

# Changing Suburban Neighbourhoods in Rotterdam

*Densification and sustainable urban mobility  
in Prins Alexander in Rotterdam*



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## Preface

*‘The Environment of the Human is the Fellow Man’* – Jules Deelder (Rotterdam poet, 2011)

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Hereby I present my thesis, written for my Master Spatial Planning at the University of Utrecht. The reason for the chosen research topic is that I am an active supporter of sustainable development of cities. The courses ‘Planning for Sustainable Cities’ and ‘Smart Urban Governance’ in the Master’s programme confirmed my interest in this area of expertise. I am aware of the fact that, nowadays, it is crucial to contribute to a sustainable development of the world at all levels. This means that every part of a city needs to be taken into account. A sustainable development of cities is important for the physical environment and for the environment of the human, which is the fellow man as stated in the quote above. Within this, governance is playing a significant role. The choice for the city of Rotterdam as my research area is simple. ‘I have heart for the city’. Besides living in the city, I wanted to contribute to a sustainable development of the city by the means of a research which is relevant for the municipality of Rotterdam. Therefore, I did my internship at the municipality of Rotterdam. The combination of the chosen topic and the chosen research area have subsequently led to my research for the master thesis. Hopefully, this master thesis can make a contribution to the Environmental Vision of Rotterdam which the municipality is currently establishing.

I have been working on this thesis since the beginning of February 2018. This thesis would not have been possible without the help and advice of various people. A special thanks goes out to my supervisor of the university, Jochen Monstadt, and my supervisor of the municipality of Rotterdam, Frank van den Beuken, for their time and effort. Both their expertise on urban planning and their feedback really helped to improve the quality of the thesis. My supervisor of the university really helped me accomplishing this master thesis, because of his experience with doing and writing research. I would also like to thank all the respondents which I have interviewed for their input and time. Without their input, this research would not have been established. Furthermore, the six fellow students of my student circle were also a great help during the writing of my master thesis. They made it possible to share struggles and ideas. Lastly, I would like to thank my surroundings for the support they gave me during the time I was writing this thesis.

Now I have finished this master thesis, my life as a student has come to an end. During the last four years I have learned a lot, scientifically and personally. My internship at the municipality of Rotterdam was my first experience with the work of planners, which was very interesting. I am looking forward to meet new challenges and to apply what I have learned into practice.

Enjoy reading!

Marieke Bakker  
Rotterdam, October 2018

## Abstract

Worldwide, large cities are dealing with new trends and transitions. A growing population is a prevalent example. An increasing number of people living in cities leads to unsustainable urban forms. Therefore, sustainable development of cities has become an unavoidable agenda item of cities. The city of Rotterdam is also dealing with a growing population, which causes a housing shortage. Besides, the city is dealing with other trends and transitions, such as climate change and a major mobility transition. The municipality is aiming for sustainable forms of mobility and a decrease of car use. It is expected that the mobility transition has the most impact in the inner city.

A compact urban form is seen as promising for a sustainable development of cities. The municipality of Rotterdam is already pursuing a compact city development in terms of densification. However, the focus of densification has traditionally been on the inner city. The suburban neighbourhoods are left out of the strategy which corresponds to the academic literature. Densification in suburban neighbourhoods could be an opportunity to counter urban sprawl and car dependency. In terms of sustainable mobility in suburban neighbourhoods, much has still to be achieved. Densification and sustainable mobility are two key components of smart urban growth and are required for a sustainable development of cities, including the suburban neighbourhoods. This research focuses on smart growth in the suburban neighbourhoods of Rotterdam, with a specific focus on the suburban neighbourhoods of the district Prins Alexander. The aim of the research is to examine how the municipality of Rotterdam can initiate the sustainable redevelopment of suburban neighbourhoods by mobilising synergies between densification and sustainable urban mobility (i.e. smart growth). This has led to the following research question: *‘How could the municipality of Rotterdam mobilise synergies between suburban densification and sustainable mobility and thus contribute to smart suburban growth?’*

The theoretical approach of this research is mainly based on two theoretical concepts: (1) densification and (2) sustainable (urban) mobility. From the literature study, transit-oriented development (TOD) also appeared to be a relevant concept for this research. TOD is a combination of densification and sustainable mobility since it integrates transit with land-use. In addition to an elaborated literature study, an empirical research has been done. In order to answer the research question, qualitative research methods have been used, including the analysis of policy documents of the municipality of Rotterdam, semi-structured interviews with experts, and a small focus group.

The empirical research made clear that densification and sustainable mobility in suburban neighbourhoods are seen as required for a sustainable development of the city, especially because of the housing need and mobility transition. Both densification and sustainable mobility are seen as sustainable for the environment and for others. It preserves the open landscape, limits car dependency and is beneficial for the quality of life. Densification can lead to more support of facilities and mixed-use development which is favourable for the attractiveness and liveability of neighbourhoods. Proximity of facilities leads also to the limitation of car use and can stimulate walking and cycling. Yet, it appears that the densification process does not go fast enough in Rotterdam. Therefore, all the possible densification locations in the suburban neighbourhoods need to be explored by the municipality. However, every suburban neighbourhood has different opportunities and challenges in terms of densification, due to the existing ‘DNA’ of these neighbourhoods. Densification around public transportation nodes is seen as most promising in suburban neighbourhoods. This is especially true for Prins Alexander. Other opportunities for densification in suburban neighbourhoods are around sub centres, in mono-functional areas, around existing infrastructure, and the transformation of old buildings to housing. However, it is important that the spatial qualities of the suburban neighbourhoods, such as green and open spaces, are preserved. Suburban neighbourhoods are mainly characterised by its

greenness and open space. Most residents of suburban neighbourhoods have chosen for these green living environments. Therefore, these residents often resist to densification measures. Besides, densification is not an end in itself. It should contribute to the achievement of other goals of the municipality. This also applies to sustainable mobility, because sustainable mobility should contribute to other tasks. Forms of sustainable mobility are walking, cycling, public transportation and clean vehicles. Sustainable mobility is beneficial for the environment, but can also be beneficial for public health. However, the implementation is challenging, because of a high car ownership and car use among most residents of suburban neighbourhoods. This car dependency of these residents in suburban neighbourhoods has to change. Therefore, it is important that sustainable forms of mobility, such as public transportation, walking and cycling, are attractive alternatives to car use. The attractiveness of these alternatives is related to the quality and connectivity of these alternatives. Besides, the low-density structure of the suburban neighbourhoods is a challenge. Fewer residents per square meter leads to less support for public transportation facilities. Yet, new mobility systems and multi-modal mobility can be promising in suburban neighbourhoods, especially the combination bicycle and metro.

This research concludes that linking densification to public transportation nodes is seen as most promising in achieving a sustainable redevelopment of suburban neighbourhoods. Existing public transportation makes it possible to densify, and densification leads to more support for public transportation. The combination of densification and sustainable mobility around nodes is seen as transit-oriented development (TOD). Within the municipal organisation of Rotterdam, increasing support for TOD seems to emerge. Yet, a specific vision of the municipality for TOD is missing. Furthermore, it can be concluded that area-oriented plans are important since the opportunities and challenges of both densification and sustainable mobility differ per suburban neighbourhood. There seems to be a clear interdependency between densification and sustainable mobility. Therefore, it is recommendable for the municipality to integrate densification and sustainable mobility in the planning process in order to be more effective. Integrated urban planning is required with concrete and area-oriented visions. This requires a shift in thinking within the organisation of the municipality, from sectoral to integrated thinking. This means that better communication between urban and mobility planning is needed. In addition, the municipality is seen as responsible for the long-term direction of the suburban neighbourhoods. Furthermore, all the opportunities for densification and sustainable mobility in suburban neighbourhoods need to be explored and utilised. The municipality should facilitate initiatives, but the municipality itself must also contribute to the realisation of densification. However, the existing spatial qualities of suburban neighbourhoods have to be taken into account as well as the needs of the residents. In addition, the municipality should stimulate sustainable behavioural change of the residents and should make the sustainable alternatives for car use attractive. This makes participation of residents and communication between the municipality and residents important.

Besides recommendations for the municipality of Rotterdam, recommendations for further research can be done as well. It is recommendable to do further research on the social and economic perspective of the research since the research mainly focused on the policy dimension. In addition, it is recommendable to explore the opportunities and challenges of densification and sustainable mobility in suburban neighbourhoods of other cities. It is not yet possible to make generalized statements since the research only focused on the suburban neighbourhoods of Rotterdam. Finally, in the academic literature, the opportunities for TOD in suburban neighbourhoods should be investigated more since there is hardly any focus on this in the literature, despite the fact that TOD is seen as promising for the sustainable redevelopment of suburban neighbourhoods.

*Keywords: Densification, Sustainable Urban Mobility, Smart Urban Growth, Transit-oriented Development, Integrated Urban Planning, Suburban Neighbourhoods.*

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# 1. Introduction

## 1.1 Background

Many cities in the world are facing major future challenges such as climate change, energy transition, and the greening of their economies. At the same time, cities are globally popular and still grow due to the global growth in urbanisation (Jenks et al., 2003). The high amount of people living in cities will inevitably cause problems, including intensive use of resources, overstretching of infrastructure, poor sanitation and health, and social and economic inequalities, which lead to unsustainable urban forms (Jenks et al., 2003, p. 2). Therefore, it is a challenge for cities to remain sustainable (environmentally and socially) and to develop a sustainable urban form (Lehmann, 2017; Williams et al., 2000). One common and globally used model for the achievement of sustainable development of cities is the compact urban form (Burgess & Jenks, 2000). Many researchers argue that a more compact city is more sustainable (Lehmann, 2017).

For the last few years, the city of Rotterdam, in the Netherlands, is experiencing a growth of population as well. The city has become very popular. Figure 1 shows this (renewed) growth of the population and a prediction of the growth until 2035. Moreover, the city is dealing with the above mentioned challenges as climate change, energy transition and the greening of its economies and urban growth patterns (Gemeente Rotterdam, 2018). Because of these challenges and an increasing population, Rotterdam is facing a variety of challenges to sustainability.

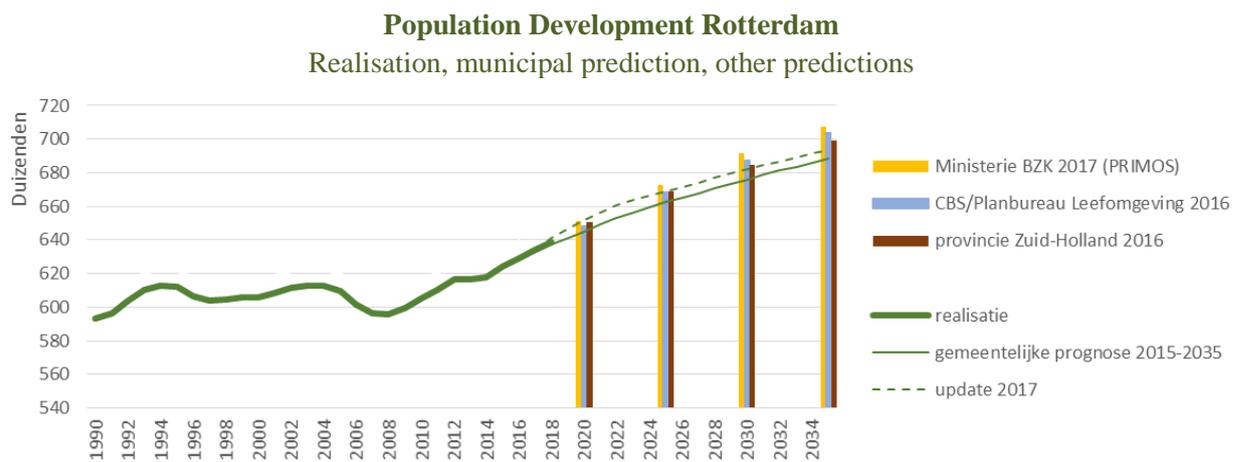


Figure 1: Population development Rotterdam (Gemeente Rotterdam, Ministerie BZK, CBS/PBL, Provincie Zuid-Holland, 2017)

To achieve a sustainable development of the city, the municipality of Rotterdam is currently working on a new Environmental Vision (*Omgevingsvisie*) in order to improve the physical living environment at all levels. The Environmental Vision consists of five perspectives to provide a direction and a more integrated approach. The five perspectives are: compact city, healthy city, inclusive city, circular city and productive city (Gemeente Rotterdam, 2018). Due to the growing popularity of the city of Rotterdam, the compact city is a relevant perspective. The compact city is a classic response to urban sprawl and is about the densification of urban and suburban areas (Neuman, 2005). The densification of urban areas also applies to Rotterdam. Ten years ago, the City Vision Rotterdam (*Stadsvisie*) was established. An important key decision in the City Vision is ‘building in existing urban areas in order to serve the housing need’. The municipality aims to implement a construction program of 56.000 homes for the period 2005-2020 (Gemeente Rotterdam, 2007, p. 62). This implementation means densification in the inner city of Rotterdam since an increased density could potentially better accommodate the population growth (Lehmann, 2017). This is also included in the Environmental Vision; it states that a

compact and denser city is more energy efficient and less polluting. Because of the clustering of activities, the impact on the environment remains at an acceptable level, and thus the quality of the living environment as well (Gemeente Rotterdam, 2018).

