes of the shared mobility services. Moreover, the users' costs of the services can be lowered for low-income people who can not afford to pay market prices (Kodransky & Lewenstein, 2014; Shaheen et al., 2017). So, this can be executed in the form of discounts by service providers or subsidies by public parties. Kodransky & Lewenstein (2014) add that an option to make the people that gain social assistance or live in social housing be eligible for discounts and subsidies since this information can be verified.

Comparison

So, literature states that offering discounts by service providers or subsidies by public parties can be a policy opportunity to overcome the financial barriers for inhabitants in disadvantaged neighbourhoods. Currently, public parties do not give any type of subsidies to people in disadvantaged neighbourhoods, like Tarwewijk. Moreover, the service providers do also not discount specific areas or neighbourhoods, except Felyx with their dynamic pricing. However, dynamic pricing has started since May 2020. So, the impact of the system is rather unknown. So, to overcome the potential barrier of income, public parties and service providers may implement these solutions.

Culture & Education

Besides income and digital divide, other potential barriers are mentioned in the literature like culture and education. Cultural values of certain groups can influence the usage of shared mobility services. This can be influenced by several factors, such as the lack of trust about financial, privacy and security, discomfort with the shared mobility systems and preference to other vehicles (Kodransky & Lewenstein, 2014). Another aspect can be the lack of information and education of shared mobility services in a disadvantaged neighbourhood. If persons do not know how to use a certain system, this can influence the usage of shared mobility services negatively. When people do not know how to use systems or understand their potential benefits, they will be likely not to use it.

Tarwewijk is known as a multicultural neighbourhood since various groups live together. Almost, 80% of the inhabitants in Tarwewijk have an immigrant origin in comparison to 20% of Dutch inhabitants. Kodransky and Lewenstein (2014) add that is still unclear to what extent ownership of a vehicle is a status symbol, across these groups. Moreover, the inhabitants of Rotterdam-South cycle compared to the rest of the Netherlands. This to several reasons, among other cultural factors, but also skills to do so (Van den Ende, 2018).

Policy and strategy opportunities

From literature, potential strategies can be conducted to approach cultural values and lack of education in shared mobility services. Hereby, the users should be made more comfortable with using these shared mobility systems. It is also important to state that not all systems will suit a specific group or neighbourhood. Therefore, public parties should reach a neighbourhood in a tailored way (Kodransky & Lewenstein, 2014). Besides, more outreach programmes can help to overcome the barriers of absent information and education for users. These programmes should focus on why certain groups do not or can not use shared mobility systems. If public parties partner up with local community organizations, this can potentially help to guide and implement such programmes into disadvantaged neighbourhoods (Shared-Use Mobility Center, 2019; Shaheen & Cohen, 2019).

Comparison

So, from the literature, it can be stated that public parties should reach disadvantaged neighbourhoods in a tailored way. Since not all smart mobility systems will suit all residents. Furthermore, specific outreach programmes should be implemented in collaboration with a local community organization. In Rotterdam-South, the municipality, the Verkeersonderneming and other parties are already implementing various pilots and projects (Advisor Mobility, personal communication, 27 March 2020). Moreover, the advisor mobility (Personal communication, 27 March 2020) mentions that the municipality conducts various pilots, where shared mobility is a part of to see what is necessary to implement good businesses cases.

For instance, one of the pilots executed from November 2018 till April 2019 was the Mobility as a Service (MaaS) experience with 100 participants. The Rotterdam MaaS experience was set up to support the development of MaaS and gain insights into the travel behaviour of the inhabitants of Rotterdam (De Verkeersonderneming, 2019). A variety of participants were selected to participate since the pilot had to be a good reflection of the total inhabitants of Rotterdam. Hereby, attention was paid to a representative distribution based on household disposable income, cultural origin, car ownership and age (De Verkeersonderneming, 2019). The pilot consisted of two phases. During the first phase of the Rotterdam MaaS experience, participants were able to travel with a mobility card (with a monthly budget of 200 euros) for four months using various transport services. These services include among other public transport, (electric) bicycles, shared mobility services, taxis, etc.

The second phase was a follow-up period of two months whereby participants were able to choose from a follow-up offer, in which they had to partly pay for themselves. Participation in this second phase was optional (De Verkeersonderneming, 2019). The results of the pilot showed that almost all participants were interested in the concept of "Mobility as a Service". However, it also became clear that not all participants have equally good access to MaaS services. This due to their financial situation, the availability of transport in the neighbourhood, exclusion by payment systems or lacking the digital skills to plan trips. So, the Verkeersonderneming (2019) concluded that when developing a MaaS service, there is a need to take into account a diverse group of travellers.

A project that is already implemented is the "Fietsenbank". This project offers inhabitants with low-income living in the district Fijenoord, Rotterdam-South, the opportunity to rent or buy bicycles for little money (De Afrikaanderwijk Coöperatie, 2019). This project aims to make bicycles accessible to everyone. Since it is known that the inhabitants of Rotterdam-South are the least mobile, the Fietsenbank also gives cycling lessons and information about the practical things about cycling. Moreover, it allows inhabitants to gain work experience by repairing or refurbishing bicycles.

7.2 CONCLUSION POSSIBLE SOLUTIONS

As concluded from the cross-case analysis of Tarwewijk in comparison to the five criteria of service providers, opportunities and potential barriers have become visible. These were among other the low usage of services, income and vandalism. This chapter aimed to find possible solutions to contribute and potentially overcome these barriers. This was done by comparing the findings from the literature study with empirical research.

Hereby, the following potential solutions are found that can help to overcome barriers to use shared mobility services in disadvantaged neighbourhoods, more specific for Tarwewijk.

- Granting governmental subsidies to service providers, which can serve as an incentive so they can provide for services in disadvantaged neighbourhoods. Hereby, these subsidies can address the risk of reduced financial viability for service providers is these areas.
- Provide shared mobility services in the form of mobility hubs at strategic and main locations within the neighbourhood. Herewith, the risk of vandalism to the systems can possibly be reduced. Moreover, it can contribute to the digital divide of shared mobility services.
- Introduction of dynamic pricing for all shared mobility services by service providers, whereby discount can be given to specific areas or neighbourhoods.
- Not only granting subsidies to service providers, but also for low-income persons could be a potential solution to overcome financial barriers. Hereby, public parties should reflect on which groups can be eligible for these subsidies.
- Public parties should reach disadvantaged neighbourhoods in a tailored way. Since not all smart mobility systems will suit all residents. Furthermore, specific outreach programmes should be implemented in collaboration with a local community organization.

08

CONCLUSION, DISCUSSION & RECOMMENDATIONS

08 CONCLUSIONS

This chapter aims to provide the conclusions derived from the research. Firstly, the sub-question based on the theoretical output from the literature review will be answered. Thereafter, the sub-questions will be answered based on the empirical research output. These answers will serve as the basis for answering the main research question, which is presented in the final section.

8.1 ANSWERING THE SUB-QUESTIONS

Before answering the main research question of this research, "in what way can public parties use smart mobility services to stimulate urban neighbourhood renewal in Rotterdam-South?" this section will present the conclusions of the sub-questions.

1. What is urban renewal?

Urban areas are no static entities since they can change and age over time when used by its residents, visitors and businesses. While some areas can continue performing well, others can be confronted with a decline and various urban problems (e.g. deterioration of streets, disappearing facilities, an increase of crime and vandalism, etc). Eventually, these urban areas need maintenance and renewal. Herewith, the concept of urban renewal can be explained as an integrated vision and strategy to solve urban problems in areas that are in a state of decay by improving and upgrading the economic, social, physical and environmental conditions. Figure 39 summarises the main elements of the four aspects of urban renewal.

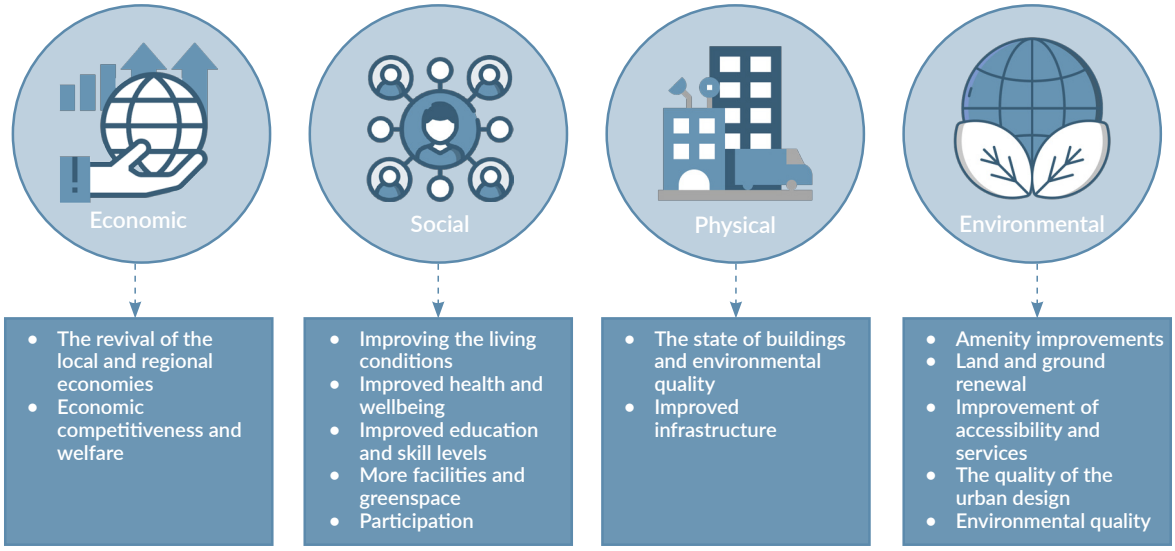


Figure 39: The four aspects of urban renewal (own illustration)

2. Which shared mobility services and business models are available?

One of the four key components of concept smart mobility is “new mobility services”. These are among others, shared (micro-) mobility services (e.g. car sharing, ride sharing, bike sharing and scooter sharing), on-demand riding services and Mobility as a Service.

Car sharing: is provided by mobility providers and offers its users turn-key services. This means, that users only pay for the time they use the vehicle or the distance they drive with the vehicle. Two types of car sharing services can be distinguished. These are the Business-to-Consumer (B2C) and Peer-to-Peer (P2P)model.

Ride sharing: allows more than one person to travel in a vehicle. This ensures that multiple people do not have to drive to a location themselves. This concept of ride sharing is not new and is already used for a long time. Carpooling and vanpooling are examples of this. However, rapid new developments in ICT has led to the emergence of new businesses models, namely on-demand riding services. These services are application-based, whereby it can in real-time match the geo-located demand and supply.

Bike-sharing: the growing concerns about urban problems have led to the increase of sustainable transport modes, such as bike-sharing. Bike-sharing services offer users hourly access to the use of bicycles within the services areas of a city. Bike-sharing systems can be distinguished in three type of systems, station-based bike-sharing systems, dockless bike-sharing systems and hybrid bike-sharing systems. Within these systems, various bike-sharing business models have evolved. These are among others: street furniture bike-sharing, sponsorship based bike-sharing, non-profit bike-sharing, for-profit bike-sharing, public transport agency bike-sharing and publicly owned bike-sharing.

Scooter sharing: like bike-sharing, these services allow users hourly access to the use of scooters within the services areas of a city. A distinction can be made into two types of scooters, namely moped-style scooters and standing electric scoters. The second type is also known as a step.