However, regarding the compact city perspective in the city of Rotterdam, Rotterdam is facing a major mobility challenge. This challenge is being emphasised by The Urban Traffic Plan Rotterdam 2017-2030+ (*Stedelijk Verkeersplan Rotterdam*). The municipality of Rotterdam aims for a mobility at the service of a healthy, economically strong and attractive city, i.e. sustainable urban mobility (Gemeente Rotterdam, 2017). The municipality states that mobility is not a goal in itself, but that mobility is a precondition to improve the city. It is important to consider how mobility can have a valuable contribution to the quality of life in Rotterdam of the future. The effects of changing mobility behaviour are most obvious in the inner city. In the longer term, the municipality is aiming for a car-free city centre (Gemeente Rotterdam, 2017). According to Dieleman & Wegener (2004), policies which lead to higher urban density are therefore needed. Compact city policies, like in Rotterdam, have the potential to counter urban sprawl and further growth in car use. Both concepts, sustainable urban mobility and densification, are two key components of the smart urban growth debate. Within the academic research, a debate on the value of smart urban growth policies exist (Burgess & Jenks, 2000, p. 14). This means that, besides advantages, smart urban growth has disadvantages as well which needs to be considered in the research.

So the compact city perspective in the Environmental Vision of the municipality of Rotterdam seems like a potential and significant strategy for a more sustainable urban mobility which can improve the physical living environment. However, caused by the further urban densification, the mobility transition will be the strongest in the inner city and in the urban neighbourhoods (Gemeente Rotterdam, 2017). But what about densification and the transition to sustainable forms of mobility in suburban neighbourhoods? So far, these neighbourhoods have been completely left out of the strategy. The redevelopment and the attractiveness of these neighbourhoods are a significant task as well. Therefore, the opportunities (and restrictions) of densification and sustainable forms of mobility in the suburban neighbourhoods need to be taken into account.

## **1.2 Research Problem**

So far, the main focus of academic research on compact cities has been on the densification and accessibility of inner city areas and thus on areas that are already compact (Lam & Head, 2012). However, a lot is unclear about the densification of suburban neighbourhoods, and the connected transition to more sustainable mobility in these areas. The current compact city theories do not have an elaborated focus on the already existing suburban neighbourhoods (Charmes & Keil, 2015). The associated objectives tend to be normative, structured by a critique of the negative effects attributed to sprawl. It is required to develop more convincing viable models when proposing an increase of density to existing suburbs (Lehmann, 2017). Therefore, a more critical and reflective perspective is needed, there is a research gap which makes the scientific relevance high. Lehmann (2017) argues that densification of existing suburbs seems unavoidable. In many urban regions, suburban neighbourhoods reflect patterns caused by urban sprawl. A strategy to counter sprawl might be densification of existing suburban neighbourhoods. In order to achieve sustainable (sub)urban development the whole city region has to be integrated in the process. Densification and the transition to sustainable forms of mobility need to be considered in the suburban neighbourhoods as well. This is confirmed by Jenks et al. (2003, p. 86), because ‘there is a belief that urban managers should adopt a realistic, balanced approach and that the compact city concept could be extended to include the intensification of a wider variety of settlements, including sub-centres and suburbs’.

Considering the City Vision of Rotterdam, the focus of the current policy so far has been on densification of the inner city and low-density development in the suburban neighbourhoods (Gemeente Rotterdam, 2007). This corresponds with the academic literature, wherein the focus of densification is mainly on the inner city. Up to now, the densification of the inner city of Rotterdam has been portrayed by the city of Rotterdam as being conducive for the quality of life; by creating a more dynamic and attractive city centre (Gemeente Rotterdam, 2018). However, due to the popularity of the city, the increasing housing need and the sustainability issue, the city is facing new challenges and tensions which are a threat for the (spatial) quality of the city, also of the suburban neighbourhoods. The densification process does not go fast enough (Gemeente Rotterdam, 2018). In order to preserve and improve the quality of life, a new policy of the municipality is required. It is relevant for policy making to reconsider the opportunities of densification in suburban neighbourhoods, not only in the inner city. Compactness is a part of enduring urban qualities (Lehmann, 2017). With urban design, cities could encourage walkability in areas with higher densities, which has positive consequences for public health (Sarkar et al., 2018). This means that densification of suburban neighbourhoods might not only be a potential for accommodating the increasing housing need, but it might also have beneficial consequences for the quality of life in the suburban neighbourhoods, especially in the older ones which need redevelopment. This emphasises the social relevance.

The aim of this research is to examine how the municipality of Rotterdam can initiate the sustainable redevelopment of suburban neighbourhoods by mobilising synergies between densification and sustainable urban mobility, i.e. by applying guidelines developed in the debate on smart urban growth. This research examines whether and how both concepts of sustainable mobility and densification could reinforce each other. It is significant to figure out how sustainable mobility could be a mean, not a goal on itself, for redevelopment in the suburban neighbourhoods. On the other hand, it is important to figure out whether and how dense development could be a mean or not for sustainable mobility since different perspectives on densification exists in academic research. For a sustainable development of the city, it is urgent that the current policy of the municipality of Rotterdam has to change and has to be future-oriented, so it has a valuable contribution for Rotterdam of the future. This emphasises the role of spatial planning.

The corresponding research question reads *‘How could the municipality of Rotterdam mobilise synergies between suburban densification and sustainable mobility and thus contribute to smart suburban growth?’*

The subquestions are:

- What are the main benefits and trade-offs of densification and what are its opportunities and challenges in implementing suburban densification policies in Rotterdam?
- What are the main drivers and/or restrictions of sustainable (sub)urban mobility?
- What is currently done in the city of Rotterdam to contribute to smart suburban growth? With what effects?
- What could be the role of urban planning in Rotterdam in mobilising synergies between densification and sustainable suburban mobility?

### **1.3 Research Area**

This research has a specific focus on the district called Prins Alexander located in the east of the city of Rotterdam. On January the 1<sup>st</sup> in 2018, the district counted 94.901 residents and 45.000 houses (Wijkprofiel Rotterdam, 2018). The district has a surface area of 17.6 km<sup>2</sup> and contains eight, relatively old, suburban neighbourhoods which have been built since the 1960s and 1970s. The eight neighbourhoods are: Het Lage Land, Kralingseveer, Nesselande, Ommoord, Oosterflank, Prinsenland, Zevenkamp and ‘s-Gravenland. In figure 2, a map of the city of Rotterdam is given, which shows the location of the district Prins Alexander in the east of Rotterdam. Figure 3 gives an overview of the eight

suburban neighbourhoods within the district Prins Alexander. Due to the growth of the city in the 1950s, Rotterdam needed to expand its urban area. The area of Prins Alexander was chosen as location for this expansion. The construction of the first district, Het Lage Land, started in the early 1960s. In 2000, Rotterdam started to build a completely new neighbourhood in the district, called Nesselande. This is the newest neighbourhood of Prins Alexander (Wijkprofiel Rotterdam, 2018). With the exception of Nesselande, the neighbourhoods in Prins Alexander are relatively old wherein redevelopment is necessary (Gemeente Rotterdam, 2007). Most of the neighbourhoods in the district are connected to an existing transportation network. However, there are still obstacles concerning accessibility and connectivity with the inner city and other suburban neighbourhoods of Rotterdam (Gemeente Rotterdam, 2017). For the municipality of Rotterdam, mobility is not a goal in itself. Rotterdam wants (sustainable) mobility to be a way to improve the quality of the city and to connect people. This means that densification with housing within the urban area has given priority by the municipality (Gemeente Rotterdam, 2017). Therefore opportunities of densification and sustainable mobility in the suburban neighbourhoods of Prins Alexander need to be taken into account as well. Densification could be, in turn, a potential mean for the redevelopment of these suburban neighbourhoods.

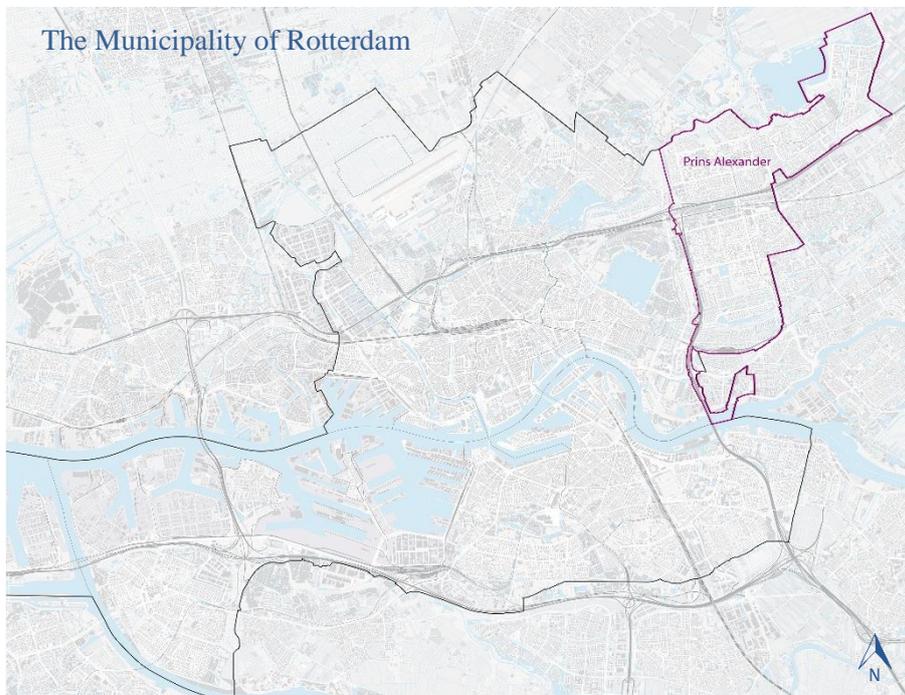


Figure 2: Location of district Prins Alexander in Rotterdam (ArcGIS, 2018)

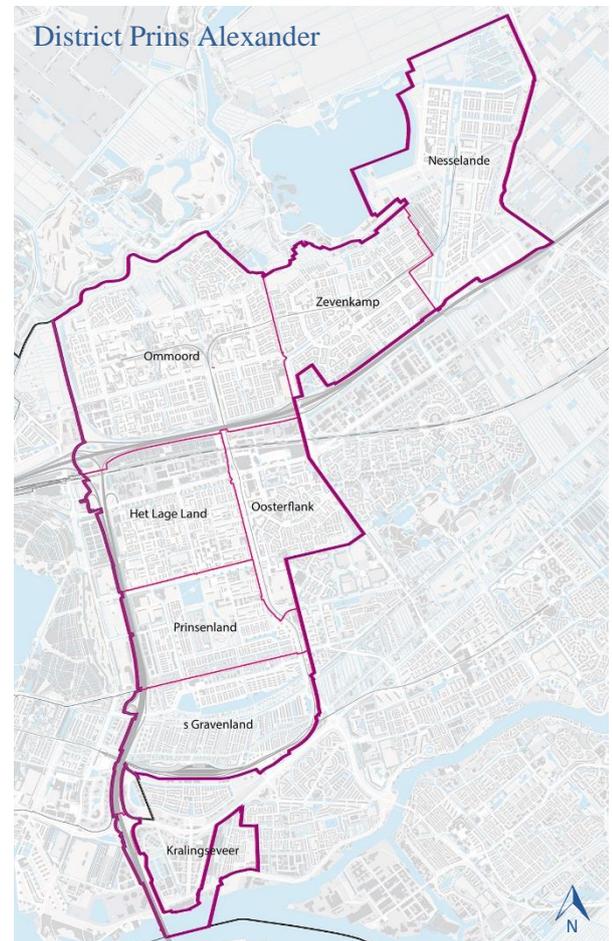


Figure 3: Location of the eight neighbourhoods in Prins Alexander (ArcGIS, 2018)

## 1.4 Thesis Outline

The first chapter introduced the research including the reason of the research, the research problem and question, the purpose and the scientific and social relevance. The rest of the thesis has been divided into four parts. Chapter two provides a theoretical framework wherein an overview of the existing academic literature is given with all the relevant concepts for the research. The emphasis is on smart urban growth, with a specific focus on two key components of smart urban growth, namely densification and sustainable urban mobility. These two concepts are explained in detail and connected to other relevant concepts, such as the urban planning debate. This will give insights about the different relations between the concepts. Finally, the conceptual framework of the research is provided which visualizes the relevant concepts and their interconnections. The conceptual framework forms the analytical framework for the empirical research and should be helpful for the conclusion and recommendations at the end.

Chapter three discusses the used methodology, including the research method and data collection. The different choices and considerations of the methods are justified and how the data has been analysed is explained. Attention is also paid to the reliability and validity of the research.

Subsequently, in chapter four, the collected data is analysed and is divided into three parts based on three different scales, namely the city of Rotterdam, suburban neighbourhoods, and Prins Alexander. The results of the analysis are presented and explained in chapter four. The data of the different research methods can be used for answering the subquestions and eventually the research question.

In the concluding chapter five, a discussion about the theoretical and empirical results is provided and the subquestions are answered. Based on the results and the answered subquestions, a conclusion is drawn and an answer is given to the research question: *'How could the municipality of Rotterdam mobilise synergies between suburban densification and sustainable mobility and thus contribute to smart suburban growth?'* After answering the research question, recommendations are provided for both the policy of the municipality of Rotterdam and for further research. These recommendations are based on the results of the research. Finally, a critical reflection on the research is given, which includes a methodological and theoretical reflection.

Chapter 6 contains the references and chapter 7 the accompanying appendices.

## 2. Theoretical Framework

In a denser city, one can get anywhere quickly with walking and cycling (Gehl, 2011, p. 32). It is commonly known that urban land use and transport are closely connected (Dieleman & Wegener), which means that the process of densification is connected with sustainable urban mobility. Densification makes it possible to travel easier and more accessible to a destination with limited impact on the environment and others, this refers to the principle of sustainable urban mobility (Lam & Head, 2012). The organisation of mobility is an important feature when urban sustainability is aimed at, which is recognised in the compact city concept (Burgess & Jenks, 2000). The amount and the way in which a city like Rotterdam expands, has influence on its level of sustainability and thereby on the quality of life, showing a coherence with mobility and the level of densification of existing areas. The concepts of densification and sustainable urban mobility are both key components of smart urban growth. In this chapter, the smart urban growth debate is explained and the two concepts of densification and sustainable urban mobility are elaborated in more detail. In addition, relevant concepts which are connected to smart urban growth and thereby the two concepts are explained as well. For the research, it is valuable to take all these concepts into account.

### 2.1 Smart Urban Growth

Smart urban growth policies promote compact and traditional development of neighbourhoods (Song, 2005). Supporters of smart growth believe that smart growth could reduce urban sprawl through better land use and transportation planning (Miller & Hoel, 2002). Smart growth concentrates growth in compact walkable urban centres to avoid sprawl (Wey & Hsu, 2014). Urban sprawl does not have a clear definition, rather it has vague connotations: low density, served only by the automobile, located on the urban fringe at the expense of green space, random, and a weak mix of land uses (Miller & Hoel, 2002). According to Song (2005, p. 241), it is argued that neighbourhoods referred as ‘compact’, ‘smart growth’ or ‘transit-oriented’ can decrease automobile dependency, reduce air pollution, reduce the amount of land affected by impervious surfaces such as roads and parking lots, and reduce the consumption of agricultural land. This counters urban sprawl and contributes to a sustainable development. The goal of sustainable development is ‘securing a better quality of life for all, now and for future generations, by pursuing responsible economic growth, equitable social progress, and effective environmental protection’ (Cavagnaro & Curiel, 2017, pp. 1). These three dimensions of sustainable development interact with each other and refer to a sustainable society. In order to achieve sustainable societies, it is essential that both societies, organisations and individuals choose for sustainability (Cavagnaro & Curiel, 2017).

Goals of smart growth include better coordinated planning with input from the public, providing multiple transportation and housing choices, providing green space in order to make communities attractive, the use of mixed-use development, and infill strategies (Miller & Hoel, 2002). Smart growth should stimulate residents using transit instead of private cars in high-density areas (Song, 2005). Supporters of smart growth suggest that streets and highways should be attractive and easily accessible to pedestrians and cyclists, while traffic producers (homes, employment sites, and commercial centers) should be located within walking distance of one another, and the service of transit should be expanded (Miller & Hoel, 2002). According to Sarkar et al. (2018), there is a relationship between neighbourhood walkability and high blood pressure, because urban design could potentially influence individual behavior and lifestyle. With urban design, cities can optimize walkability and promote active lifestyles which improve long-term health outcomes (Sarkar et al., 2018). This is beneficial for public health. Furthermore, according to Lehmann (2017), there is evidence that when people gather together more

closely and interact due to higher densities, innovation can happen more easily and new ideas are created more often.

In short, smart urban growth combines land use with transit in order to decrease car dependency and to counter urban sprawl. However, regarding the key components of smart urban growth, densification and sustainable urban mobility, restrictions exist as well. These key components of smart urban growth and their opportunities and restrictions are elaborated below.

## 2.2 Densification

One key component of smart urban growth is densification which is the opposite of urban sprawl. Most urbanists and planners favour dense and compact cities to counteract urban sprawl, because of ecological and economic discourses. A denser and more compact city is considered as a more sustainable city. Charmes & Keil (2015, p. 587) state that ‘living in a lower-density environment usually means being far from the concentrated resources of a city and depending on the car for even the shortest trips’. This car dependency has negative impacts on the environment. Living in low-residential areas is no longer perceived as being about getting closer to the countryside, rather it is regarded as being unsustainable to the environment. In addition, an economic perspective on the consequences of low-density development exist. The more spread out a city is, the longer its networks and infrastructures need to be which emphasises the costs of sprawl (Charmes & Keil, 2015). Higher densities require much less land which is favourable for the environment and, as mentioned above, higher densities have positive impacts on public health since urban design could influence individual behaviour and lifestyles (Sarkar et al., 2018). Densification does not have to lead to poorer public spaces and different forms of densification exist. Figure 4 shows three different forms of densification. All the three forms have different political and social meaning (Charmes & Keil, 2015). The density of construction is the same, but it shows the distinction between soft and hard densification. According to Touati (2015), soft densification could be a compromise between exchange value and use value, balancing economic interests emerged from urban growth with the interests of the residents. It can overcome resistance from residents, while hard densification may trigger strong opposition.

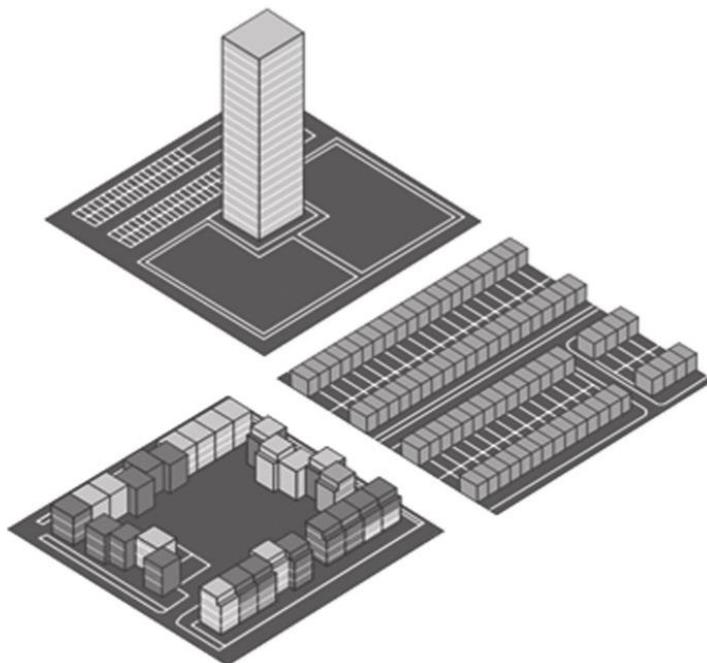


Figure 4: Different forms of density (Charmes & Keil, 2015)

It is remarkable that in the literature, there is barely a focus on densification in existing suburban neighbourhoods (Charmes & Keil, 2015). The reason for this is that most suburban neighbourhoods originally have a low-density development. The shift of these neighbourhoods towards higher-density is a challenge, because these large areas remained underexploited due to the low residential density, and densification raises a lot of resistance, especially from the residents (Touati, 2015). The reason for this resistance is that increasing densities can easily conflict with other social, economic or environmental goals (Lehmann, 2017). Nevertheless, some older suburbs are changing through a process described as post-suburbanization which involves densification, complexification and diversification of the suburbanization process (Charmes & Keil, 2015). It is important to notice that this is not a distinct typology, suburbs versus post-suburbs, but rather a historical change of the process de-densification (classical suburbanization) to a process that involves densification, complexification and diversification of the suburbanization process. For instance, in both France and Canada, urbanists and planners now favour dense and compact cities in order to counter sprawl. These countries share a built environment of peripheral high-rise housing, including in suburban neighbourhoods. Yet, a lot of diversity between the cases exists regarding the design of the suburbs, hard and soft densification, and regarding the local bodies governing those (Charmes & Keil, 2015). This is confirmed by Touati (2015), nowadays suburbs experience densification processes of varying degrees depending on local dynamics. The implementation of different densification in different areas depends on district characteristics, e.g. the presence of public transportation, urban functions and socio-demographic characteristics, municipal political objectives, and the cultural conditions (at national and municipal level) governing the political production of urban regulation. In Canada, densification policies are regulated at the provincial level, whereas in France urban planning, including densification policies, is devolved to the municipal level. Charmes & Keil (2015) conclude that 'we need to accept that post-suburbia is now ubiquitous' (p. 600). Lehmann (2017) argues as well that densification of existing suburban neighbourhoods is unavoidable. Increasing density is relevant to the entire city, not only for inner city areas. This process of post-suburbanization, containing different densification policies, is relevant for the research.

However, while the smart growth policies, which are promoting compact and traditional development patterns through higher density, are profuse, there is little empirical evidence regarding the efficacy of these policies (Song, 2005). Filion (2009, p. 518) argues that recent urban development trends are not all that favourable for the start and further expansion of nodes (i.e. dense areas) and that even well-developed dense areas face difficulties in meeting walking and public-transit objectives. Even dense urban forms can disrupt ecological and social systems, when dense development is not in the right place, at the right time, and in the right form (Song, 2005). The implementation of higher-density areas turns out to be difficult, because of the existence of multiple obstacles (Filion, 2009). Smart growth plans lack nontraditional aspects of planning for the encouragement of mixed land uses and to improve regional accessibility. Besides, the integration of activities within these higher-density areas is not sufficient and public-transit patterns are still well below expectations (Song, 2005; Filion, 2009). Within higher-density development, the social dimension is a key challenge, since cities are becoming the focus of delivering high quality of life in the context of urban sustainability (Lehmann, 2017). Communities need to provide some input into the process for public acceptance (Song, 2005; Banister, 2008). Moreover, very dense high-rise cities (e.g. Hong Kong) are not the best sustainable solution, because a high-density city can increase the risk of the urban heat island effect. A medium-density compact development (of four-to eight-storey blocks) would be a more preferred option (Lehmann, 2017). Finally, long-distance trips (for pleasure or business) are often ignored, whereas these trips increase with higher densities, due to, among other things, the need for respite from the noise and stress of dense city centres (Charmes & Keil, 2015). This needs to be considered in the research.

### 2.2.1 Compact City

Compact city development is a form of densification and smart growth which can discourage sprawl (Song, 2005). Compact city approaches are defined by Burgess & Jenks (2000, p. 9) as ‘to increase built area and residential population densities; to intensify urban economic, social and cultural activities and to manipulate urban size, form and structure and settlement systems in pursuit of the environmental, social and global sustainability benefits derived from the concentration of urban functions’. As mentioned before, many researches argue that a denser, more compact city is a more sustainable city. There is an agreement that further expansion of the city footprint into critical habitat areas is environmentally unacceptable (Lehmann, 2017). The compact city approach is an attempt to regulate urban form and has been a classic response to urban sprawl (Dieleman & Wegener, 2004; Neuman, 2005). As mentioned before, urban sprawl is a vague concept. It is the combined effect of growing affluence, changing lifestyles and the fast advance in personal mobility made possible by the private automobile. Dieleman & Wegener (2004) confirm that compact city policies have the potential to keep the urban sprawl and further growth in car use in control. The compact city increases efficiencies in urban infrastructure and services through shorter distribution networks. Finally, urban theorists and economists have both acknowledged compact cities as engines of progress and idea producers (Lehmann, 2017, p. 70). When cities attract people, acts as information hubs and empower the public and private sectors to cooperate on development projects, they are seen as successful. The compact city policy has a high potential to support quality of life with amenities close by (Lehmann, 2017).