Mobility as a Service (MaaS): can be described as a digital platform, where different mobility services (e.g. bike- and car sharing, etc.) and traditional transport modes are combined. This digital platform is operated by one single provider which distributes the services to its users.

3. Who are the users of shared mobility services?

The concept of shared mobility has experienced growth and is nowadays becoming more and more mainstream. When looking at the users of this concept. In general, there is no clear profile for the users of shared mobility services. This because the number of studies on the users are limited or based on small samples. Yet, the typical users of shared mobility services appear to have some key generalities. The users are in general well educated, young and digital experienced adults living in urban areas of the city. Also, the users often belong to higher-income households, who do not have children (yet) and own fewer cars per household.

4. What are potential barriers for using smart mobility services in disadvantaged neighbourhoods?

The inhabitants of disadvantaged neighbourhoods are more likely to face transport challenges, which hinders them to access various services and opportunities in their daily lives (employment, health care, education, etc). Shared mobility services are seen as an opportunity for these inhabitants since it can bring improvement of equity and accessibility to transport. However, it is also known that these shared mobility services do not reach this group and therefore the usage of the services is lower. This to several challenges and barriers for the user's to access and use these services. These challenges and barriers can be classified into five areas, which are: 1) Social, 2) Economic, 3) Digital approach, 4) Spatial & Geographic and 5) Culture & Education.

1. *Social:* when offering shared mobility services for certain groups, such as elderly, people with limited mobility, people with disabilities, various barriers can arise. This, if no accessible shared mobility service or an equivalent alternative is offered for this group.
2. *Economic:* for this area, multiple barriers can occur for users. Firstly, shared mobility services work on a pay-as-go pricing method. This means that users pay for the amount of time or distance they use these services. The costs for these services are often more expensive than for instance the use of public transit, walking, cycling. Besides, the usage of these services can bring additional costs, like membership fees and application costs. Secondly, most mobility services require users to have a bank/credit card for the payment of their services. So, people who do not own these cards can not make use of shared mobility services.
3. *Digital approach:* besides a bank/credit card, service providers also require that users have a smartphone with access to internet data. Since most shared mobility services are used through a mobile application. This can be a barrier for certain groups, who have limited smartphone ownership.
4. *Spatial & Geographic:* studies have shown shared mobility systems and stations should have easy and safe access, for users to actually use it. However, shared mobility systems and stations are rarely located within walking or at an acceptable distance from disadvantaged neighbourhoods. So, if shared mobility services do not serve a disadvantaged neighbourhood for different reasons than this can be a physical barrier for users.
5. *Culture & Education:* barriers that can influence the usage of shared mobility services are potential cultural values of certain groups. Hereby, factors as lack of trust, discomfort with the shared mobility systems and preference to other vehicles can play a role. Besides, the lack of information and education of shared mobility services in a disadvantaged neighbourhood can influence the usage as well. When people do not know how to use systems or understand their potential benefits, they will be likely not to use it.

5. What is the main motivation of the municipality of Rotterdam when selecting a specific neighbourhood for implementing a shared mobility pilot project?

So, the municipality of Rotterdam wants to conduct a shared mobility pilot in the neighbourhood of Tarwewijk. This in response to a successfully conducted pilot with shared mobility services elsewhere in Rotterdam. Hereby, the municipality wants to examine the impact of shared mobility services on the liveability of the neighbourhood and possibly the addition of more green in the public areas. This since the neighbourhood of Tarwewijk has a major parking task and deals with high parking pressure. The previous pilot was executed in a neighbourhood within the city centre and the municipality has not conducted such a pilot before in a disadvantaged neighbourhood, which is dealing with various socio-economical problems. Furthermore, which is also experiencing problems as transport poverty. Therefore, the municipality of Rotterdam has decided to conduct a pilot in the neighbourhood of Tarwewijk to see what the potential is of shared mobility services.

6. Which shared mobility services are used in Rotterdam?

This study is focusing on a specific aspect of shared mobility services, namely micro-mobility services. Among micro-mobility services, bike-sharing, scooter and other forms of low speeds modes can be found. Since begin 2020, the municipality of Rotterdam works with a permit system for shared mobility services. Currently, six shared mobility services are granted with a permit with which they are allowed to operate in the city. These are Mobike, Donkey Republic and JUMP for bike-sharing and for scooter sharing these are Felyx, GO Sharing and Check.

When looking at the bike-sharing system. All three systems are fourth-generation bike-sharing systems and use smart lock systems with GPS. Moreover, all services are available by a smartphone application. Two out of the three services (Mobike and JUMP) are dockless bike-sharing services, also known as free-floating systems. On the contrary, Donkey Republic is a dockless bike-sharing system, however not free-floating. This system is based on a hub-centric model, whereby users have to drop their bicycle at a specific drop-off location within the city. All services allow their users to drive outside their predetermined service areas. However, at the end of their usage, they need to be returned to a service area. Like the bike-sharing systems, the scooter sharing systems also work on smartphone application-only base. All three services are free-floating systems and allow their users to drive outside the services areas. However, like the bike-sharing systems, the scooters need to be returned to a service area.

7. In which areas of Rotterdam are these services distributed?

All services providers determine their specific services areas within the city based on certain factors. From the interviews the following factors have emerged: 1) Density & Usage, 2) Target groups, 3) Income & Vandalism, 4) Interest areas and 5) The use of the applications.

In Rotterdam, the service providers are mainly active within the city centre. Besides they are also operating the East and North parts of Rotterdam. When looking for shared mobility services in Rotterdam-South only two out of the six service providers do operate in the area. These are the bike-sharing service of Donkey Republic and GO Sharing. However, these providers also do not operate in all neighbourhoods of Rotterdam-South.

8. Why are service providers providing services in Rotterdam-South or why are they not?

From the conducted interviews in the empirical research, three main factors are found that play a role in why service providers do or do not operate in Rotterdam-South. These are providing a regional solution, the usage of services and vandalism.

- *Providing a regional solution:* one of the reasons that some service providers do operate in Rotterdam-South is that they want to offer regional solutions. Hereby, the need for mobility does not only exist in the dense city centre but also in rural areas of the city.
- *The usage of services:* when the service providers operated in the neighbourhoods of Rotterdam-South, the usage of the services were lower compared to the rest of the city. Because of this low usage, the vehicles were often left at loose places. So, service providers needed to redistribute their vehicles to more popular places within the city. However, this led to high redistribution costs.
- *Vandalism:* the shared mobility services that have operated in the past in Rotterdam-South have experienced high numbers of vandalism. Herewith, bikes and scooters were often demolished or stolen. So, for service providers, the costs of operating in Rotterdam-South were higher than the revenues. This because of the experienced vandalism and the low usage of services. Hereby, the economic risks that Rotterdam-South entailed were too high and therefore service providers decided to reduce their services areas and not include parts of Rotterdam-South anymore.

9. What policy does the municipality of Rotterdam have for the implementation shared mobility services?

In the begin of 2020, the municipality has introduced a permit system for shared mobility services that operate in Rotterdam. This permit applies to (electric) bicycles, electric scooters, steps, cargo bikes, etc. Before, the introduction of the permit system, the collaboration between the municipality of Rotterdam and service providers was based on verbal and written agreements. With this new permit system, the municipality wants to improve the quality of shared systems and hereby ensure that users do not experience any inconvenience. This means that service providers are obligated to identify and manage the risks of their services and vehicles. Moreover, they also have to think about certain aspects as parking places, the number of vehicles, quality of the vehicles, etc. Before issuing a permit, these aspects are assessed by the municipality.

Another change that came with the introduction of the permit is the number of vehicles. The municipality has decided to establish a maximum number of permits for each service within the city. This to ensure that the supply of shared vehicles matches with the demand in the city and therefore there will be no nuisance in public space. Each year the maximum number will be reviewed again to ensure it is matching with the current demand. For 2020, the municipality has decided for a maximum number of 6.500 permits for the city of Rotterdam. Hereby, a distinction is made into different vehicles. For the number of maximum permits, this means the following: 3.000 (electric) bicycles, 2.000 electric scooters, 1.000 electric steps and 500 car bikes and other forms of shared mobility. Since there are only a number permits, the municipality has decided to issue the permits for 5 years. This to ensure a fair playing field for all service providers. After this 5 years, service providers can request again for another permit.

8.2 ANSWERING THE MAIN RESEARCH QUESTION

The main goal of this research was to get a better understanding of how shared mobility services affect and can stimulate urban neighbourhood renewal. Therefore this research addressed the following main research question:

> "In what way can public parties use shared mobility services to stimulate urban neighbourhood renewal in Rotterdam-South?"

Urban renewal is about improving and upgrading the economic, economic, social, physical and environmental conditions of a neighbourhood. By implementation of shared mobility services in disadvantaged neighbourhoods public parties can positively affect and stimulate two urban renewal aspects. These are the social and environmental conditions of a neighbourhood.

With the implementation of shared mobility services in neighbourhoods in Rotterdam-South, the mobility options for users can be expanded. Hereby, this can contribute to the accessibility for users to various services and opportunities, like health services, work, education etc. On top of this, this can positively affect not only their happiness in life but also improve transport poverty. So, shared mobility can contribute to the social aspects of urban renewal. Moreover, the implementation of shared mobility services can potentially contribute to the decrease of car-ownership. Hereby, these car-oriented streets can be transformed to low-traffic streets and people-oriented streets. As a result, more space will be available for green and social/community activities. Furthermore, the implementation of shared mobility can improve the environmental climate and quality of a neighbourhood. Since, shared mobility will provide for less congestion and particulates, which will lead to cleaner and quieter neighbourhoods. So, hereby shared mobility can contribute to the environmental aspects of urban renewal.

However, it must be stated that although the implementation of shared mobilities can offer opportunities for urban renewal areas. It can also bring several barriers and challenges. It is known that these shared mobility services often do not reach residents of disadvantaged neighbourhoods and therefore the usage of the services is lower. So, before implementing shared mobility services to stimulate urban renewal, public parties must consider how to implement policies/strategies. This to ensure that the barriers to using these shared mobilities are eliminated. The following policies and strategies are suggested:

- Granting governmental subsidies to service providers, which can serve as an incentive so they can provide for services in disadvantaged neighbourhoods. Hereby, these subsidies can address the risk of reduced financial viability for service providers is these areas.
- Provide shared mobility services in the form of mobility hubs at strategic and main locations within the neighbourhood. Herewith, the risk of vandalism to the systems can possibly be reduced. Moreover, it can contribute to the digital divide of shared mobility services.
- Introduction of dynamic pricing for all shared mobility services by service providers, whereby discount can be given to specific areas or neighbourhoods.
- Not only granting subsidies to service providers, but also for low-income persons could be a potential solution to overcome financial barriers. Hereby, public parties should reflect on which groups can be eligible for these subsidies.
- Public parties should reach disadvantaged neighbourhoods in a tailored way. Since not all smart mobility systems will suit all residents. Furthermore, specific outreach programmes should be implemented in collaboration with a local community organization.

09 DISCUSSIONS AND RECOMMENDATIONS

This chapter will discuss the vision based on the research results. Following the limitations of this research and the validity and generalization of the research results. Thereafter, recommendations for practice and further research will be given.

9.1 DISCUSSION

9.1.1 Vision based on the research results

The main goal of this research was to get an understanding of how shared mobility services affect urban neighbourhood renewal and how they may improve the quality of a disadvantaged neighbourhood. Hereby, this research concluded that by the implementation of shared mobility services in disadvantaged neighbourhoods public parties can positively affect and stimulate two urban renewal aspects. These are the social and environmental conditions of a neighbourhood. Based on these findings and results this section will present a vision and reflection on what this implementation will mean for the case study area of Tarwewijk.

Tarwewijk is one of the eight neighbourhoods located in the district of Charlois in Rotterdam-South. The neighbourhood is relatively old and can be characterized as a working-class district. Already since its history, Tarwewijk has struggled continuously with poverty and decline. Therefore, since the end of the last century, the government and the municipality of Rotterdam have been working on improving the situation in Tarwewijk focusing on the economic, social, physical and environmental conditions.

To reflect on the potential effects of the implementation of shared mobility services in the neighbourhood, it is important to recognise the strengths and weaknesses of the area. The neighbourhood has a good connection to the other parts of the city of Rotterdam by car traffic and public transport. Hereby, the subway station Maashaven is seen as an important public transport node for Tarwewijk. Unfortunately, the station is lacking the accessibility and the appearance for the neighbourhood. When looking at the spatial character of Tarwewijk, it shows it is determined by the large (traffic) structures that run along or through the neighbourhood. Moreover, Tarwewijk is mainly car-oriented and has high parking pressure. This high land use by parking or other means of transport causes various problems within the neighbourhood, such as the liveability and public space. Consequently, the slow traffic routes are limited to the neighbourhood and do not connect with the surroundings. The same applies to the network of public space, which is also restricted to the neighbourhood. So, because of this spatial and physical character, Tarwewijk is isolated from the surrounding neighbourhoods and has a more inward orientation.

From the interviews, it became clear that by offering various types of options for different kinds of trips, shared mobility services can facilitate a shift from car-ownership and encourage non-motorized mobility. However, the quality and availability of shared mobility services will play an important role to be an attractive alternative for car use. Hereby, these services must include quality, accessibility, safety and comfort. Besides these factors, the availability of slow-traffic routes is crucial. Hereby, Tarwewijk must become more integrated within the urban fabric. This can be achieved by strengthening the infrastructural connections between Tarwewijk and the rest of the city. This is necessary for the support of social-economic related opportunities, such as employment, education, service elsewhere in the city of Rotterdam. A good connection by public transportation and car traffic is already covered in the current situation of the neighbourhood. So, the existing slow traffic network needs to expand and made more attractive. This to make the facilities within the surrounding neighbourhoods more accessible for the residents of Tarwewijk. Moreover, this will attract people from the surrounding neighbourhoods to make use of the facilities of Tarwewijk, which can increase the target market of entrepreneurs. A proposed slow traffic route would be from the Zuiderpark, Zuidplein, Tarwewijk, Rijnhaven and the city centre (Figure 40). Hereby, Tarwewijk can serve as a connection between the two large urban area developments of Hart van Zuid and Rijnhaven.

So, expanding and improving the current slow traffic route of Tarwewijk can be important to stimulate shared mobility services. Moreover, this can lead to a decrease in car-ownership, which can reinforce the trend of slow-traffic streets or more people-oriented streets. Within these trends, public space provides an important setting where social interaction and cohesion can take place. Especially looking at the income of the inhabitants of Tarwewijk, which are among the lowest of Rotterdam. This indicates that the inhabitants will not always have the financial resources to undertake sport or cultural leisure activities elsewhere outside the neighbourhood. Moreover, it is known from the neighbourhood profile that the inhabitants of Tarwewijk are not satisfied with the public spaces in Tarwewijk. Therefore, improving the public space will be important for the quality of their lives. With the decrease in car-ownership and lowering parking pressure, public space can be reclaimed back. Hereby, the various fragmented public spaces, such as the squares can be connected again, emphasizing their various characteristics. This will create a continuous public space, which not only connects the "small" neighbourhoods within Tarwewijk but also connects to the urban landscapes off the Maashaven, het Zuiderpark and the adjacent neighbourhoods (Figure 40). Within this continuous public space, continuous pedestrian paths and slow-traffic routes will create a network of meeting opportunities in public space. Hereby, urban design is seen as an opportunity to influence the behaviour of the public, which can stimulate walking and cycling.

Furthermore, from the interviews, it became clear that service providers do not want to operate in Rotterdam-South and Tarwewijk because of the high risk of vandalism. Hereby, it was suggested to offer shared mobility services in the form of a mobility hub instead of a free-floating system. A hub must be near a subway station or at the main street. When looking at the subway station in Tarewijk, the station of Maashaven is currently not easily accessible and lacks the appearance. Also, the NPRZ has stated that the appearance of the Maashaven subway station should be improved. Despite, the Maashaven station has the potential to be transformed into an important transportation node and mobility hub, were not only different transport streams come together but also cycle routes, bicycle parking, real-time transport information and pedestrian facilities. This will make the mobility hub very well accessible and makes it possible for travellers to easily switch from public transport to shared mobility services. Moreover, the mobility hub will strengthen the urban character of the entrance to the neighbourhood and will serve as an important link on the slow traffic route between the city centre and the rest of Rotterdam-South. Consequently, the opportunity to transform the Maashaven subway station to a major mobility hub will make it an interesting location for both the inhabitants of Tarewijk as the businesses.

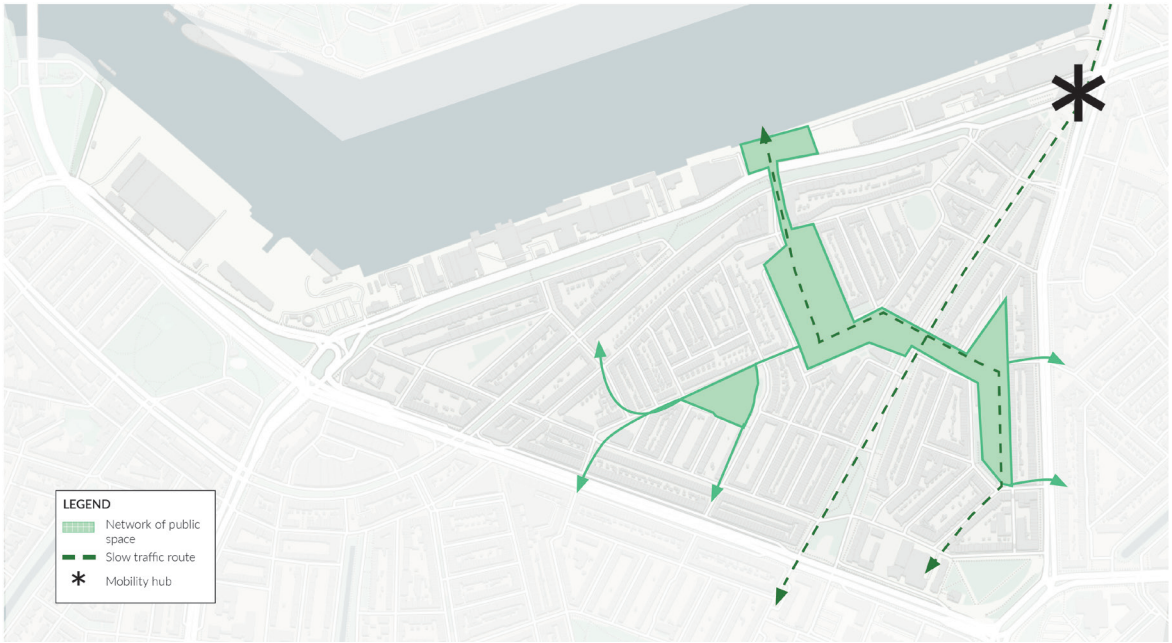


Figure 40: Vision slow traffic route and network of public space (own illustration)

So overall, the implementation of shared mobility services can help to connect the neighbourhood of Tarwewijk again and improves its isolated position. Hereby, it directly affects the social and environmental conditions of the neighbourhood. However, it must also be stated that the implementation can also have an indirect effect on the other aspects of urban renewal (economic and physical conditions) since the four aspects of urban renewal also have mutual relationships. Moreover, when the economic and physical conditions of the neighbourhood are improved by other factors, this can also have a positive or negative effect on the implication of shared mobility services. When for instance the bad image of Tarwewijk is addressed by improving the current state of the buildings and by the development of new mixed-use building this can also attract new residents and visitors. Thus will lead to the use of more shared mobility services. The same applies to economic conditions

However, an important point of attention to mention is that the actual effect of shared mobility services is uncertain yet. Since it depends on the service providers and the will of the inhabitants of Tarwewijk and whether they seize and accept the opportunities or not. A critical player in overcoming both users- and service providers-related barriers is the municipality of Rotterdam. Since its formal authority, the municipality of Rotterdam can play an important role in guiding and steering the expansion of shared mobility services in disadvantaged neighbourhoods, such as Tarwewijk. By both regulation and subsidies, the municipality can stimulate or require service providers to serve in disadvantaged and low-income neighbourhoods. For solving the user problems, the general mobility patterns of the inhabitants must be taken into account. Therefore it is important that the municipality comes with tailored approaches and area-based vision. The inhabitants should be personally informed about the broader benefits of shared mobility services for their neighbourhood and city. This by receiving information from personal sources, such as talking with someone from an outreach programme or community centre. Since there are multiple barriers related to the lack of knowledge about shared mobility services, marketing, education, and outreach programmes are key to increasing the use of services. Moreover, it is known that the population of Tarwewijk is relatively young compared to the rest of Rotterdam, which is an opportunity for the use of shared mobility services. Therefore, the municipality should especially focus to reach this target group by attractive campaigns.

Besides, overcoming both users- and service providers-related barriers it is important that the municipality combines urban renewal and transport policy as part of long-term planning to improve the quality of the urban life in the neighbourhood.

9.1.2 Limitations of the research

The given conclusions must, however, be nuanced. Since there are several limitations to consider alongside this research. The following points of limitations will be discussed:

Urban renewal

- Urban renewal consists of four aspects, namely economic, social, physical and environmental. The four aspects have been described as stand-alone terms. Nonetheless, the four aspects of urban renewal also have mutual relationships. For instance, when an area is economically performing well, this can influence the other aspects of an area positively. However, the opposite is also possible. So, these relationships can cause either a positive effect on urban renewal or a negative effect. The mutual relationships can also ensure that the implementation of shared mobility services has an indirect effect on the other aspects of urban renewal. These interrelationships were disregarded in the study, thus a limitation of this research.
- When examining the effects of shared mobility services on urban renewal, the other aspects of urban renewal must remain stable (or should be monitored). Otherwise, the other aspects may influence the effect on urban renewal.

- Over the last 50 years in Europe countries have set up various urban renewal policies to renew their cities. It is known that the direction of these policies has changed several times, giving priority to different aims and objectives. Hereby, the four aspects economic, social, physical and environmental have influenced and are still influencing the policy and type of urban renewal programmes implemented. In addition to these four aspects of urban renewal, there may be other aspects that can influence urban renewal, such as political. Since the political scene and ideologies of the prevailing party can determine the direction of urban policy, which affects the choice of programmes and funding support. Therefore, the political aspects need to be added to the other four aspects of urban renewal.