However, compact city policies face several challenges as well. Neuman (2005) exemplifies this with a compact city paradox. The Compact City Paradox ‘compares the compact city with urban sprawl with a view toward resolving the urban desirability versus suburban liveability paradox’ (p. 12). The compact city ideal in planning debate is a response to urban sprawl. However, yet a response to overcrowding arose. Relieving crowding by letting in more light and air led to less compact urban forms (Neuman, 2005, p. 11). For a city to be sustainable, it is being argued that functions and population must be concentrated at higher densities. But by contrast, Neuman (2015) argues that for a city to be liveable, functions and population must be dispersed at lower densities. Therefore urban sprawl is seen, in turn, as a response to the compact city. In the 1970s, people escaped the dense city and its pollution and moved to low-density, suburban neighbourhoods. According to Charmes & Keil (2015), these neighbourhoods were seen as attractive for its greenness and people had the opportunity to own a single-family home with a private garden. The challenge of the compact city is being confirmed by Haaland & van den Bosch (2015), because there is a challenge concerning the provision of urban green space for a liveable city. Urban densification processes can be a threat to urban green space since green space may need to be removed for densification purposes. Planning and management of urban green space is a fundamental issue in the context of the compact city (Haaland & van den Bosch, 2015, p. 761). Urban green space offers essential habitat for wildlife and is beneficial for urban residents. It is important for the public health and wellbeing which lead to higher living quality. This makes providing sufficient urban green space in densification areas an important challenge (Haaland & van den Bosch, 2015). Moreover, Williams et al. (2000) are not decisive about the link between densification and reduced automobile trips. It depends on the type of auto trip. Short trips may decrease through densification, but longer travel distances (e.g. unique shopping, specialized employment) can be independent of urban density or even increase (Williams et al., 2000; Charmes & Keil, 2015). The compact city approach raises some important questions. Burgess & Jenks (2000, p. 9) are asking ‘what should be the principal spatial point of reference in undertaking compaction?’ [...] ‘Should it be the city itself or the metropolitan region, the broader region or the urban system?’ [...] ‘Should the compaction efforts be concentrated on the development of new settlements or on modifying existing ones?’ Williams et al. (2000) question the emphasis that is placed on the achievement of sustainability through one model, the compact urban form. Not just one simple and universal model of sustainable urban form exists. Williams

et al. (2000) argue that it should be recognised that there may be a range of urban futures that may be called sustainable.

Despite the downsides and challenges of the compact city approach, many researchers support the compact city as a sustainable urban form (Lehmann, 2017; Burgess & Jenks, 2000). From the sustainable perspective, according to Lehmann (2017, p. 81), ‘the ideal city is the European urban model: compact, with well-defined edges in a gridded block and street pattern, formed by medium-rise mixed-use perimeter block buildings that are neither too high nor too low: four to eight storeys high, with the taller buildings around railway stations and transport nodes’.

2.2.2 Decentralised Concentration and Mixed-use

Another densification strategy to counter sprawl is decentralised concentration, which means the densification of already existing neighbourhoods. The aim of decentralised concentration is to re-orient the existing urban structure by focussing development at places with high accessibility in order to support an effective public and private transport system. These places could be one or multiple nodes of concentrated activity connected both physically and by telecommunications (Curtis, 2008, p. 105). Sites on bus routes, along train lines and close to shopping hubs are the most likely to be densified (Lehmann, 2017). According to Holden & Norland (2005), the concept of decentralised concentration is based on sustainable development and urban form policies, such as slowing down the decentralisation process. At the same time, it is based on realising that extreme forms of the compact city are unrealistic and are, moreover, undesirable. It maximises advantages and, at the same time, minimises disadvantages offered by different versions of the compact city. Holden & Norland (2005) argue that there is a connection between land use characteristics and household consumption of energy and transport. Decentralised concentration could lead to even lower energy use in households. A form of decentralised concentration which takes place in existing suburban neighbourhoods, is suburban retrofitting (‘sprawl repair’), by ‘making existing suburbs denser, more urban, more mixed-used and interconnected’ (Lehmann, 2017, p. 82). Suburban retrofitting has become a strategy to improve and repair the suburban areas, including grassroots-driven urban densification strategies which provide room for local action.

The interest in the shape and ideal density of cities has a long history (Lehmann, 2017). The idea of decentralised concentration originates from the ‘Garden City’, proposed by Ebenezer Howard (1898), with its vision that city growth should involve the gradual transformation of existing centrally concentrated cities into decentralised towns (Burgess & Jenks, 2000). Figure 5 shows the Garden City idea which illustrate the idea of decentralised concentration. In the Garden City idea, density is combined with greening and mixed-land use in order to combine the best of both city and country living.

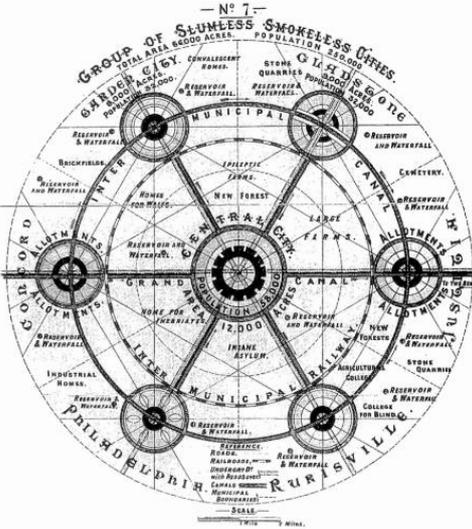


Figure 5: Garden City by Ebenezer Howard (Lehmann, 2017)

The last decade shows a renewed interest in the historical model for the mixed-use, compact city. The focus has shifted to the transformation of low-density settlements and urban sprawl since urban sprawl is unsustainable (Lehmann, 2017). Mixed-used development is one of the goals of smart urban growth (Miller & Hoel, 2002) and is according to Hoppenbrouwer & Louw (2005) an ambiguous planning ideal. It is a response to the separation of the four main functions of the city (housing, employment, recreation and transport) which was advocated by CIAM (Congrès Internationaux d'Architecture Moderne). This CIAM town planning led eventually to the segregation of land use, including suburban sprawl. In theory, mixed-use forms part of a wider strategy for sustainable development. It describes developments and areas that combine diverse uses, such as residential, commercial, retail and office uses, which are clustered in one project (Lehmann, 2017). 'The different uses can be either layered vertically in a single building, or in a horizontal arrangement' (p. 79). Mixed-use development is seen as a significant instrument to create and maintain attractive, liveable and sustainable urban environments. The closeness of the different uses should reduce the need to travel, conserve energy and reduce pollution (Hoppenbrouwer & Louw, 2005). Furthermore, it is argued that mixed-use development should contribute to urban diversity and vitality, which provides opportunities to improve the quality and attractiveness of the urban area.

However, several constraints can be identified. Mixed-use cannot provide the benefits of economic vitality, social equity, and environmental quality, when cultural and economic forces promote the separation of land uses, for instance an economic force as the real estate sector. Besides, activities of a real estate sector still demand separation from the other uses, particularly residential, since they prefer safe, reliable investments. For instance, heavy industry is generally incompatible with housing (Hoppenbrouwer & Louw, 2005). Despite these constraints, mixed-use development is generally seen as an important instrument in urban planning for achieving vital cities and its benefits are largely taken for granted. When analysing mixed-use developments, four aspects are important which need to be taken into account. These four aspects are: urban functions, dimension, urban scale, and urban texture. A mix of two or more of the main functions of cities, advocated by CIAM above, can be defined as mixed land use. These urban functions can be mixed at various scales and at different times (Hoppenbrouwer & Louw, 2005).

### **2.3 Sustainable Urban Mobility**

When looking at the purpose of smart urban growth, residents using transit instead of private cars in high-density areas (Song, 2005), sustainable urban mobility is another key component of smart urban growth and is related to densification. Theories on the influence of urban form on travel have concluded that dense and concentrated urban development is more conducive to sustainable mobility than low-density spatial expansion of the urban area (Naess et al., 2011). Vice versa, better accessibility to transit, pedestrian-friendly neighbourhoods and connectivity between neighbourhoods can enforce compact growth and discourage sprawling development (Song, 2005). Sustainable mobility has a central role to play in the future of sustainable cities since mobility patterns in (developed) countries have become unsustainable (Holden, 2007). For a long time, the private car has been the dominant transport mode in passenger transport, due to the need of individuality, independence, flexibility and due to suburbanization (Schuppan et al., 2014). This car use has effects on the ecological and social environment, showing risks for road users because of the risk of accidents, cutting of landscapes, and causing emissions, noise and air pollution which contributes to climate change. As a result, cities suffer and become unsustainable. The continuing urbanisation trend will foster the urban mobility challenges even more (Willing et al., 2017). These unsustainable traditional patterns of mobility need to change into sustainable ones. Sustainable urban mobility is about 'the ease, convenience, affordability, and accessibility of travelling to one's destination with minimal impact on the environment and others' (Lam & Head, 2012, p. 359). Sustainable mobility requires that the impacts of transport activities must not be

a threat to long-term ecological sustainability, that the basic mobility of the public must be satisfied and that there is mobility equity, which means that everyone should have access to a specified minimum level of mobility (Holden, 2007). According to Lam & Head (2012), travel should be safe, at optimal speeds, and by the most direct routes. In many cities, traditional forms of mobility are responsible for a large percentage of the total carbon emissions. These traditional forms of mobility are now in doubt and driven by three main factors: climate change; environment and health; and economy. More sustainable forms of mobility are essential for the decrease of carbon emissions and for addressing climate change impacts. Lam & Head (2012) explain that when walking, cycling, green public transport, and shared vehicle use are getting more leading, and supported by ICT, cities can become less reliant on the traditional, personal and unsustainable forms of mobility. Figure 6 shows this new ‘hierarchy’ of forms of mobility with the emphasis on sustainable forms (e.g. walking, cycling and public transportation). These more sustainable ways of mobility are not only beneficial for climate change impacts, but for public health as well (Khreis et al., 2017). The reason for this is that the use of traditional forms of mobility, such as car-use, lead to greater congestion and worsen air quality which has negative impacts on the public health (Lam & Head, 2012). The relationship between urban transport and a large burden of global disease and early mortality make these negative impacts on the public health clear. Policy measures that are beneficial to health, such as sustainable urban mobility, need to be implemented to reduce the burden of urban transport (Khreis et al., 2017).

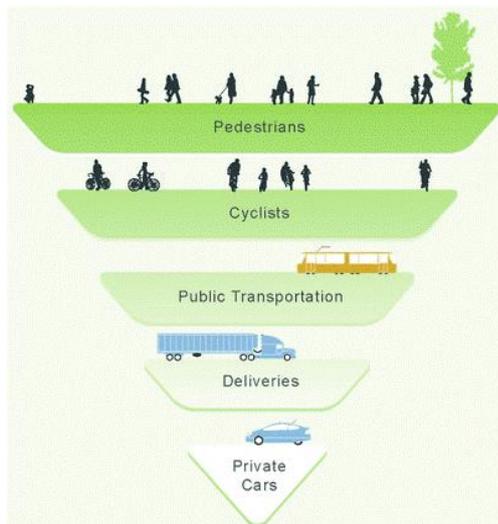


Figure 6: Hierarchy sustainable urban mobility (Lam & Head, 2012)

Because of the ongoing urbanisation and the rise of the sharing economy, a growing number of cities try to reduce car use by the development and implementation of strategies (Schuppan et al., 2014). In recent years, the number of urban transportation means has increased, such as, for instance, bus, metro and bicycle (Willing et al., 2017). Digitalisation and Information Systems (IS) solutions have enabled new and more sustainable alternatives. In many urban areas personal car travel is partially being replaced by other means of transportation. Travel demand management are targeting behaviour change and can on the one hand restrict or disable habitual behaviour, ‘push measures’, or on the other hand attract a mode shift by providing information and/or giving incentives, ‘pull-measures’ (Schuppan et al., 2014). Schuppan et al. (2014, p. 553) emphasise ‘the growing dominance of multimodal mobility and the declining role of private cars in everyday mobility in dense urban areas’. Multimodal mobility is the use of different forms of sustainable mobility, such as public transportation, cycling and walking. These forms of mobility are alternative modes of transport for car use (Schuppan et al., 2014). Willing et al. (2017) define ‘multimodal behaviour’ as ‘utilizing different transportation modes depending on one’s momentary needs, as opposed to always travelling by personal car’. These different means of

transportation are interconnected (Gallotti & Barthelemy, 2014). These interconnections can have crucial consequences on the behaviour of the whole system. A special case of multimodality is intermodal mobility behaviour, whereby two or more travel modes are combined within a single trip (Willing et al., 2017). According to Schuppan et al. (2014) it is necessary to encourage the use of alternative transport means and to make car use and car ownership unattractive. To achieve this, re-design of the current parking management is needed in order to support a rethinking of habitualised car use and further car abolishment. It is crucial to improve infrastructures and to keep alternative means of transport attractive and to respond precisely to citizens' need (Schuppan et al., 2014).

Most attempts which have been made to achieve sustainable mobility have been of the sustainable mobility variety: 'the development of more efficient conventional transport technology, the use of alternative fuels; the promotion of an efficient and affordable public transport system; the encouragement of environmental attitudes and awareness; and the use of sustainable land-use planning' (Holden, 2007, p. 1). These attempts are often taken for granted, but 'how is sustainable mobility to be achieved?' According to Lam & Head (2012), in order to achieve sustainable urban mobility, good urban design, behaviour change, advance technology, supportive policies, economic incentives, and city engagement and leadership are required. Especially urban design, i.e. built environment, has an essential role to play. The urban built environment can influence travel behaviour and thus sustainable mobility (Zegras, 2005).

However, making mobility patterns sustainable is seen as the most challenging theme of sustainable development (Holden, 2007). It is difficult to create a comfortable match between transport and sustainable development, the main challenges relate to the necessary conditions for change (Holden, 2007; Banister, 2008). These conditions are dependent upon high-quality implementation of innovative actions. Moreover, achieving sustainable mobility requires more than just enhanced knowledge about technological solutions (Holden, 2007). Banister (2008) argues that the achievement of sustainable mobility will only be successful through the understanding and acceptance by the people. The habits of the people need to change. So far, consumers, businesses and tourism all demand that traditional travel, dependent on personal vehicles, is cost-efficient (Lam & Head, 2012). Individual attitudes may play an influencing and difficult to capture role in travel behaviour (Zegras, 2005). In order to change these unsustainable forms of mobility, active involvement and action of the public are required through an interactive and participatory process. An open and active involvement of the stakeholders would be more effective, because the stakeholders can understand the reasons behind policy initiatives (Banister, 2008). Yet, at the same time, individual behaviour and habits are related to mobility practices which are embedded in socio-technical and spatial arrangements, such as the urban structure (Naess, 2006). Studies on the effects of urban structures on travel behaviour assume that structural conditions have a potential to influence human actions. The residential location and the accessibility to facilities play an important role in travel behaviour.

Banister (2008, p. 78) listed four key elements to achieve sustainable mobility: 1) making the best use of technology, including investment in technology in transport modes, information systems and in the transport system itself, and in giving industry directions on priorities; 2) Regulation and pricing means that the external costs of transport should be reflected in the actual costs of travel through higher fuel prices or through some form of road user charging; 3) land-use development, including planning and regulations, needs to be integrated; 4) clearly targeted personal information is also crucial. The third element shows the relationship of sustainable urban mobility with spatial planning and the urge of an integrated process. An integrated land-use development should be used to support shorter travel distances (Banister, 2008). Therefore, integrated spatial planning is playing an essential role in the achievement of sustainable urban mobility and densification.

## 2.4 Transit-oriented Development

When focusing on both sustainable urban mobility and densification, transit-oriented development becomes relevant. This development combines sustainable urban mobility with densification. According to Suzuki et al. (2013), the integration of transit and land use is one of the most important strategic initiatives for developing more sustainable urban futures. The ‘Network City’ planning concept is an approach for the integration of land use and transport (Curtis et al., 2016). It embraces sustainable accessibility. A spatial framework should guide transit and other infrastructure investments. The channelling of higher urban densities along high-capacity transit corridors is of particular importance, this refers to the concept of transit-oriented development (TOD). TOD is a development pattern that is focused on its proximity and reliance on high-frequency transit, it aims at densifying urban settlements along transport networks and hubs (Bishop, 2015, p.1; Khan & Carville, 2017). It is an urban form which is increasingly seen as being important to sustainable urban futures (Suzuki et al., 2013). TOD is medium-to-high density and has a mix of uses (Bishop, 2015). A correlation between basic transport and land use exists. TOD pursues a combination of stimulating transit and a more connected and safe walking and cycling network, which is shown in figure 7 (Curtis et al., 2016; Bishop, 2015). Therefore, transit and land-use integration is one of the most promising means of reversing the trend of automobile-dependent sprawl and developing cities in a sustainable way (Suzuki et al., 2013). Transit-oriented neighbourhoods eases increased accessibility because it brings alternatives to automobile land uses which, in turn, reduces air pollution (Curtis et al., 2016). Furthermore, TOD ‘creates more activity and vibrancy and community life in a centre by having more people living closer together’ (Curtis et al., 2016, p. 173). For instance, in cities like Copenhagen and Singapore, convincing regional policies focused on high-capacity transit investments have produced desired urban-form outcomes (Suzuki et al., 2013). According to Bishop (2015), municipalities have a relevant role to play in order to reach a sustainable and efficient city by using TOD.

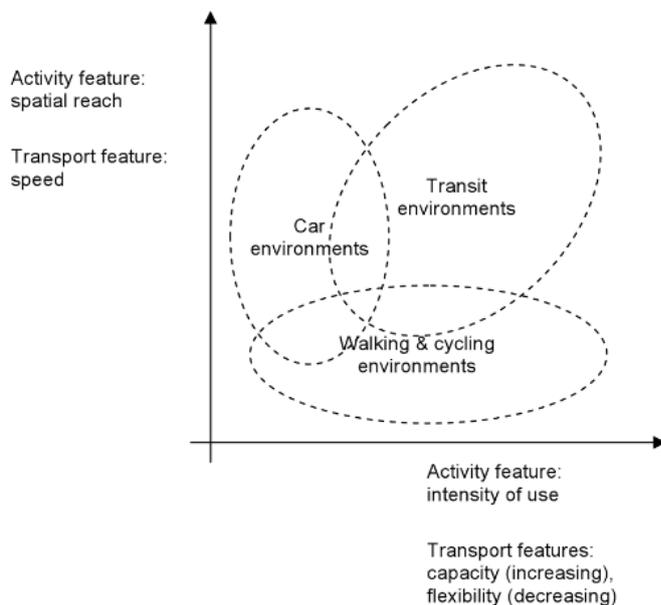


Figure 7: Basic transport and land use correlations (Curtis et al., 2016)

An example of a TOD based system is the Public Transport Accessibility Level (PTAL) in London. PTAL is ‘a detailed and accurate measure of the accessibility of an area to the public transport network, taking into account walk access time and service availability’ (Mayor of London, 2015, p. 8). It reflects walking time from the area of interest to the public transport access points; the reliability of the service modes available; the number of services available within the catchment; and the level of service at the public transport access points. PTAL is promoting sustainability, because in locations with

high accessibility to public transport, car-free developments should be promoted. Despite stimulating public transport, the policy recognises that these developments should always include parking provision for disabled people (Mayor of London, 2015).

Despite the promising consequences of TOD developments, it is being argued that the people who can afford to live in TOD development areas are often those with high-paying jobs, who own higher-quality cars. Residents of suburban neighbourhoods often share this characteristic. This means that these groups of people are often least likely to use public transport for their daily travel (Khan & Carville, 2017).

## **2.5 Urban Planning and Mobility Planning**

Within the debate of smart urban growth, urban planning has a role to play. There have been consistent calls for urban planning to be more effectively integrated with transport investments, and to be used to reduce travel by private car (Hickman et al., 2013). An integrated urban planning and development process is essential for a sustainable development, as it allows greater level of public transport usage, walking and cycling and more localise trip patterns (Yigitcanlar & Teriman, 2015; Hickman et al., 2013). This is confirmed by Lam & Head (2012, p. 364), 'integrated urban planning and design should promote high density, compact development around major, clean public transportation nodes, green networks, and business links'. The processes of urban planning and development should not cross the boundaries of the ecosystem in order to achieve sustainability in the longer term (Yigitcanlar & Teriman, 2015). As mentioned before, planners belief that better connectivity between neighbourhoods can enforce compact growth and discourage sprawling development (Song, 2005; Lehmann, 2017). A strong communications system is necessary to decrease the need to travel. It would allow policy-makers and residents in cities to have greater precision in travel choices, speeds, and times (Lam & Head 2012). Sustainable transport futures are possible and people are aiming for it, however it is very difficult to achieve in terms of implementation (Hickman et al., 2013). Cities cannot be changed or transformed quickly or easily (Lehmann, 2017). The purpose of urban planning is precisely to influence these transformation processes in a way that is more favourable for society (Naess, 2006, p. 13). If travel is needed, it has to be linked with, first walking and cycling, and then with eco-public transportation. The use of private cars should be the last option and rarely used. TOD could be a solution for the reduction of car use since it brings alternatives for the use of cars and stimulates transit (Bishop, 2015). Regarding TOD, building centres linked to transit requires a strategic planning framework as a set of policy tools to help implement these TODs (Curtis et al., 2008). The implementation of TODs, which combines densification and sustainable mobility, is a complex challenge as well.

In order to achieve a sustainable development by decreasing carbon emissions, improving environmental quality, and serving greater economic and social value, sustainable urban mobility becomes crucial. Cities are the places to pursue sustainable urban mobility, because of their growing populations, economic weight, governance ability, and density. Lam & Head (2012) have stated four strategies for cities to follow in pursuing sustainable urban mobility: integrated urban planning and design; expanding eco-vehicle use; enact behavioural change; and low emissions policy. The first two strategies are a task for which the urban planning is responsible. An urban plan should discourage the use of traditional forms of mobility, such as cars, through an integrated planning design, supporting communications and logistics system, and inter-city connections. It is being argued that 'offering real-time location-based information will provide uses with a better service, and provide city leadership with data on mobility patterns, occupancy rates and interaction'. Integrated urban design should promote higher density and compact development around transportation hubs and networks, and car clubs, hybrid, and/or electric vehicles should be encouraged. Even public transport, fuelled by renewable and alternative energy, would also be heavily embedded into urban design according to Lam & Head (2012). Besides, multimodal accessibility is seen as important, bike lanes and some pedestrian-only streets

should be heavily used and connected to the transportation network of the city. The importance of urban planning and design is highlighted by Naess et al. (2011) as well. The choice of residents of transportation means are for instance influenced by the provision of roads and the availability of parking places (Naess et al., 2011). Personal transportation is one of the areas most in need for change. Integrated urban design and planning and expansion of eco-vehicles will certainly support sustainable urban mobility and steer consumers away from traditional personal vehicles, the third strategy. But still consumers have to be encouraged to use alternatives with change management so they see the benefits of the alternatives (Lam & Head, 2012). Every aspect is intertwined, the linkages and connections are called ‘virtuous cycles’, shown in figure 8. Virtuous Cycles encourage more holistic thinking and promotes technical specialists or city agencies to work together. Different technical strategies can support the development of sustainable urban mobility (Lam & Head, 2012).

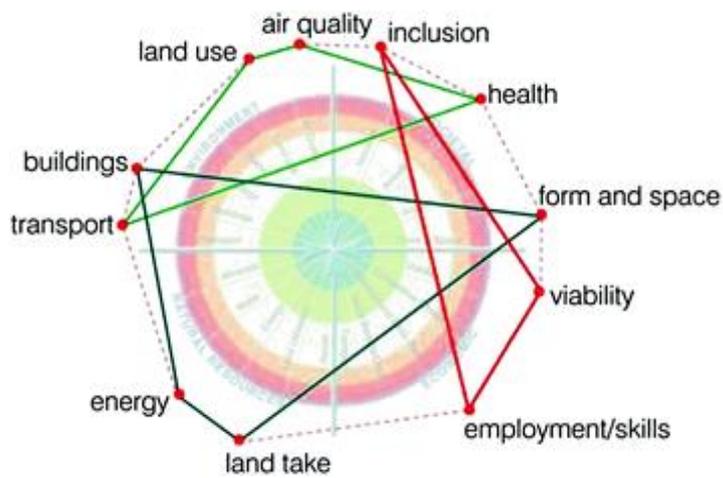


Figure 8: Virtuous cycle (Lam & Head, 2012)

However, when aiming for a sustainable development through urban planning, one has to deal with barriers to sustainability. These barriers consist of lack of coordination between sectors, levels and administrative territories, including municipalities, ministries and transport forms (Naess et al., 2011). For instance the competition between different municipalities for investments and taxpayers is a barrier to sustainable urban development. Especially with transport infrastructure policies, different sectors within public administration have pulled in different directions (p. 308). The different promotions between two ministries may in part reflect different organisational cultures. In addition, lack of coordination could also occur across municipal borders. According to Naess et al. (2011), it is important that national planning authorities support the compact urban developmental strategy followed by a municipality in order to make the strategy work. Lack of coordination often exists, because some actors do not want to take the interests of other entities into consideration. This has to do with power relations, e.g. between ministries. Bierman et al. (2009) argue that moderate degrees of fragmentation may lead to both significant costs and benefits, whereas higher degrees of fragmentation are likely to decrease the overall performance of the governance system. The possibility of institutional fragmentation and lack of coordination between sectors, levels and administrative territories need to be taken into account for the research.