Shared mobility services

- This research aimed to identify how shared mobility services can affect urban renewal areas and how this can improve the neighbourhoods in Rotterdam-South. Currently, there are limited services active in Rotterdam-South. So, the conclusion of this research is based on the assumption that service providers will operate again in Rotterdam-South in the future. This if the factors of vandalism and usage for shared mobility services will be improved. This might not be the case in practice.
- For this research, several interviews were held with advisors, the municipality of Rotterdam and service providers. However, due to circumstances of COVID-19, the perspective of the inhabitants of disadvantaged neighbourhoods could not be obtained. This because conducting only an online survey would not be sufficient. Since it is known that Tarwewijk is a disadvantaged neighbourhood and an online survey could count out a large group of respondents, such as the elderly or people with a digital divide. So, this is a limitation of this research since the potential barriers and challenges for use of shared mobility services from derived literature could not be compared to the practice.
- Moreover, this research has focused mainly on the micro-mobility aspects of shared mobility. So, bike-sharing and scooter sharing. This can be seen as a potential limitation since the potential effect of car sharing on urban renewal could give other results.

9.1.3 Validity and generalization

- It was decided that a qualitative approach would be appropriate for this research. However, this type of research is generally seen as a research method sensitive to biases. To overcome this, the general data gathered from the semi-structured interviews were compared to the literature. This overview of academic literature can be found in the reference part of this research.
- The interviews were an important part of the data collection in this research. This to obtain different opinions and perspectives from both the municipality as the service providers. However, this also challenges the validity of the findings since they can be influenced by their perceptions. Moreover, for the researcher, it was important not to act biased and choose aside. Therefore, also interviews with advisors were conducted. Conducting more interviewees could have reduced the bias even more.
- Another limitation of the interviews relating to the bias is the fact that during the first interviews new knowledge is gathered from the former interviews. This new information and knowledge are then applied to the following interviews. Hereby, not all interviews are completely comparable.
- Additionally, the final findings within this research are mainly based on the findings from the interviews and empirical research. These are partly evaluated during the interviews. Hence, the conclusion might require a more critical evaluation from experts. So, the accuracy and applicability of these results can be increased.
- The main research question of this research refers to Rotterdam-South, while the case study focuses specifically on the neighbourhood of Tarwewijk. This neighbourhood might not be representative for the rest of Rotterdam-South. Therefore, for the next study, more neighbourhoods in Rotterdam-South should be examined and compared with each other to make this research more valid.
- This research has concluded that shared mobility services can have a positive effect on the social and environmental aspects of urban renewal. However, this does not exclude that shared mobility services can potentially have a positive effect on the other aspects of urban renewal.

9.2 RECOMMENDATIONS

This section will present the recommendations based on the findings and conclusions of this research. Firstly, the recommendations for practice will be given, followed by the recommendations for future research.

9.2.1 Recommendations for practice

This research aimed to help public parties on gaining insights on how shared mobility services work and how they can be implemented in disadvantaged neighbourhoods. Hereby, the following points of advice are given to private parties:

- **A tailored approach for shared mobility services in disadvantaged neighbourhoods.**
  Before implementing and stimulating shared mobility services, it is important to get the know the inhabitants of these neighbourhoods. What are the barriers and challenges for them to use shared mobilities or what does it take for them to get rid of their car? These are crucial aspects to know, before starting any type of shared mobility implementation. So, the needs of the inhabitants should be made clear, by engaging with the inhabitants. This can be in the form of surveys or specific conversations. Moreover, public parties must engage with the local community organization to reach these groups. When the needs of these inhabitants are transparent. Then a more tailored approach for shared mobility services can be developed.

- **Explore the possibility of subsidies**
  From the interviews with the service providers, it became clear that they need a type of incentive before they start to operate in areas of Rotterdam-South again. Hereby, public parties are advised to explore this possibility of subsidies, so it can address the risk of reduced financial viability for service providers is disadvantaged neighbourhoods. Moreover, it is advised to explore a subsidy programme for low-income people.

- **Mobility hubs**
  One of the main aspects mentioned in this research is the risk of vandalism when serving in disadvantaged neighbourhoods. Since all service providers in Rotterdam work on a free-floating base, it is advised to explore the potential of mobility hubs in disadvantaged neighbourhoods. Hereby, it is important to find the right strategic locations within the neighbourhood so that it is accessible to everyone.

- **Dynamic pricing**
  One of the six service providers is using the system of dynamic pricing for low demand areas. Public parties should engage with service providers to test this system and what the potential effect can be in disadvantaged neighbourhoods.

9.2.2 Recommendations for further research

The presented research can be extended in many directions. For this thesis, the focus was on the effects of shared mobility services on urban renewal. The following suggestions are given for further research.

- This research focused on the effect of shared mobility on urban renewal. Part of the research were interviews with advisors, public parties and service providers to get the perspectives on these services. Hereby, adding the perspective of users and non-users is necessary to understand their perceptions of shared mobilities. This would, therefore, be among the foremost recommendations for further research.
- Another interesting aspect for further research is to examine the impact of subsidies on the actual usage of services by low-income people.
- Furthermore is advised to explore the potential of mobility hubs in disadvantaged neighbourhoods. Further research is needed on how these hubs should be organised and where they should be placed within a disadvantaged neighbourhood.

10 REFLECTION

10 REFLECTION

This document presents a reflection on the graduation research and process based on several topics. Firstly, the position of the research topic within education will be discussed. Secondly, the relevance of this research is reflected. This is followed by a reflection on the used research methods. Thereafter, the encountered ethical concerns are discussed. Finally, the chapter closes off with the reflection on the research process from a personal point of view.

10.1 TOPIC OF RESEARCH

This thesis is conducted for the master track Management in the Built Environment. More specific, within the specialisation of Urban Development Management. According to the Delft University of Technology (n.d.), the specialisation of UDM is about managing the decision of the many stakeholders involved within developments of urban areas. Which should lead to high-quality urban areas and place for everyone. Moreover, it aims to design strategies that promote urban environments that meet various sustainability and resilience challenges. With this in mind, this research has two interfaces with the existing graduation themes of UDM. These are the themes of "Sustainable Urban Development and Cities" and "Urban Redevelopment Strategies".

Graduation themes

Due to the urbanization, it is expected that the population will increase and more people will live in urban areas. This can lead to new problems and challenges for cities, but also the transportation sector to meet new objectives regarding sustainability and the quality of life for the people living and working in the cities. Shared mobility services are seen as an opportunity for more sustainable transport in the city. So, since this research is focusing on shared mobility services it will contribute to the Sustainable Urban Development theme of UDM. Moreover, this research is about the potential effect of shared mobility services on urban renewal and how these services can potentially improve the quality of disadvantaged neighbourhoods. Hereby, urban renewal can also be interpreted as urban redevelopment (Wassenberg, 2010). Therefore, this research will also contribute to the theme of Urban Redevelopment Strategies.

The master track " Management in the Built Environment"

Since urban renewal is related so all aspects of the built environment (physical, environmental, social and economic) this research also relates to master track and master programme "Management in the Built Environment.

10.2 RELEVANCE

This section will discuss the relevance of this research by reflecting on scientific and societal relevance.

Scientific relevance

Shared mobility services consist of several services and systems, among others micro-mobility. Shared micro-mobility can be seen as a new and expanding subfield of urban transportation research (McKenzie, 2020). Previous studies have shown that micro-mobility has attributable impacts to offer environmental social gains. However, there is little academic research conducted on the impact of other aspects of urban renewal. This research has tried to fill in the gap, by researching the effect of shared mobility services (more specific bike-sharing and scooter-sharing) on all four aspects of urban renewal in disadvantaged neighbourhoods. Moreover, this to get an understanding of how public parties can use these services to stir on each aspect to stimulate urban renewal.

Societal relevance
Not only in Rotterdam-South but many cities in the Netherlands experience social and transportation disadvantages. So, to determine the potential barriers and providing advice on how shared mobilities can be implemented in disadvantaged neighbourhoods, can be helpful for public parties and service providers. Moreover, this can help the inhabitants of the disadvantaged neighbourhood, since public parties and service providers can respond better to their needs and wishes. Besides, effectively implementing of shared mobility services can contribute positively to transport poverty in Rotterdam-South.

10.3 RESEARCH METHODS

The following section will discuss the different research methods that have been applied during this research. The following methods were used in this research: literature review, semi-structured interviews and a case study research.

Literature review
The literature study served as a base for the empirical research of the research. Therefore, it can be seen as the primary source of information for this research. Hereby, the literature study focused on three topics: "Urban Renewal, "Smart Mobility and "Shared mobility services". Hereby, the aim was to understand how shared mobility services can affect the aspects of urban renewal. Finding knowledge and relevant studies about the concept of "Urban Renewal" was easy. However, it must be said that in literature also different and similar terms were used to describe the renewal of an area. Therefore, it was tried to adopt a definition that was broadly accepted in literature. After this, the four aspects of urban renewal could be described. For the concept of "Smart Mobility," it was a bit more difficult to find literature since this a relatively new concept. However, it was managed to give a good definition and describe the elements of smart mobility. From smart mobility also the concept of shared mobility services occurred. The concept of shared mobility services is increasing in popularity and continues to grow. Therefore, enough literature could be found about the various services and business cases. Nonetheless, since it's a relatively new concept, the described impacts of the shared mobility services on the built environment are limited, especially on urban renewal. So, this led to a knowledge gap in research.

Document study
Compared to the literature study, it was easier to find information about the vision of the municipality about mobility and their approach to shared mobility services. As the municipality created, various vision and policy documents, which were openly accessible. Moreover, numbers and information about the case study could be found effortless, through the created neighbourhood profiles and the website of the Research and Business Intelligence department of the Municipality of Rotterdam.

Semi-structured interviews
Several interviews were conducted during the empirical research. Hereby, a distinction is made in advisors, service providers and the municipality. This to get insights from various perspectives. All services providers that got a permit to operate in Rotterdam were contacted. Whereby, five out of the six responded. After having contact, one of the service providers did not want to cooperate with this research. Moreover, one service provider that agreed on an interview later cancelled the interview. This, the impacts of COVID-19 on their business operations was too time-consuming. Unfortunately, this was one of the two service providers that did operate in Rotterdam-South. So, this information would have been valuable. Still, from the interviews with the other service providers relevant information was gathered, for instance about why service providers make certain choices.

Besides service providers, interviews were conducted with advisors to get insights on shared mobilities and the connection with urban renewal and the built environment. Multiple parties were contacted, however, only a few gave a response. Moreover, interviews were conducted with advisors from the municipality. This to get their point of view about services in Rotterdam.

Case study
A case study was part of this research to create empirical knowledge. In this context, the phenomenon that is being investigated is the effect of shared mobility services on urban renewal in disadvantaged neighbourhoods. Hereby, a neighbourhood in Rotterdam-South was chosen, since the area of Rotterdam-South struggles with large socio-economic problems and are the least mobile. From an interview with the advisor smart mobility of the municipality, the idea came to focus on the neighbourhood of Tarwewijk. The reason for this was that the municipality is planning to conduct a pilot with shared mobility services in the neighbourhood. Such a pilot is not executed before in a low-income/disadvantaged neighbourhood. Therefore, the information from this empirical research can add new knowledge to the pilot of the municipality. The information gathered for the case study is conducted by document and data analysis and interviews. Moreover, an aspect of the case study was to conduct surveys with the inhabitants of this neighbourhood. However, due to the measures concerning the COVID-19, this, unfortunately, had to be cancelled.

10.4 ETHICAL ISSUES AND DILEMMAS

While conducting this research, there were no ethical issues or concern encountered. All participants contributed voluntarily to the interviews. Moreover, before the interviews, an introduction letter was sent to the participants with the aim and purpose of this research. So, herewith the participants could make an informed decision to participate or not participate in the interview.

10.5 PERSONAL RESEARCH PROCESS

Towards the P2
The Graduation Laboratory started in September 2019 with an introduction of the four themes within the MBE department. Within the first week, we had to decide on our theme and our first mentor. In my opinion, this time was too short to make a substantiated choice. However, I knew I wanted to graduate in the Department of Urban Development Management. Since I have worked for two years as a concept developer for a development company, my interests are clearly within this field.

Within the theme of UDM, I was interested in new emerging concepts, such as the “Smart City”, “Smart Tools” and “Smart Mobility”. Towards my P1, I decided to explore and research the use of digital platforms (including social media) and understand in what way they impact an urban development or upgrading neighbourhoods. However, searching and finding useful literature about digital platforms turned out to be very difficult. Therefore, it was decided to change the research topic to the emerging concept of “Smart Mobility”. Hereby, the following main research question was established: “How can the use of smart mobility technologies (services) impact urban neighbourhood renewal?”.

After changing the topic to smart mobility, the research process towards the P2, in general, went well. Hereby, most time was spent on reading and analysing literature about urban renewal, smart mobility and services within smart mobility. The first part of my literature study was mainly explorative and towards the end, it became a more systematic literature review. During the process, there was only one challenging aspect and that was making contact with the municipality of Rotterdam. Since my research focuses on the disadvantaged area of Rotterdam-South a graduation internship within the municipality of Rotterdam seemed logical. However, this turned out to be difficult to arrange, because there came no response from the municipality. After doing some research about businesses and companies within the working field of smart mobility, I came across the company “The Future Mobility Network”. This is a knowledge- and advice agency, focusing on the mobility of the future. After a meeting with them, it became clear that my topic was very interesting for them. In addition, to support my graduation research, they have all the right connections within the Municipality of Rotterdam, the Verkeersonderneming and service providers. Therefore, it was decided to follow a graduation internship within this company.

Towards the P3

After my P2 presentation, it became clear that I had to focus on my methodology and research questions. Since these aspects and the outcome of my research remained too vague for my mentors. So, this was an area I had to work on. During this time I also started with my internship at the "Future Mobility Network". This internship made it for me possible to come easily in contact with the interviewees. Furthermore, I got introduced at for instance the Verkeersonderneming and the municipality. Whereby, multiple people were enthusiastic and helped me again to reach more persons for my research. So, besides interviews, I also had good conversations with several experts. During this period it was also planned to conduct surveys with inhabitants of a neighbourhood in Rotterdam-South. However, the emerging COVID-19 made this impossible. I was disappointed by this fact since the "user" part was an important aspect of empirical research.

Towards the P4

After my P3 presentation, I started with the empirical research about a specific neighbourhood in Rotterdam-South. I was struggling to select the right neighbourhood of my empirical research. Until I spoke with the advisor smart mobility of the municipality of Rotterdam. She told me that the municipality was planning to conduct a pilot with shared mobility in Tarwewijk. This gave me a starting point for my case study. Hereby, I tried to map the socio-economic aspects, living conditions, accessibility and connection. However, during this case study, I was not sure how this information was addressing my research questions. After talking to my mentor, this became more clear to me. And finally, from this, I was able to identify the opportunities and barriers that existed in this neighbourhood, whereby I could connect the information to findings from the interviews. Besides conducting interviews with service providers, I also had interviews about the four aspects of urban renewal concerning shared mobility. It soon became clear that not all four aspects of urban renewal can be related to shared mobility services.

Personal study targets

To acquaint the most knowledge from the graduation process, I developed a couple of personal and study targets during my P1. For my study targets these were: contribute to current academic knowledge, understand and apply different research methods and techniques and finally discover and close the gap between theory and practice. For my personal study targets, these were understanding how shared mobility services can possibly affect disadvantaged neighbourhoods and understand the main aspects of urban neighbourhood renewal. When reflecting op my study targets, I am happy to say that I think these are accomplished. With my research, I contributed to the current academic literature by finding a gap between theory and practice. Moreover, during my research, I had the time to use different research methods, whereby I think my skills have improved. When looking at my personal study target. I think these are also accomplished. With my literature review about urban renewal, I got to know all aspect of urban renewal. Besides, this thesis contributed to my understanding of how shared mobility services can possibly affect disadvantaged neighbourhoods in Rotterdam-South.

REFERENCES

Alam, M., Feirrera, J., & Fonseca, J. (2016). *Intellegent transport system.* Springer, New York.

Alessandrini, A., Campagna, A., Site, P. D., Filippi, F., & Persia, L. (2015). Automated Vehicles and the Rethinking of Mobility and Cities. *Transportation Research Procedia*, 5, 145-160.

Allwinkle, S., & Cruickshank, P. (2011). Creating Smart-er Cities: An Overview, *Journal of Urban Technology*, 18(2), 1-16.

Anderson, J. (2007). *Paris embraces plan to become city of bikes*. The Washington Post, March 24, 2007, Page A10.

Architectenweb. (2020). *Masterplan met hoogbouw en drijvend stadspark voor Rijnhaven gepresenteerd*. Retrieved on 28-04-2020 from: https://architectenweb.nl/nieuws/artikel.aspx?ID=47303

Arnd W.H., Drews, F., Hertel, M., Langer, V., & Wiedenhöft E. (2019). *Integration of shared mobility approaches in sustainable urban mobility planning.* Eltis.

Audit Commission. (2006). *Economic Regeneration. A Guide to National and Local Indicators.* Audit Commission, London.

Bachand-Marleau, J., Lee, B. H. Y., & El-Geneidy, A. M. (2012). Better Understanding of Factors Influencing Likelihood of Using Shared Bicycle Systems and Frequency of Use. *Transportation Research Record*, 2314(1), 66–71.

Bastiaanssen, J., Martens, K., & Polhuijs, G. (2013). *Vervoersarmoede in Rotterdam-Zuid* (VK 5/2013). Retrieved from Verkeerskunde on 23-10-2019: http://www.verkeerskunde.nl/internetartikelen/vakartikelen/vervoersarmoede-in-rotterdam-zuid-(vk-5-2013).33957.lynkx.

Belk, R. (2014). You Are What You Can Access: Sharing and Collaborative Consumption Online. *Journal of Business Research*, 67(8), 1595–1600.

Bergman, J. (2013). "*Inclusivity is a big hurdle for bike-share programs*." AxisPhilly. M

Bieliński, T & Ważna, A. (2019). Hybridizing Bike-Sharing Systems: The Way to Improve Mobility in Smart Cities. T*ransport Economics and Logistics*.

Borsboom-van Beurden, J., Kallaos, J., Gindroz, B., Costa, S., & Riegler, J. (2019). *Smart City Guidance Package: A roadmap for integrated planning and implementation of Smart City projects*. Faculty of Architecture and Design, Alfred Getz vei 3, 7491 Trondheim.: Norwegian University of Science and Technology / European Innovation Partnership on Smart Cities and Communities.

Botsman, R., & Rogers, R. (2010). *What's Mine Is Yours: How Collaborative Consumption is Changing The Way We Live*. London, UK: Collins.

Bryman, A. (2012). *Social research methods*. Oxford, United Kingdom: Oxford University Pres.

Bührmann, S., & Rupprecht Consult Forschung & Beratung GmbH. (2008). *Public Bicycles* (pp. 12).

Carneiro, F.S., Corban, C., Ehrlich, D., Florczyk, A., Kemper, T., Maffenini, L., Melchiorri, M., Pesaresi, M., Schiavina, M. & Tommasi, P. (2019). *Atlas of the Human Planet*. EUR 30010 EN, Publications Office of the European Union, Luxembourg

Chan, E. C., and G. K. L. Lee. 2008. "Critical Factors for Improving Social Sustainability of Urban Renewal Projects." *Social Indicators Research* 85 (2): 243–256.

Cohen, B., & Kietzmann, J. (2014). Ride On! Mobility Business Models for the Sharing Economy. O*rganization &amp Environment*. 27, 279-296.

Couch, C. Fraser A., & Percy, S. (eds). (2003). *Urban Regeneration in Europe*, Oxford Blackwell Publishing, Chapter 6.

CROW. (2014). *Loopafstanden in cijfers*. Retrieved on 29-04-2020 From: https://www.crow.nl/duurzame-mobiliteit/home/systeemintegratie/voetganger/loopafstanden-in-cijfers

Curl, A., Clark, J. & Kearns, A. (2017). Household car adoption and financial distress in deprived urban communities over time: a case of 'forced car ownership'? *Transport Policy* 65, 61 – 71.

CultuurWerkplaats Tarwewijk. (n.d.). *Over de wijk*. Retrieved on -01-05-2020 from: https://cultuurwerkplaatstarwewijk.nl/over-ons/de-wijk/

Curran, A. (2008). TransLink Public Bike System Feasibility Study. *Quay Communications Inc*., Vancouver.

Czischke, D., Moloney C., & Turcu. C. (2014). *State of the Art on Sustainable regeneration in urban areas*, URBACT II capitalisation.

Davis, D. (2018). "Governmental Capacity and the Smart Mobility Transition", Marsden, G., & Reardon, L. (Ed.) *Governance of the Smart Mobility Transition*, Emerald Publishing Limited, 105-122.

DeMaio, P. (2009). Bike-sharing: History, Impacts, Models of Provision, and Future. *Journal of Public Transportation*, 12(4), 41-56.

De Afrikaanderwijk Coöperatie. (2019). *Diensten: Fietsenbank*. Retrieved on 05-05-2020 from: *http://www.wijkcooperatie.org/nl/diensten/fietsenbank/*

De Vasconcellos, E. A. (2005). Urban change, mobility and transport in São Paulo: three decades, three cities. *Transport Policy*, 12(2), 91-104.

De Verkeersonderneming. (2019). *Rotterdam MaaS-beleving: Inzichten uit een reisexperiment met 100 Rotterdammers*. Retrieved on 10-06-2020 from: https://www.verkeersonderneming.nl/wp-content/uploads/2019/11/2019_Rapport_Rotterdam-Maasbeleving.pdf

De Verkeersonderneming. (n.d.). *Over ons*. Retrieved on 10-01-2020 from: https://www.verkeersonderneming.nl/over-ons/

Di Bartolo, C., Bosetti, S., de Stasio, C., & Malgieri, P. (2020). *Cities towards Mobility 2.0: connect, share and go*. Civitas Policy note.

Docherty, I., Marsden, G. & Anable, J. (2018). The governance of smart mobility. T*ransportation Research Part A: Policy and Practic*e, 115, 114-125.

Donkey Republic. (2020). W*elcome to the Donkey Republic*. Retrieved on 10-03-2020 from: https://www.donkey.bike/about/

Droste C., Lelevrier C., & Wassenberg F. (2008). Urban regeneration in European social housing areas. *Social housing in Europe vol. II*, C. Whitehead & K. Scanlon (eds.), LSE, London.

Eckhardt, J., Aapaoja, A., Nykänen, L., Sochor, J., Karlsson, M., & König, D. (2017). *Deliverable 2: European maas roadmap 2025*. MAASiFiE project funded by CEDR.