Based on the previous concepts, the implementation of higher-density and more accessible and sustainable transit in the suburban neighbourhoods of Rotterdam seems promising for a sustainable (re)development. However, it is also concluded that the process of this implementation is very complex and faces different challenges including lack of coordination. Sufficient urban planning has a crucial role to play. All the advantages and disadvantages of compactness, densification and TOD development

need to be taken into account in the research. For a sustainable growth towards a compact but green city, a shift in thinking is needed (Lehmann, 2017). An effective and integrated development model and policy are required which are convincing in order to achieve a sustainable development (Yigitcanlar & Teriman, 2015), including the suburban neighbourhoods. The urban planners of the municipality of Rotterdam play a relevant role in achieving this (Bishop, 2015). Within this, national support plays an important role (Naess et al., 2011).

## 2.6 Conceptual Framework

Based on the discussed debates, links between the different concepts can be made. This is visualized in a conceptual framework, shown in figure 9.

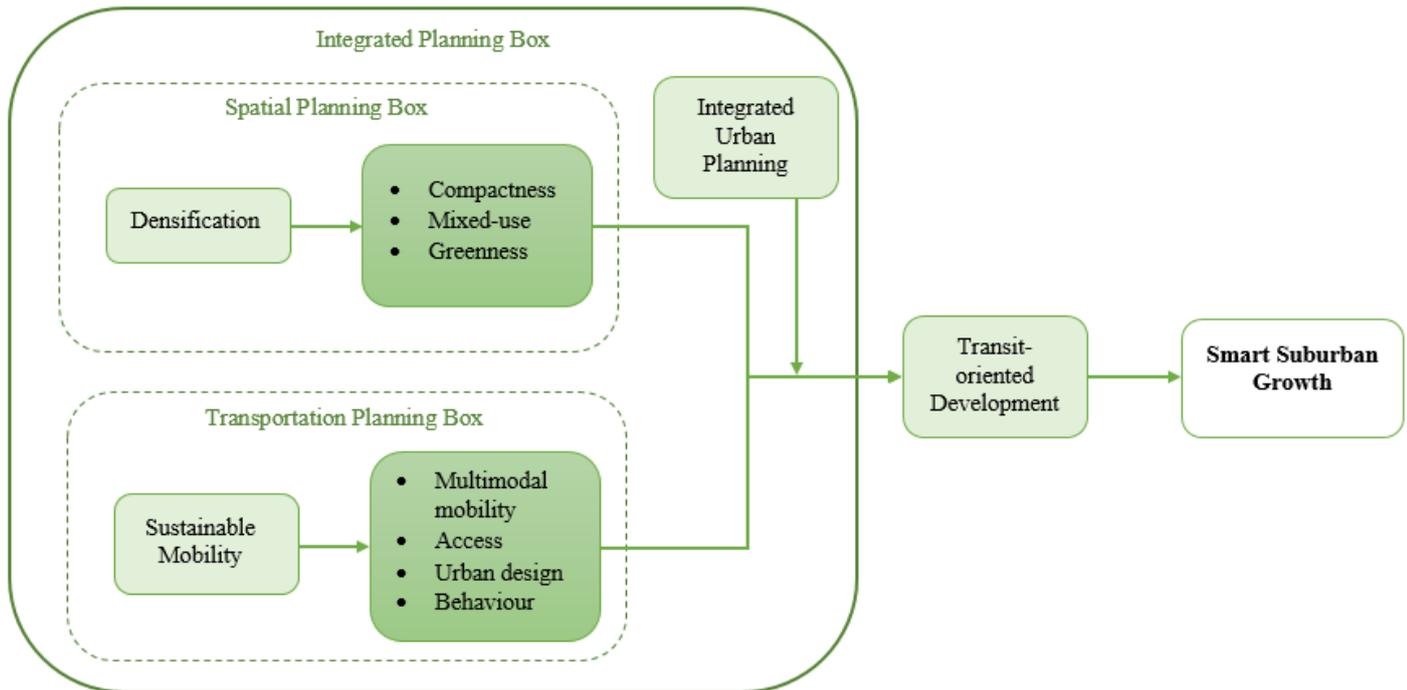


Figure 9: Conceptual framework

The conceptual framework is a primarily visual representation of the theories underpinning the research and the expected cause-effect relations in the research. The smart urban growth debate is the overarching debate of the research. Smart urban growth combines land use with transit in order to decrease car dependency and to counter urban sprawl. It is argued that the purpose of smart urban growth is to stimulate residents to use transit instead of private cars in high-density areas. This shows a relationship between two key concepts of smart urban growth where the research is focusing on, namely densification and sustainable mobility, see figure 9. Based on the theoretical framework, the research assumes that there is an interconnection between the process of densification and sustainable mobility. Theories have concluded that the combination of the two concepts lead to a more sustainable development of cities, because ‘compact’ and ‘transit-oriented’ neighbourhoods can counter urban sprawl.

Densification can be divided into two different forms which both counter urban sprawl, namely compact city and decentralised concentration. The most important difference between these two forms is that decentralised concentration occurs in already existing neighbourhoods, including suburban neighbourhoods, focused at places with high accessibility, whereas compact city approaches can be implemented in new areas. Higher density requires much less land which is favourable for the

environment and it has a positive impact on public health since it increases walkability. It is argued that higher density is relevant to the entire city, so to the suburban neighbourhoods as well. However, densification in suburban neighbourhoods is challenging due to their low-density development. Different researches have concluded that in order to implement densification successfully, both in the inner city as in the suburban neighbourhoods, several preconditions need to be met. These preconditions are compact development, mixed-use development and preserving and/or adding green in the public space, shown as variables in the conceptual framework. It seems to be that these preconditions occur simultaneously, but occur in varying degrees in different areas.

Sustainable urban mobility is relevant since traditional forms of mobility have become unsustainable. Besides being beneficial for climate change impacts, sustainable mobility is seen as positive for public health. In order to successfully implement sustainable mobility, several preconditions need to be met. Multimodal mobility is one precondition of sustainable mobility which is a combination of sustainable forms of mobility. It is argued that a growing dominance of multimodal mobility in dense areas is important in order to change peoples’ travel behaviour and reduce car use. These different means of mobility are interconnected. Based on the literature, other preconditions seems to be good access to sustainable forms of mobility, attractive urban design, and behaviour change of people, see figure 9. Considering the research, when aiming for successful densification and sustainable mobility in the suburban neighbourhoods of Rotterdam, the preconditions of both concepts need to be taken into account in the research.

Furthermore, based on the literature, similarities and relations can be found between densification and sustainable mobility concerning benefits and drivers, as well as trade-offs and restrictions which can be categorised on the basis of the three dimensions of sustainability: environmental, social and economic (Cavagnaro & Curiel, 2017). As mentioned before, these dimensions interact with each other. These similarities and differences are visualised in table 1 and 2.

<b>Benefits &amp; Drivers</b>		
<b>Sustainability</b>	<b>Densification</b>	<b>Sustainable Urban Mobility</b>
<i>Environmental</i>	<ul style="list-style-type: none"> <li>-Dense city = More sustainable city</li> <li>- Counters urban sprawl</li> <li>- Decrease of ecological footprint</li> <li>- Walkability, compactness</li> </ul>	<ul style="list-style-type: none"> <li>- Relevant for sustainable futures</li> <li>- Less impact on environment</li> <li>- Addressing climate change impacts</li> </ul>
<i>Social</i>	<ul style="list-style-type: none"> <li>- Beneficial for public health</li> <li>- Decrease of car dependency</li> <li>- Interaction of public</li> </ul>	<ul style="list-style-type: none"> <li>- Beneficial for public health</li> <li>- Decrease of car dependency</li> <li>- More environmental attitudes and awareness</li> </ul>
<i>Economic</i>	<ul style="list-style-type: none"> <li>- More support for facilities</li> <li>- Facilities close by</li> <li>- Mixed-use development</li> <li>- Less or no costs of sprawl</li> </ul>	<ul style="list-style-type: none"> <li>- Easy access of walking, cycling and transit</li> </ul>

Table 1: Benefits & drivers

### Trade-offs & Restrictions

<b>Sustainability</b>	<b>Densification</b>	<b>Sustainable Urban Mobility</b>
<i>Environmental</i>	<ul style="list-style-type: none"> <li>- Loss of urban green space</li> <li>- Risk of ‘urban heat island’</li> <li>- Increase of long-distance trips</li> <li>- Low-density of suburbs</li> </ul>	<ul style="list-style-type: none"> <li>- Existing urban design and infrastructure</li> </ul>
<i>Social</i>	<ul style="list-style-type: none"> <li>- Public resistance</li> <li>- Noise, stress</li> <li>- Liveability</li> </ul>	<ul style="list-style-type: none"> <li>- Acceptance and understanding of public required</li> <li>- Role of individual attitudes in travel behaviour (habits)</li> </ul>
<i>Economic</i>	<ul style="list-style-type: none"> <li>- Implementation is challenging</li> <li>- Not everywhere favourable</li> </ul>	<ul style="list-style-type: none"> <li>- Implementation is challenging</li> <li>- High-quality implementation of innovative actions</li> <li>-Technology (costs)</li> </ul>

Table 2: Trade-offs & restrictions

Since multiple researchers argue that the implementation of densification and sustainable mobility is a challenge, it seems to be that urban planning has to be more effectively integrated with transport developments, i.e. the process of densification and sustainable urban mobility has to be integrated in order to support sustainable development. It is argued that integrated urban planning and design should promote high density and compact development around major, clean public transportation nodes, green networks, and business lines. This shows the interrelationship between densification and sustainable mobility as well. Integrated urban planning is therefore the next important step in the conceptual model of figure 9. It is significant for the research to examine how the current urban planning of the municipality Rotterdam is organised and how the municipality can achieve integrated urban planning. The integration of densification and sustainable urban mobility refers to the concept of Transit-oriented development (TOD). This is visualised in figure 9, wherein densification and sustainable mobility are the variables of TOD. TOD is an urban form which integrates transit and land use and is therefore increasingly seen as being important to sustainable urban futures. Theories conclude that focussing higher urban densities along high-capacity transit corridors is of particular importance. TOD focuses on proximity, mixed uses and eases increased accessibility. Based on the advantages, TOD might be a suitable strategy for the redevelopment of suburban neighbourhoods of Rotterdam in order to support sustainable development. Therefore, the options and requirements of TOD for the suburban neighbourhoods of Rotterdam need to be examined as well in the research.

Based on the theoretical framework, the categories for analysing the empirical data can be identified. The analytical framework is organised according to the used categories in table 1 and 2, but in a more elaborated way. The category environment also covers the spatial dimension and the category economy also covers the policy and regulation dimension, combined in the term politics. Based on these categories, including the advantages and disadvantages discussed in the theoretical framework and shown in table 1 and 2, the empirical data can be analysed.

Moreover, based on the theoretical framework, some assumptions and hypotheses can be stated. It can be assumed that when the suburban neighbourhoods in Rotterdam meet the preconditions for both densification and sustainable urban mobility, these suburban neighbourhoods could develop in a more sustainable way, which accommodates the growing housing demand in Rotterdam as well. However, the different trade-offs and challenges of the implementation of both concepts, generally and in suburban neighbourhoods specific, need to be taken into account in the research as well. When both concepts are implemented in the right way at the right place, the different benefits and opportunities found in the literature might occur in the suburban neighbourhoods of Rotterdam as well. As stated above, this requires integrated urban planning of the municipality of Rotterdam. Eventually, this development might contribute to the achievement of the objectives of the municipality as explained in the new Environmental Vision. These assumptions form the first hypothesis, namely that when the municipality of Rotterdam is pursuing integrated urban planning in the suburban neighbourhoods of Rotterdam it might contribute to sustainable redevelopment of these suburban neighbourhoods. Another hypothesis is that the implementation of both densification and sustainable mobility in suburban neighbourhoods is challenging, because of social and environmental aspects, such as public resistance, loss of green space, and existing urban design. A final hypothesis is that transit-oriented development (TOD) may have potential for sustainable redevelopment of suburban neighbourhoods, since TOD is seen as a promising means of reversing the car dependency and sprawl and developing cities in a sustainable way.