Ellen MacArthur Foundation. (2019). *Urban mobility system*. Retrieved on 10-03-2020 from: https://www.ellenmacarthurfoundation.org/assets/downloads/Mobility_All_Mar19.pdf

Emerce. (2019). *Uber introduceert elektrische fietsdienst JUMP in Rotterdam*. Retrieved on 15-03-2020 from: https://www.emerce.nl/nieuws/uber-introduceert-elektrische-fietsdienst-jump-rotterdam

Emerce. (2020). *Nieuwe deeldienst e-scooters live in Rotterdam*. Retrieved on 15-03-2020 from: https://www.emerce.nl/nieuws/nieuwe-deeldienst-escooters-live-rotterdam

Faghih-Imani, A., Eluru N., El-Geneidy, A.M., Rabbat, M., & Haq, U. (2014). How land-use and urban form impact bicycle flows: evidence from the bicycle-sharing system (BIXI) in Montreal. *Journal of Transport Geography*. Volume 41, 306-314.

Felyx. (2020). *Over Felyx.* Retrieved on 15-03-2020 from: https://felyx.com/nl/nl

Firnkorn, J., & Müller, M. (2011). What will be the environmental effects of new free-floating car-sharing systems? The case of car2go in Ulm,*Ecological Economics*, Volume 70(8), 1519-1528.

Fleming, K. L. (2018). Social Equity Considerations in the New Age of Transportation: Electric, Automated, and Shared Mobility. *Journal of Science Policy & Governance*, Vol.13, Issue 1.

Flüchter, K., & Wortmann, F. (2014). *Implementing the connected e-bike: challenges and requirements of an IoT application for urban transportation*.

GCPH. (2016). *Principles for effective social regeneration and interventions: learning from sistema Scotland.* Briefing paper 50. Retrieved on 10-01-2020 from: https://www.gcph.co.uk/publications/689_briefing_paper_50_principles_for_effective_social_regeneration.

Gemeente Rotterdam. (2019) *Nota vergunningen deelmobiliteit. Meer grip op deelfietsen, elektrische scooters en -steps.* Retrieved on 28-02-2020 from: https://rotterdam.groenlinks.nl/sites/groenlinks.nl/files/downloads/newsarticle/Nota%20vergunningen%20deelmobiliteit.pdf

Gemeente Rotterdam. (2020). R*otterdamse Mobiliteits Aanpak*. Retrieved on 01-03-2020 from: https://rotterdam.groenlinks.nl/sites/groenlinks.nl/files/downloads/newsarticle/RMA.pdf

Ginsburg, N. (1999). Putting the social into urban regeneration policy, *Local Economy*, 14(1), 55-71.

Goldman, T., & Gorham, R. (2006). Sustainable urban transport: Four innovative directions. T*echnology in society.* 28(1-2), 261–273

Golub, A., Satterfield, V., Serritell, M., Singh, J., & Philips, S. (2019). Assessing the barriers to equity in smart mobility systems: a case study of portland, Oregon, *Case Studies on Transport Policy.*

GO Sharing. (2020). *Over ons.* Retrieved on 10-03-2020 from: https://go-sharing.nl/over-ons/

Groat, L. N., & Wang, D. (2013). Architectural Research Methods. New Jersey, Hoboken: John Wiley & Sons, Inc.Hamari, J., Sjöklint, M., & Ukkonen, A. 2016. The Sharing Economy: Why People Participate in Collaborative Consumption. *Journal of the Association for Information Science and Technology*, 67(9).

Grotenhuis, J.-W., Wiegmans, B. W., & Rietveld, P. (2007). *The desired quality of integrated multimodal travel information in public transport: Customer needs for time and effort savings.*

Hameed, A.A. (2019). *Smart city planning and sustainable development*. IOP Conf. Ser.: Mater. Sci. Eng

Han, S. S. (2010). Managing motorization in sustainable transport planning: the Singapore experience. *Journal of Transport Geography*, 18(2), 314-321.

Hart van Zuid. (2020). *Alles is op zuid.* Retrieved on 25-04-2020 from: https://www.allesisopzuid.nl/alles-is-op-zuid/

Haywood, R. (1997). *Railways, urban form and town planning in London: 1900–1947*. Plan. Perspect., 12, 37

Heijmans. (2016). *Hart van Zuid: Rotterdam op weg naar een nieuw centrum voor Rotterdam Zuid.* Retrieved on 24-04-2020 from: https://www.heijmans.nl/media/filer_public/ad/0b/ad0b549e-6a6f-4156-9f18-b22105d8f82a/factsheets_hvzr_def.pdf

Het Parool. (2019). *In 17 landen zoeven ze rond, maar hier niet: de e-step.* Retrieved on 12-03-2020 from:https://www.parool.nl/nederland/in-17-landen-zoeven-ze-rond-maar-hier-niet-de-e-step~b3dce97d/?referer=https%3A%2F%2Fwww.google.com%2F

Howland, S., McNeil, N., Broach, J., Rankins, K., MacArthur, J., & Dill, J. (2017). Current Efforts to Make Bikeshare More Equitable: Survey of System Owners and Operators. *Transportation Research Record*, 2662(1), 160–167.

Jeekel, J. F. (2017). Social sustainability and smart mobility : exploring the relationship. In F. Ulengin, K. Li, & M. Boltze (Eds.), *World Conference on Transport Research*.

Jittrapirom, P., Caiati, V., Feneri, A.M., & Ebrahimigharehbaghi, S., Alonso Gonzalez, M., & Narayan, J. (2017). Mobility as a Service: A Critical Review of Definitions, Assessments of Schemes, and Key Challenges. *Urban Planning*. 2.

Kamargianni, M., Li, W., Matyas, M., & Schäfer, A. (2016). A Critical Review of New Mobility Services for Urban Transport, *Transportation Research Procedia*, 4.

Keijer , M. J. N., & Rietveld , P. (2000). How do people get to the railway station? The Dutch experience. *Transportation Planning and Technology*, 23(3), 215-235.

Kleinhans, R. (2004). Social implications of housing diversification in urban renewal: A review of recent literature. Journal of Housing and the Built Environment 19, 367–390.

Kodransky, M., & Lewenstein, G. (2014). *Connecting Low-Income People to Opportunity withShared Mobility*. Institute for Transportation and Development Policy and Living Cities.

Litman, T. (2018) Evaluating transportation equity. Victoria Transport Policy Institute.

Los Angeles Department of City Planning. (2016). *Mobility hubs*. Retrieved on 10-05-2020 from: http://www.urbandesignla.com/resources/docs/MobilityHubsReadersGuide/lo MobilityHubsReadersGuide.pdf

Lub V. (2017). *Neighbourhood Watch in a Digital Age: Between Crime Control and Culture of Control*. London: Palgrave MacMillan.

Lucas, K., Bates, J., Moore, J. & Carrasco, J. A. (2016). Modelling the relationship between travel behaviour and social disadvantage, *Transportation Research Part A*, 40, 157-171.

Machado, C., De Salles Hue, N., Berssaneti, F., & Quintanilha, J. (2018). "An Overview of Shared Mobility," *Sustainability*, vol. 10, no. 12.

Martin, E. & Shaheen, S. (2011). The impact of carsharing on household vehicle ownership. *Access*. 38. 22-27.

Martens, K. (2004). The bicycle as a feedering mode: experiences from three European countries. Transportation Research Part D: *Transport and Environment*, 9(4), 281-294.

May, T. (2003). Social Research: Issues, Methods and Process, 3rd edn.Open University Press, Buckingham, UK. OECD. 2012. *OECD Environmental Outlook to 2050*. OECD Publishing: Paris.

Mchoogkwartier. (2020). *Mobility challange*. Retrieved on 10-05-2020 from: https://mchoogkwartier.nl/

Midgley (2009) The Role of Smart Bike-sharing Systems in Urban Mobility. *Journeys*, 23-31.

McNeil, N., Dill, J., MacArther, J., Broach, J., & Howland, S. (2017). Breaking Barriers to Bike Share: Insights on Equity. *Transportation Research and Education Center* (TREC), 1-20.

McKenzie, G. (2020). Urban mobility in the sharing economy: A spatiotemporal comparison of shared mobility services. *Computers, Environment and Urban Systems*. Vol. 79.

Meeuwisse, M. (2015). *Psychologie van de stad*. Maklu, Uitgever.

MRDH. (2020).*Subsidies Vervoersautoriteit MRDH 2020*. Retrieved on 01-05-2020 from: https://mrdh.nl/doen/subsidies-vervoersautoriteit

Noack, E. (2011). *Are Rural Women Mobility Deprived? – A Case Study from Scotland*. Sociologia Ruralis 51(1), 79-97

Notten, T. (2012). *Vleermuisouders en andere essays over het opgroeien in de stad*. Maklu, Uitgever

Noy K., & Givoni M. (2018). Is 'Smart Mobility' Sustainable? Examining the Views and Beliefs of Transport's Technological Entrepreneurs. *Sustainability*. 10(2), 422.

Orsato, R., & Clegg, S. (1999). 'The political ecology of organizations: Toward a framework for analyzing business–environment relationships,' *Organization & Environment*, 12(3), 263 –279.

Papa, E., & Lauwers, D. (2015). Mobility Governance in Smart Cities of the Future. In Luuk Boelens, D. Lauwers, & F. Witlox (Eds.), *Adaptive mobility : a new policy and research agenda on mobility in horizontal metropolis* (pp. 177–190). In-planning.

Programma bureau NPRZ. (2013). *Handelingsperspectief Tarwewijk*. Retrieved on 13-04-2020 from: https://www.rotterdam.nl/wonen-leven/opgave-nprz/handelingsperspectief-Tarwewijk.pdf

Programmabureau NPRZ (2019). *Uitvoeringsplan 2019-2022*. Retrieved on 15-03-2020 from: https://www.nprz.nl/over-nprz/onze-documenten/uitvoeringsplan

Pucher, J., Dill, J., & Handy, S. (2010). Infrastructure, programs, and policies to increase bicycling: An international review. [Review]. *Preventive Medicine*, 50,

Pyrialakou, V. D., Gkritza, K., & Fricker, J. D. (2016). Accessibility, mobility, and realized travel behavior: Assessing transport disadvantage from a policy perspective. *Journal of Transport Geography*, 51, 252–269.

Richardson, B. C. (2005). Sustainable transport: analysis frameworks. *Journal of Transport Geography*, 13(1), 29-39.

Riederwaard C.V. (2018). *Hart van Zuid. Verkeersplan*. Retrieved on 08-05-2020 from: https://docplayer.nl/105736546-Hart-van-zuid-verkeersplan-riederwaard-c-v.html

Roberts, P. (1995) *Environmentally Sustainable Business: A Local and Regional Perspective*, Paul Chapman, London.

Roberts, P., & Sykes, H. (2008). *Urban regeneration: A handbook* London: SAGE Publications Ltd.

Rode, P., Floater, G., Thomopoulos, N., Docherty, J., Schwinger, P., Mahendra, A., & Fang, W. (2017). Accessibility in Cities: Transport and Urban Form. *Disrupting Mobility*, 239-273.

Sanjari, M., Bahramnezhad, F., Fomani, F. K., Shoghi, M., & Cheraghi, M. A. (2014). Ethical challenges of researchers inqualitative studies: the necessity to develop a specific guideline. *Journal of Medical Ethics and History of Medicine:* 7(14).

Schaller, B. (2016). *Between public and private mobility examining the rise of technology enabled transportation services: Taxi, sedan, and limousine industries and regulations*. TRB Special Report 319. Washington, DC: Transportation Research Board.

Shafrin, J., Sullivan, J., Goldman, D.P., & Gill, T.M. (2017) The association between observed mobility and quality of life in the near elderly. *PloS one*, 12(8).

Shaheen, S., Cohen, A., & Zohdy, I. (2016). *Shared Mobility*: *Current Practices and Guiding Principles.* Retrieved on 01-05-2020 from: https://ops.fhwa.dot.gov/publications/fhwahop16022/fhwahop16022.pdf

Shaheen, S., Bell, C., Cohen, A., & Yelchuru, B. (2017). Travel behavior: Shared mobility and transportation equity. *Federal Highway Administration Report* No. PL-18-007.

Shaheen S., & Cohen A., (2018) F*ive Strategies to Enhance Transportation Equity in Shared Mobility.* Retrieved on 10-05-2020 from Medium: https://medium.com/move-forward-blog/five-strategies-to-enhance-transportation-equity-in-shared-mobility-e36adfd7933e

Shaheen, S., & Cohen, A. (2019). *Shared Micromoblity Policy Toolkit: Docked and Dockless Bike and Scooter Sharing*. UC Berkeley: Transportation Sustainability Research Center.

Shaheen, S., & Guzman, S. (2011). Worldwide Bikesharing. *ACCESS Magazine*, 1(39), 22-27.

Shaheen, S., Guzman, S. & Zhang, H. (2010). Bikesharing in Europe, the Americas, and Asia Past, Present, and Future. Transportation Research Record Journal of the Transportation Research Board p. 159–167.

Shared-Use Mobility Center. (2019). *Shared-use mobility Toolkit for cities*. Retrieved on 01-05-2020 from: https://sharedusemobilitycenter.org/wp-content/uploads/2016/07/SUMC-Toolkit-Final-Report.pdf

Shay, E., Combs, T. S., Findley, D., Kolosna, C., Madeley, M., & Salvesen, D. A. (2016). Identifying transportation disadvantage: Mixed-methods analysis combining GIS mapping with qualitative data. *Transport Policy*, 48, 129–138.

Skayannis, P., Goudas, M., Rodakinias, P. (2017) Sustainable mobility and physical activity: A meaningful marriage. *Transportation Research Procedia*, 24, pp. 81-88.

Smith, P. C. (2000). Sustainability and urban design. In W. S. Wong & E. H. W. Chan (Eds.), Building Hong Kong: *Environmental considerations*. pp. 17–42.

Snellen, D. & Hollander, G. (2017). ICT'S change transport and mobility: mind the policy gap!. *Transportation Research Procedia*. 26.

Springco Cartotool (2020). *Mobiliteitsmileus.* Retrieved on: 15-04-2020 from: https://www.cartotool.nl/v4/

Stake, R. E. (1995). *The art of case study research*. Sage Publications, Inc.

Stouten, P. (2010). C*hanging contexts in urban regeneration: 30 years of modernisation in Rotterdam. Amsterdam:* Techne Press.

Tan, S., Zhao, Y., & Huang, W. (2019). Neighborhood Social Disadvantage and Bicycling Behavior: A Big Data-Spatial Approach Based on Social Indicators. *Social Indicators Research*, 1-15. Springer Netherlands.

Taylor S.J., & Bogdan, R. (1998). I*ntroduction to Qualitative Research Methods: A Guidebook and Resource*. 3rd ed. John Wiley & Sons, Inc.; New York, NY, USA.

Team Rijnhaven. (2020). *Masterplan Rijnhaven*. Retrieved on: 28-04-2020 from: https://www.rotterdam.nl/wonen-leven/rijnhaven/Masterplan-Rijnhaven.pdf

Thakuriah P., Tilahun N.Y., & Zellner M. (2017). Introduction to Seeing Cities Through Big Data: Research, Methods and Applications in Urban Informatics. In: Thakuriah P., Tilahun N., Zellner M. (eds) *Seeing Cities Through Big Dat*a. Springer Geography. Springer, Cham.

Transportation for America. (2020). *Shared Micromobility Playbook*. Retrieved on 17-03-2020 from: https:// playbook.t4america.org/

Trouw. (2012). *Het geld is op, maar daarmee is de wijkaanpak nog niet failliet.* Retrieved on 10-05-2020 from: https://www.trouw.nl/nieuws/het-geld-is-op-maar-daarmee-is-de-wijkaanpak-nog-niet-failliet~b25ebdc1/

Tsenkova, S. (2002). *Urban Regeneration: Learning from the British Experience*. Faculty of Environmental Design, University of Calgary.

United Nations (UN). (2018). *68% of the world population projected to live in urban areas by 2050, says UN.* Retrieved on 10-03-2020 from:https://www.un.org/development/desa/en/news/population/2018-revision-of-world-urbanization-prospects.html

Uyterlinde, M., van der Velden, J. & Bouwman. R. (2020). *Wijk in zicht. Kwalitatief onderzoek naar de dynamiek van leefbaarheid in kwetsbare wijken*. Platform 31. The Hague.

Vandenbulcke, G., Dujardin, C., Thomas, I., de Geus, B., Degraeuwe, B., Meeusen, R., & Panis, L. I. (2011). Cycle commuting in Belgium: Spatial determinants and 're-cycling' strategies. [Article]. T*ransportation Research Part a-Policy and Practice*, 45(2), 118-137.

Van den Ende, T. (2018). In Rotterdam-Zuid wordt het minst gefietst van heel Nederland. Waarom? Retrieved from van Vers Beton on 10-05-2020: https://versbeton.nl/2018/11/in-rotterdam-zuid-wordt-het-minst-gefietst-van-heel-nederland-waarom/

Van den Ende, T. (2018). V*ervoersarmoede: wat is het en wat doet Rotterdam eraan?* Retrieved from van Vers Beton on 23-10-2019 : https://versbeton.nl/2018/06/vervoersarmoede-wat-is-het-en-wat-doet-rotterdam-eraan/

Van der Bijl, R., & Van der Steenhoven, H. (2019). *Vervoersarmoede in de grote stad ontrafelen*. Retrieved on 10-01-2019 from https://www.ovmagazine.nl/2019/02/vervoersarmoede-in-g4-is-ontluisterend-1511/.

Vinci, I., & Di Dio, S. (2016). *Reshaping the urban environment through mobility projects and practices: lessons from the case of Palermo.*

Wang, Q., Philips, N.E., Small, M.L, & Sampson, R.J,. (2018). Urban mobility and neighborhood isolation in america's 50 largest cities. *Proceedings of the National Academy of Sciences,* 115(30).

Wassenberg, F. (2010). Towards sustainable urban renewal In the Netherlands. *Open house international Vol 35,* No.2, 15-24.

Wijkprofiel Rotterdam. (2020). *Uitleg wijkprofiel*. Retrieved on 29-04-2020 from: https://wijkprofiel.rotterdam.nl/nl/2020/uitleg

Wikipedia. (2020). *Jump (transportation company).* Retrieved on 13-03-2020 from: https://en.wikipedia.org/wiki/Jump_(transportation_company)

Wilkinson, M. D., Dumontier, M., Aalbersberg, I. J., Appleton, G., Axton, M., Baak, A., & Bouwman, J. (2016). The FAIR Guiding Principles for scientific data management and stewardship. *Scientific data*, 3.

Wired. (2017). *Chinese Bike-Sharing Startup Mobike Has Its Eye on Expansion.* Retrieved on 15-03-2020 from: https://www.wired.com/story/chinese-bike-sharing-startup-mobike-has-its-eye-on-expansion/

Yan, A., & Howe, B. (2019). *Fairness in Practice: A Survey on Equity in Urban Mobility.* University of Washington

Yin, R. K. (2009). *Case study research: Design and methods (4th Ed.)*. Thousand Oaks, CA: Sage.

APPENDIX

APPENDIX I
INTRODUCTION + CONSENT FORM

INFORMED CONSENT
For the interviewees in the graduation research of Meltem Tamer

INTRODUCTION

Dear participant,

Welcome to this interview. First of all, I would like to thank you for participating in my research. I will shortly introduce myself. My name is Meltem Tamer and I am a graduate student at the Technical University of Delft following the master track "Management in the Built Environment". For my graduation project, I am researching the effect of the use of shared mobility services on urban renewal areas. More specifically, this research is focusing on the use of shared mobility services in Rotterdam-South.

The purpose of this interview is to gather and analyse information related to the use of smart mobility services in Rotterdam-South. I would like to analyse which shared mobility services are offered and how they are distributed in Rotterdam-South. Following this, the interview aims at learning about what the reasons are for a service provider to offer or not to offer these services in Rotterdam-South. You were invited to take part in this research because your knowledge and expertise in the use of smart mobility in Rotterdam are very valuable to my academic research.

To properly conduct this research, I would like to ask your permission to record this interview. The recording will be used for transcription purposes and will allow gathering the core information from the provided answers. The recordings are strictly confidential and will not be distributed to other parties. Your answers will remain private and will be processed anonymously. Only your function and the kind of organisation you work for will be mentioned. This to indicate what kind of persons have been interviewed. The interview results are only used for research purpose.

Additionally, I would kindly ask you to fill in the provided consent form. This to meet the Human Research Ethics Committee requirements assigned by the Technical University of Delft.

Thank you in advance for your collaboration and effort.

Kind regards,

Meltem Tamer

Contact details
Contact details for further information:
Meltem tamer
T: +31 (0)6 43155928
E: m.tamer@student.tudelft.nl

CONSENT FORM

The following informed consent form is meant for the interviewees that are participating in the graduation research of Meltem Tamer.

Please tick the appropriate boxes.	Yes	No
Taking part in the study		
• I have read and understood the study information dated [xx/xx/2020], or it has been read to me. I have been able to ask questions about the study and my questions have been answered to my satisfaction.	☐	☐
• I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.	☐	☐
• I understand that taking part in the study involves an audio-recorded interview which will be transcribed as text.	☐	☐
Use of the information in the study		
• I understand that the information I provide will be used for graduation report conducted by the master student Meltem Tamer. The information can be presented in a written report and the corresponding presentation. Unless it is indicated that certain information is confidential.	☐	☐
• I understand that personal information collected about me that can identify me, such as my name or where I live, will not be shared beyond the study team.	☐	☐
• I agree that my information can be quoted (anonymised) in research outputs.	☐	☐
Future use and reuse of the information by others		
• I give permission for the use of the graduation thesis results, that are partly based on the anonymised transcripts, to provide to be archived in the TU Delft repository, so it can be used for future research and learning.	☐	☐

Thank you for your participation.

Signatures

_____	_____	_____
Name of participant [printed]	Signature	Date

I have accurately read out the information sheet to the potential participant and, to the best of my ability, ensured that the participant understands to what they are freely consenting.

_____	_____	_____
Researcher name [printed]	Signature	Date

APPENDIX II
INTERVIEW PROTOCOL SERVICE PROVIDERS

INTERVIEW PROTOCOL (DUTCH)
Service aanbieder

Datum: _____
Locatie: _____
Geïnterviewde: _____
Organisatie: _____

ALGEMEEN
1. Mag ik uw toestemming om dit gesprek op te nemen?

INTRODUCTIE
1. Korte introductie: wie ben ik en waar doe ik onderzoek naar.