The next step after the composition of the conceptual model, is to prove the relationships in the model scientifically by the means of an empirical research. The methodology of this empirical research is explained in the following chapter.

### 3. Methodology

In this chapter the chosen research methods and the way of data collection and analysis are explained. The choices made in the research process are justified. Finally, reliability and validity of the research and ethical research are discussed.

#### 3.1 Research Method

In order to answer the research question: *‘How the municipality of Rotterdam could mobilise synergies between suburban densification and sustainable mobility and thus contribute to smart suburban growth?’* and the subquestions, a qualitative research method has been chosen. A qualitative research is best fitted to obtain such an exploratory research. This method provides in-depth information of the data to address the research (DiCocco-Bloom & Crabtree, 2006). The used qualitative research methods are expert interviews, the analysis of policy documents, and a focus group. According to Bryman (2012), interview is widely the most used method. Different types of interviews are available. This qualitative research has a focus on semi-structured interviews since unstructured interviews often produce quantitative data (DiCocco-Bloom & Crabtree, 2006). The systematizing expert interview is focused on gaining access to exclusive knowledge controlled by the expert. It is an attempt to obtain systematic and complete information (Bogner & Menz, 2009). Expert interviews are an attractive and effective way of quickly obtaining objective data. Frequently, the fact that the interviewer and the interviewee share a common scientific background or relevance system can increase the level of motivation on the part of the expert to participate in an interview (Bogner & Menz, 2009, p. 2). This fact makes expert interviews essential for the research. However, it is important to consider quality differences between experts.

Semi-structured interviews are generally organised around a set of predetermined open-ended questions, with other questions emerging from the dialogue between interviewer and interviewee/s (DiCocco-Bloom & Crabtree, 2006). Within semi-structured interviews, in-depth interviews are the most widely used interviewing format for qualitative research. For this research, individual in-depth interviews are held in order to focus in-depth on social and personal matters (DiCocco-Bloom & Crabtree, 2006). It provides more detailed and complete information about the policy of the municipality and about the required measures. In addition to these interviews, a small focus group is held. A focus group involves engaging several participants in an informal group discussion, which is focused around a particular topic or set of issues (Bryman, 2012; Wilkinson, 2004). It is usually based on a series of questions. The purpose of a focus group is the study of the interaction between the group members in order to examine the way people (collectively) construct and organise knowledge and to understand why people hold certain views. It emphasises a specific topic, in this case the research topic, which is explored in depth. The researcher usually has a moderator role which poses the questions, keeps the discussion going, and enables the group members to participate fully (Bryman, 2012; Wilkinson, 2014).

Another data source in qualitative research, which is used for the research, is document analysis (Bowen, 2009). Document analysis is ‘a systematic procedure for reviewing or evaluating documents, both printed and electronic material’ (p. 27). The purpose is to reveal meaning, gain understanding, and develop empirical knowledge. The study of policy documents is a form of document analysis. To obtain information about the current situation in Rotterdam and about the aims of the municipality, concerning densification and sustainable urban mobility in the city, the study of policy documents is an appropriate method. The use of document analysis combined with expert interviews and a focus group leads to triangulation, ‘the combination of methodologies in the study of the same phenomenon’ (Bowen, 2009, p. 28). The researcher is expected to draw upon multiple sources of evidence. Triangulation of data produces credibility and minimizes bias (Bowen, 2009). Finally, the last source of data, which is used in order to answer the research question, is a literature study. It is relevant for the research to investigate

the different debates on the processes of densification and sustainable urban mobility. Literature study (i.e. previous studies) provides this data which can be interpreted (Bowen, 2009). The literature study is based on the theoretical framework of chapter 2.

Geographic Information System (ArcGIS) is used to make a map which provides a clear overview of the research area Prins Alexander within the municipality of Rotterdam. This map is displayed in figure 2. It shows the exact location of the district Prins Alexander. Figure 3 shows the eight different neighbourhoods within Prins Alexander.

**3.2 Data Collection**

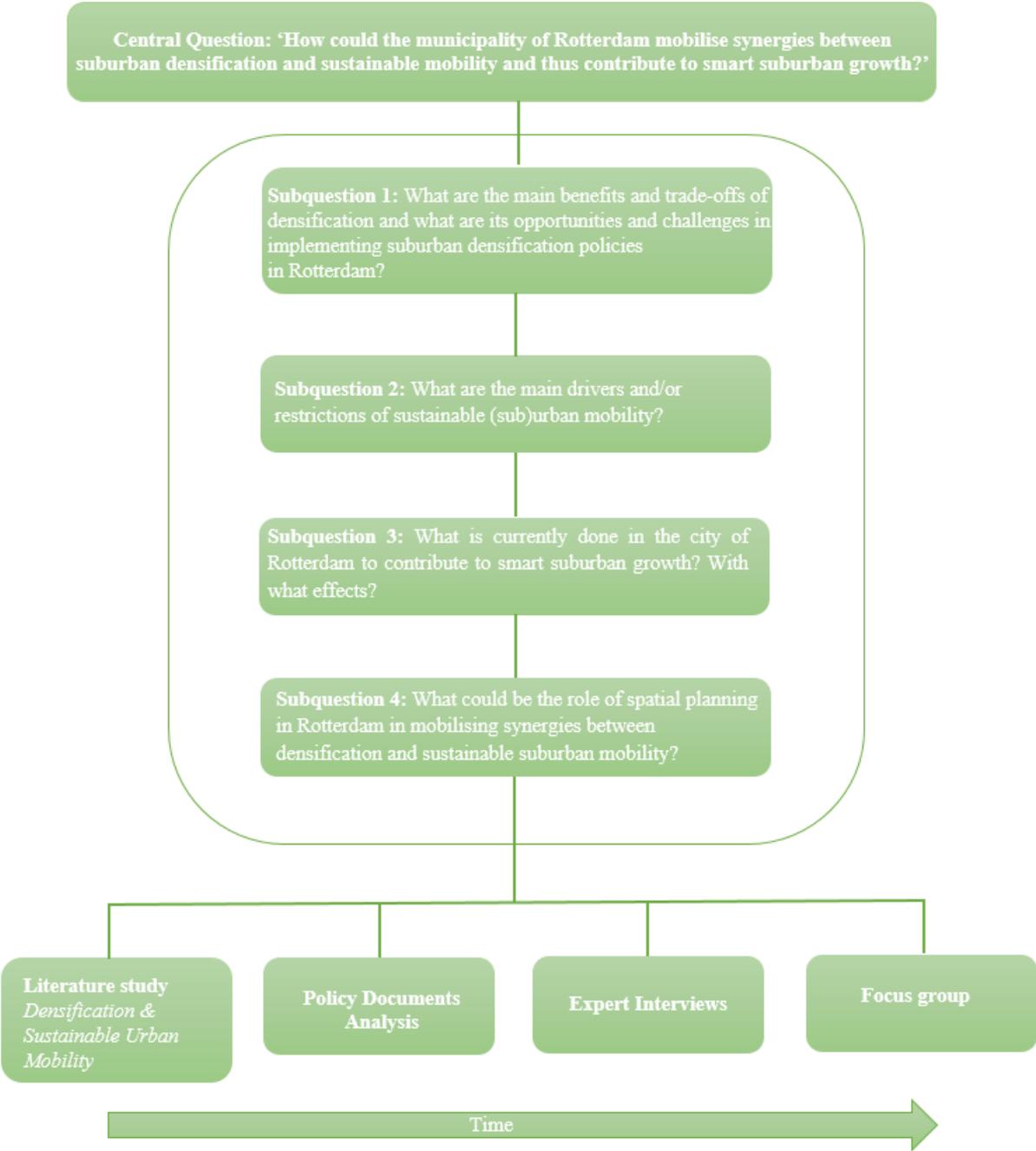


Figure 10: Research structure

In order to answer the research question, the research is divided into four subquestions which are appointed in chapter 1. Figure 10 illustrates the structure of the research including the central question, the subquestions and the research methods. It is important to highlight that the data of the different research methods (literature study, policy documents analysis, expert interview, focus group) is relevant for answering all the four subquestions. The comparison of the data from the different methods makes it possible to find significant connections and/or maybe to figure out remarkable differences between the data, which makes it possible to answer the subquestions in a valid and representative way. This means that answering the subquestions is an integrated process with the data of different research methods. This is connected to the triangulation of data (Bowen, 2009), explained in paragraph 3.1.

The research starts with a literature study. The literature study is useful for the collection of theories about the densification concept and the different perspectives on this concept. The concept is heavily debated in academic literature. The current academic debate on sustainable urban mobility reveals the drivers and/or restrictions of this form of mobility. The literature study is based on the theoretical framework of chapter 2.

After the literature study, the next step of the research is the examination of policy documents of the municipality of Rotterdam. This is useful, because it exposes the current situation and policy of the mobility and densification issue in the municipality of Rotterdam, including the challenges, goals and visions of the municipality. The used policy documents are the City Vision Rotterdam 2030 (*Stadsvisie Rotterdam 2030*), the Environmental Vision of the Municipality of Rotterdam (*Omgevingsvisie Gemeente Rotterdam*), Urban Traffic Plan Rotterdam 2016-2030+ (*Stedelijk Verkeersplan Rotterdam 2016-2030+*), Public Transportation Vision Rotterdam 2018-2040 (*Openbaar Vervoersvisie Rotterdam 2018-2040*), Bicycle Plan Rotterdam 2016-2018 (*Fietsplan Rotterdam 2016-2018*), Policy Regulation Parking Standards Rotterdam 2018 (*Beleidsregeling parkeernormen Gemeente Rotterdam 2018*), Area Plan Prins Alexander 2014-2018 (*Gebiedsplan Prins Alexander 2014-2018*) and finally a publication of the Planning Agency for the Living Environment (*Planbureau voor de Leefomgeving, PBL*) called 'Strategies for better coordination between urbanisation and infrastructure'.

However, in order to gain more in-depth information about the current situation and policy in Rotterdam, expert interviews needed to be conducted. For the research, ten expert interviews have been conducted with in total twelve experts. Expert interviews are also useful to examine different views on what should be done in Rotterdam in order to promote sustainable urban mobility and densification in suburban neighbourhoods for improving the quality of life. In-depth, semi-structured interviews are carried out with area developers of the municipality of Rotterdam which provides knowhow about the specific research areas. Land use planners and transportation and traffic experts, who are operating in the research areas, are also valuable to interview. In order to examine what the current policy of the municipality of Rotterdam is, urban planners are interviewed. Urban planners can provide in-depth information about the context of the research, both about densification and sustainable mobility. Furthermore, the main public transport operator in Rotterdam, called the RET (*Rotterdamse Elektrische Tram*), is being interviewed. This public organisation is owned by the municipality and strives to excellent infrastructure and more and better facilities. In order to learn more about their position and activities, and what they could mean for more sustainable mobility in suburban neighbourhoods, this company has been interviewed. Another company which is also (partly) owned by the municipality of Rotterdam is the Verkeersonderneming and has been interviewed as well. Verkeersonderneming is a traffic agency which is a public-private cooperation between the municipality of Rotterdam, MRDH, Ministry of Infrastructure & Water, Rijkswaterstaat and the Port Company of Rotterdam, which aims to strengthen and optimize the (use of) infrastructure within and around Rotterdam. This makes this company relevant for the research. Moreover, the Planbureau voor de Leefomgeving (PBL), a planning

agency for the living environment, is interviewed. PBL is a Dutch government agency for strategic policy analyses in the field of environment, nature and open space. Finally, a call conservation has been held with the TNO, this is a Dutch independent research organisation which operates internationally and focuses on transitions or changes in nine themes, including traffic and transport. TNO connects people and knowledge to create innovations that boost the competitive strength of industry and the well-being of society in a sustainable way. The gained insights of the interviews are relevant for answering all the subquestions. Finally, a focus group with (a part of) the interviewed experts of the municipality is held in order to figure out how opinions are expressed and modified through group discussions which leads to an in-depth exploration of the research topic.