PROFIEL
1. Kunt u meer vertellen over organisatie?
    a. Wat is uw visie?
    b. Wat is uw missie?
2. Kunt u iets vertellen over uw rol binnen uw organisatie?
3. Wat zijn uw verantwoordelijkheden binnen uw afdeling?

DEELMOBILITEIT IN ROTTERDAM
Introductie: De volgende vragen gaan over deelmobiliteit in Rotterdam en uw samenwerking met de gemeente Rotterdam.

1. Hoe bepaalt uw organisatie haar servicegebieden in Rotterdam?
2. Sinds wanneer opereert uw organisatie binnen Rotterdam?
3. Hoeveel deelfietsen/deelscooters van uw organisatie zijn momenteel actief in Rotterdam?
4. Op welke manier werkt uw organisatie samen gemeente Rotterdam samen?
    a. Welke eisen stelt de gemeente Rotterdam aan service aanbieders?
    b. In welke mate bepaalt de gemeente Rotterdam waar service providers hun deelmobiliteit (mogen) aanbieden?
5. Hoe bepalen jullie de ritprijzen?
    a. Kan de gemeente Rotterdam invloed uitoefenen op jullie ritprijzen?
6. Wie is jullie voornaamste doelgroep? En waarom?
7. Welke risico's zien jullie bij het aanbieden van deelmobiliteit?
8. Hebben jullie ook al ervaring in andere gebieden ?
    a. Zo ja waar?
    b. Zien jullie directe gevolgen van jullie deelscooters in de kwaliteit van het gebied? (economisch, sociaal., maatschappelijk)

DEELMOBILITEIT IN ROTTERDAM-ZUID:

Introductie: Er zijn er op dit moment weinig deelmobiliteit services beschikbaar in gebieden zoals Rotterdam-Zuid. De onderstaande vragen zullen hierover gaan.

1. Wat denkt u dat de redenen dat er weinig deelmobiliteit systemen zijn in Rotterdam-Zuid?
    a. Waarom kiezen service providers er niet voor om te opereren in Rotterdam-Zuid? En welke rol speelt de gemeente hierbij?
    b. Wat zijn de redenen voor uw organisatie om wel of geen deelmobiliteit aan te bieden niet in Rotterdam-Zuid (financieel, gebruikers)?
    c. Heeft uw organisatieplannen om dit in de toekomst wel te aan te bieden? Zo niet, wat zou er dan nodig zijn om dit wel te doen?
    d. Wat ziet eventuele barrières voor het gebruik van deelmobiliteit van bewoners van Rotterdam-Zuid (bijv. inkomsten, taal, bekwaamheid)?

2. Ondervindt uw organisatie problemen (o.a. vandalisme, diefstal, overlast) door het aanbieden van deelmobiliteit?
    a. Zo ja, denkt u dat er verschillen in Rotterdam-Zuid ten opzichte van andere delen in Rotterdam?

3. Zou het gebruik van deelmobiliteit vervoersarmoede in Rotterdam-Zuid kunnen verbeteren?
    a. Wat vindt u van het idee om een deelmobiliteit in de vorm van een hub aan te bieden in Rotterdam-Zuid?

APPENDIX III
INTERVIEW PROTOCOL MUNICIPALITY

INTERVIEW PROTOCOL (DUTCH)
Municipality

Datum: _____
Locatie: _____
Geïnterviewde: _____
Organisatie: _____

ALGEMEEN
1. Mag ik uw toestemming om dit gesprek op te nemen?

INTRODUCTIE
1. Korte introductie: wie ben ik en waar doe ik onderzoek naar.

PROFIEL
1. Kunt u iets vertellen over uw rol binnen de Gemeente Rotterdam?
2. Wat zijn uw verantwoordelijkheden binnen uw afdeling?

DEELMOBILITEIT ALGEMEEN
1. Wat is de doelstelling van de gemeente voor stad (bereikbaarheid, groen, etc.)?
2. Wat is het impact van deelmobiliteit op de stad?
3. Wat is het impact van deelmobiliteit op de de gebruiker?
4. Welke uitdagingen brengt deelmobiliteit met zich mee?
5. Wie zijn de voornaamste doelgroepen die gebruik maken van deelmobiliteit?
6. Wat ziet u als eventuele barrières voor het gebruik van deelmobiliteit?

DEELMOBILITEIT IN ROTTERDAM-ZUID
1. Wat is de doelstelling van de gemeente voor Rotterdam-Zuid (bereikbaarheid, groen, etc.)?
2. Heeft u gegevens/cijfers van wijken en buurten in Rotterdam-Zuid betreft de mobiliteit?
3. Welke rol speelt mobiliteit in de achterstandspositie van een wijk?
4. Wat kan deelmobiliteit voor Rotterdam-Zuid betekenen?
5. Welke concrete plannen / pilots heeft de gemeente Rotterdam voor Rotterdam-Zuid?
    a. Zo ja, waar?
    b. Kan ik hier meer informatie over verkrijgen?

DEELMOBILITEIT IN ROTTERDAM-ZUID / SERVICE PROVIDERS

Introductie: Er zijn er op dit moment weinig deelmobiliteit services beschikbaar in gebieden van Rotterdam-Zuid. De onderstaande vragen zullen hierover gaan.

1. Wat zijn de redenen dat er weinig deelmobiliteit systemen zijn in Rotterdam-Zuid?
2. Indien meer deelmobiliteit systemen zouden worden ingevoerd in Rotterdam-Zuid. Wat ziet u dan als eventuele barrières voor het gebruik van deelmobiliteit in Rotterdam-Zuid?
3. In welke mate bepaalt de gemeente Rotterdam waar service providers hun deelmobiliteit (mogen) aanbieden?
4. Op welke manier werkt de gemeente Rotterdam samen met een service provider?
5. Op welke manier stimuleert de gemeente Rotterdam service providers om toch op Rotterdam-Zuid te opereren?
6. Hoe wilt de gemeente het gebruik van deelmobiliteit stimuleren op Rotterdam-Zuid?
7. Hoe gaat de gemeente om met het vandalisme probleem op Rotterdam-Zuid?
8. Zou het gebruik van deelmobiliteit vervoersarmoede in Rotterdam-Zuid kunnen verbeteren?
    a. Zo ja, op welke manier zou dit een bijdrage kunnen leveren?
    b. Zo nee, waarom niet?
    c. Wat vindt u van het idee om een deelmobiliteit in de vorm van een hub aan te bieden in Rotterdam-Zuid?

DEELMOBILITEIT EN GEBIEDSONTWIKKELING/GEBOUWDE OMGEVING

1. Welke rol speelt mobiliteit en de bereikbaarheid in een herontwikkeling?
2. Wat zou het effect zijn als de bereikbaarheidsopgave wordt opgelost op herontwikkeling in een afstandswijk?
3. Gebiedsontwikkeling en herontwikkeling bestaat uit vier factoren, economisch, sociaal, fysiek en milieu. Wat denkt u dat de toegevoegde economische waarde is van deelmobiliteit voor een wijk?
4. Wat denkt u dat de toegevoegde sociale waarde is van deelmobiliteit voor een wijk?
5. Wat denkt u dat de toegevoegde fysieke waarde is van deelmobiliteit voor een wijk?
6. Wat denkt u dat de milieutechnische waarde is van deelmobiliteit voor een wijk?

APPENDIX IV
INTERVIEW PROTOCOL ADVISOR

INTERVIEW PROTOCOL (DUTCH)
Advisor

Datum: _____
Locatie: _____
Geïnterviewde: _____
Organisatie: _____

ALGEMEEN
1. Mag ik uw toestemming om dit gesprek op te nemen?

INTRODUCTIE
1. Korte introductie: wie ben ik en waar doe ik onderzoek naar.

PROFIEL
1. Kunt u iets vertellen over Overmorgen als adviesbureau?
2. Voor welke afdeling binnen Overmorgen bent u werkzaam?
    a. Kunt u iets vertellen over uw rol?
    b. Wat zijn uw verantwoordelijkheden binnen uw afdeling?
    c. Wat voor soort partijen adviseert u?

DEELMOBILITEIT ALGEMEEN
1. Wat is de doelstelling van de gemeente voor stad (bereikbaarheid, groen, etc.)?
2. Wat is het impact van deelmobiliteit op de stad?
3. Wat is het impact van deelmobiliteit op de de gebruiker?
4. Welke uitdagingen brengt deelmobiliteit met zich mee?
5. Wie zijn de voornaamste doelgroepen die gebruik maken van deelmobiliteit?
6. Wat ziet u als eventuele barrières voor het gebruik van deelmobiliteit?

DEELMOBILITEIT EN GEBIEDSONTWIKKELING/GEBOUWDE OMGEVING
1. Welke rol speelt mobiliteit en de bereikbaarheid in een herontwikkeling?
2. Wat zou het effect zijn als de bereikbaarheidsopgave wordt opgelost op herontwikkeling in een afstandswijk?
3. Gebiedsontwikkeling en herontwikkeling bestaat uit vier factoren, economisch, sociaal, fysiek en milieu. Wat denkt u dat de toegevoegde economische waarde is van deelmobiliteit voor een wijk?
4. Wat denkt u dat de toegevoegde sociale waarde is van deelmobiliteit voor een wijk?
5. Wat denkt u dat de toegevoegde fysieke waarde is van deelmobiliteit voor een wijk?

VERVOERSARMOEDE ROTTERDAM-ZUID

1. Heeft u informatie over hoeveel procent van de bewoners van Rotterdam-Zuid kampt met vervoersarmoede?
2. Wat zijn de gevolgen van vervoersarmoede in Rotterdam-Zuid?
3. Zijn er wijken in Rotterdam-Zuid die problematischer zijn dan andere?
    a. Zo ja, welke wijken zijn dit?
    b. Welke factoren spelen hierbij een rol (bijv. samenstelling wijk, inkomsten, afstand tot het ov)?
4. Zijn er wijken in Rotterdam-Zuid die het qua mobiliteit/vervoersarmoede beter scoren?
    a. Zo ja, welke wijken zijn dit?
    b. Door welke factoren scoren deze wijken beter (bijv. samenstelling wijk, inkomsten, afstand tot het ov)?
5. Denkt u dat grote gebiedsontwikkelingen zoals “Hart van Zuid” en “Feyenoord City” een positieve bijdrage kunnen leveren aan de vervoersarmoede in Rotterdam-Zuid?

DEELMOBILITEIT IN ROTTERDAM-ZUID / SERVICE PROVIDERS

Introductie: Er zijn er op dit moment weinig deelmobiliteit services beschikbaar in gebieden van Rotterdam-Zuid. De onderstaande vragen zullen hierover gaan.

1. Wat denkt u dat de redenen dat er weinig deelmobiliteit systemen zijn in Rotterdam-Zuid?
    a. Waarom kiezen service providers er niet voor om te opereren in Rotterdam-Zuid? En welke rol speelt de gemeente hierbij?
    b. Wat ziet eventuele barrières voor het gebruik van deelmobiliteit van bewoners van Rotterdam-Zuid (bijv. inkomsten, taal, bekwaamheid)?

2. Zou het gebruik van deelmobiliteit vervoersarmoede in Rotterdam-Zuid kunnen verbeteren?
    a. Zo ja, op welke manier zou dit een bijdrage kunnen leveren?
    b. Zo nee, waarom niet?
    c. Wat vindt u van het idee om een deelmobiliteit in de vorm van een hub aan te bieden in Rotterdam-Zuid?