### 3.3 Data Analysis

In order to ensure that the data of the interviews is valid for the research, it is important that the interviews are (semi-)structured well and the interviewer is prepared sufficient. After conducting the expert interviews, several steps need to be taken, illustrated in figure 11. These steps are transcribing, coding and analysing the interview data (Bryman, 2012). In order to provide an answer to the research question, the data provided by the different experts need to be analysed and compared in order to find relevant similarities. For the data analysis, it is necessary to transcribe the interviews. Coding is appropriate to structure the data and to make connections between the different responses. After coding the data, analysing the data is possible wherein the relevant findings become clear which can be compared with the theory and policy documents in order to draw conclusions and answer the research question. For coding the data, the software NVivo is being used which takes over the manual labour involved. However, the researcher must still interpret the data, code and then retrieve the data (Bryman, 2012).

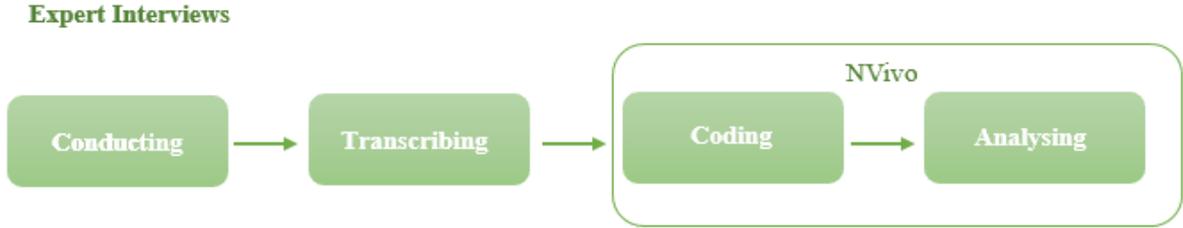


Figure 11: Data analysis expert interviews

### 3.4 Reliability and Validity

When doing research, it is important to consider the reliability and validity of the research. Reliability deals with the question whether the results of the research are stable. ‘When the research would be repeated, would the same results occur?’ It is possible that a deviation in the results will occur, when not the same experts will be interviewed, but for instance other planners. Different experts have different opinions, knowhow and different qualities (Bogner & Menz, 2009). Therefore is it important to interview multiple experts. All these experts have knowhow about the situation and the research area. Interviewing multiple different experts leads to triangulation of the data which makes it less bias and more reliable. In addition, using multiple methods for data collection, expert interviews, policy documents and literature study, leads to triangulation as well (Bowen, 2009). In order to be reliable as a researcher and avoid prejudice, it is important to be as open as possible and to make a checklist for the conduction of expert interviews and for the interpretation of the data (Bogner & Menz, 2009). This refers to the concept of confirmability and requires as much objectivity of the researcher as possible (Bryman, 2012). For the reliability of the research, the concept of dependability is relevant as well. This means whether the research is verifiable (Bryman, 2012). In order to meet this criterion, all the steps taken and the choices made in the research must be explained in detail. Moreover, according to this criterion, all

the transcribed interviews need to be attached. This research meets all the above conditions which makes it a reliable research.

When reflecting at the conclusions, it is important to have a look at the validity of the research. 'Do I know what I wanted to know?' According to Bogner & Menz (2009, p. 117), 'the success of interview-based investigations considerably depends on the 'quality' of the interviewees, which means the extent to which they meet our expectations in the interview situation'. It is necessary to consider possible influences of quality differences between experts at the beginning of the research. When possible influences of an expert are identified, it does not mean that this data is 'unreliable'. It allows the researcher to be in a better position to decide the assigned role to a certain part of information (Bogner & Menz, 2009). For validity, it is useful to create an interview guide and, for a semi-structured interview, a set of predetermined open-ended questions (DiCocco-Bloom & Crabtree, 2006). This ensures that the researcher is better prepared for the interview. After collecting the data through literature study, policy document analysis and expert interviews, the validity can be determined. When it is possible to answer the central question properly and to make useful recommendations for the municipality, validity of the research has been achieved.

Finally, it is important to respect the privacy of the respondents. Ethical research is required. The research should not harm the participants (Bryman, 2012). According to ethical research, practitioners should behave with integrity and act in ways that are just, beneficent and respectful. Ethical behaviour protects the rights of individuals, communities and environments involved, or affected, by this research (Clifford et al., 2010). The rights of the interviewees and the purpose of the research has to be communicated clearly, as well as what is going to happen with the information of the interviewees. This has been done in the interview process of this research. This should avoid the lack of informed consent (Bryman, 2012). Behaving ethically has not just morally reasons, but also a practical reason. By behaving ethically, the researcher maintains public trust (Clifford et al., 2010).

## 4. Results

In this chapter, the empirical data is analysed. The empirical data mainly consists of the expert interview data, of the data from the policy documents, and slightly of data from the focus group. The data from these different methods are integrated in this chapter. This chapter has been subdivided into three parts based on different scale levels, namely the City of Rotterdam (4.1), Suburban Neighbourhoods (4.2), and Prins Alexander (4.3). The analysis of the empirical data is based on the categories of the analytical framework developed in the theoretical framework. The main categories to be analysed are political/economical; environmental/spatial; and social. The results from the empirical data are valuable for answering the subquestions and the central research question.

### 4.1 The City of Rotterdam

The city of Rotterdam is located in the southern part of the Randstad together with The Hague. The southern part of the Randstad is nowadays the most densely populated part of the Netherlands. According to the interviewees, this leads to increased pressure on the green space and its quality. Continuing with building in rural areas would lead to even more loss of the green space. Therefore, it is argued by the municipality that this green needs to be preserved and that there should be invested in the attractiveness of this green. On the other hand, the more low-density development the more car mobility is being facilitated. When building in low-density, it is never possible to realise high quality public transportation which leads to car dependency and a lot of congestion and bottlenecks. This shows the importance of building within the existing urban area and the interrelationship between densification and sustainable mobility. This part discusses densification and sustainable mobility generally in the municipality of Rotterdam and the associated strategies and policies the municipality is pursuing.

#### 4.1.1 Densification

##### Political-economical dimension

As highlighted in chapter 1, the municipality of Rotterdam is facing several trends and transitions, such as the energy transition and a growing population. The new Environmental Vision of the municipality of Rotterdam highlights these trends and transitions. The municipality of Rotterdam started to carry a policy of densification with the City Vision Rotterdam 2030. The City Vision Rotterdam has been established in 2007 by the municipality to give direction for investments in order to achieve two goals, a stronger economy and an attractive residential city so people will bind to the city (Gemeente Rotterdam, 2007). To achieve this, it is stated that attractive houses are not enough, good accessibility and a modern inner city with sufficient amenities are important as well. The City Vision implemented a policy of densification in the inner city and several port areas.

*'Densification in the existing city increases the population, strengthens the support of facilities, and fosters the number of middle and high incomes in the city' (Gemeente Rotterdam, 2007, p. 61).*

Building in existing areas also limits the impact on the scarce space in the region. Another advantage, stated in this policy document, is that the distance for necessary displacement is limited and citizens rather use environmentally friendly means of transport which is favourable for the air quality and the quality of life (Gemeente Rotterdam, 2007). The aim of densification in the inner city is to meet the demand for living in the inner city, because of the population growth in the city. Therefore, the municipality aims in the City Vision to implement a construction program of 56.000 houses for the period 2005-2020 (Gemeente Rotterdam, 2007, p. 62). Additional housing in the inner city can

contribute to the support of facilities and activities. In the Environmental Vision, the municipality (2018) concluded that the densification in the existing inner city of Rotterdam, as pursued by the City Vision, has resulted in a more liveable and attractive inner city. The City Vision of Rotterdam is now ten years old, therefore, it is assumed by the municipality that a new spatial vision is needed. The Environmental Vision of Rotterdam fulfils this role and focuses on further densification of existing urban areas since the densification does not go fast enough.

Like all the municipalities in the Netherlands, Rotterdam is developing an Environmental Vision in the context of the Environmental Law (*Omgevingswet*). This Environmental Vision focuses on the entire territory of the municipality of Rotterdam. Nowadays, Rotterdam is facing different challenges than before, such as the energy transition and mobility transition. Furthermore, new inventions in the area development are necessary, because of increasing scarcity of open space. With the new Environmental Vision, the municipality tries to contribute to a sustainable development of Rotterdam and focuses on the improvement of the physical living environment at all levels, also in connection with the economic and social domain. All the different transitions, needs and concerns require an integrated approach. For the Environmental Vision, the municipality has chosen for an inter-sectoral modal which builds on the sectoral visions, it is not a replacement of these existing spatial policy documents. This vision must be finalised by the end of 2019.

The Environmental Vision consists of five perspectives which give direction to the future of the physical living environment of Rotterdam. The five perspectives are: compact city, healthy city, inclusive city, circular city and productive city (Gemeente Rotterdam, 2018), shown in figure 12. With the introduction of five perspectives, the municipality offers a new integrated approach in order to provide insight into opportunities and issues between the various sectors and to test policy innovation in an integrated manner.



Figure 12: Five perspectives of the environmental vision (Gemeente Rotterdam, 2018)

The compact city perspective is related to this research since it includes densification. The core values of the compact city perspective in the Vision are: proximity, the inner city as ‘city lounge’, rawness and dynamics, city of architecture, mix of city and green, and business climate. The values proximity and mix of city and green have a strong connection with densification. The Environmental Vision aims at continuing the densification process which is highlighted in the compact city perspective. The municipality defines densification as ‘more dwellings per square kilometre (Gemeente Rotterdam, 2018)’. The densification of the inner city, as proposed by the City Vision, has visibly resulted in a more lively inner city and an attractive city. Where the City Vision focused on densification in the inner city, the Environmental Vision focuses on a broader spectrum. The further densification in Rotterdam is necessary, because of the housing shortage. Therefore, as stated in the Environmental Vision, densification of living and working should take place around existing stations, and even around new stations. This means that the focus of densification is shifting slowly from the inner city to the entire

city. According to the municipality (2018), densification of existing areas is also required for the stimulation of public transportation and cycling as an alternative to car use.

The perspectives of the interviewees acknowledged the housing shortage and that the focus of densification so far has been on the inner city. In addition, the planners agreed that the densification in the inner city has been successful since the attractiveness of the inner city has increased. The area developer explained that the focus on the inner city is caused by the fact that citizens of the inner city are more susceptible for densification and sustainability measures.

*'The focus of densification is on the inner city of Rotterdam'* (Area developer, 2018)

The interviewees argued that Rotterdam, like many other big cities in the Netherlands, is facing a major housing task due to the shortage of housing for certain target groups. The perspectives of the interviewees agreed that building in the existing urban area is necessary, which requires further densification. There is a shortage of centre-urban as well as green-city living environments. According to the interviewees, there is particular a demand for (high) urban living environments in Rotterdam. With densification, the municipality of Rotterdam is able to add more housing in the existing urban area. Therefore, Rotterdam has chosen to build 50.000 houses before 2040 in the existing city. The interviews revealed that support for densification and building within the existing city has increased, and that the urgency has grown, even politically. This is seen as a positive development.

According to an urban planner of the municipality, it is important to emphasise that densification is not just a matter of adding houses, it should also be used for the investment in and realisation of a better outdoor area. According to the interviewees of the Planning Agency for the Living Environment (PBL) and the planners of the municipality, densification can even lead to a more attractive and liveable city. It can improve the outdoor space and creates a more varied living environment. Based on the perspectives of the planners, the process of densification could be used to achieve other goals, such as the housing task and mobility transition. According to one of the planners, the challenge lies in combining the goals.

*'Densification is not an end in itself, but is a good opportunity to improve the city'* (Head of planning department, 2018)

It also turned out that the implementation of densification is challenging due to fragmented land ownership. This makes it complicated to acquire an area for densification. Finally, it is argued that existing infrastructure could be a barrier to densification due to costs and/or lack of space.

However, despite the trade-offs of densification and the challenging implementation, the interviewees still supported densification of the existing city. The interviewees regarded densification as something positive and necessary, because of the growing housing challenge in Rotterdam.

*'Rotterdam needs to explore the opportunities and threats of densification and the potential to build 50.000 houses'* (Planner, 2018)

The PBL stated that different types of densification exist, which does not always include high-rise buildings. The area developer of the municipality argued that the type of densification and the type of programme are decisive for some areas. According to the PBL, the broadening of rules might be favourable for the implementation of densification as well. This is a way to make more intensive use of space possible, like adding storeys to existing buildings. Finally, the perspectives of the interviewees agreed that the municipality must take a facilitating role in the densification process and that the

municipality should contribute to the realisation of densification, which includes adjusting laws and regulations.

Figure 13 shows the current densification level of the city of Rotterdam. The map shows the density per hectare in the different neighbourhoods of the city of Rotterdam in 2017. The displayed density is determined on the basis of the number of houses per zip code. The darker the colour, the higher the density. Based on the figure, it can be concluded that the inner city has the highest density.

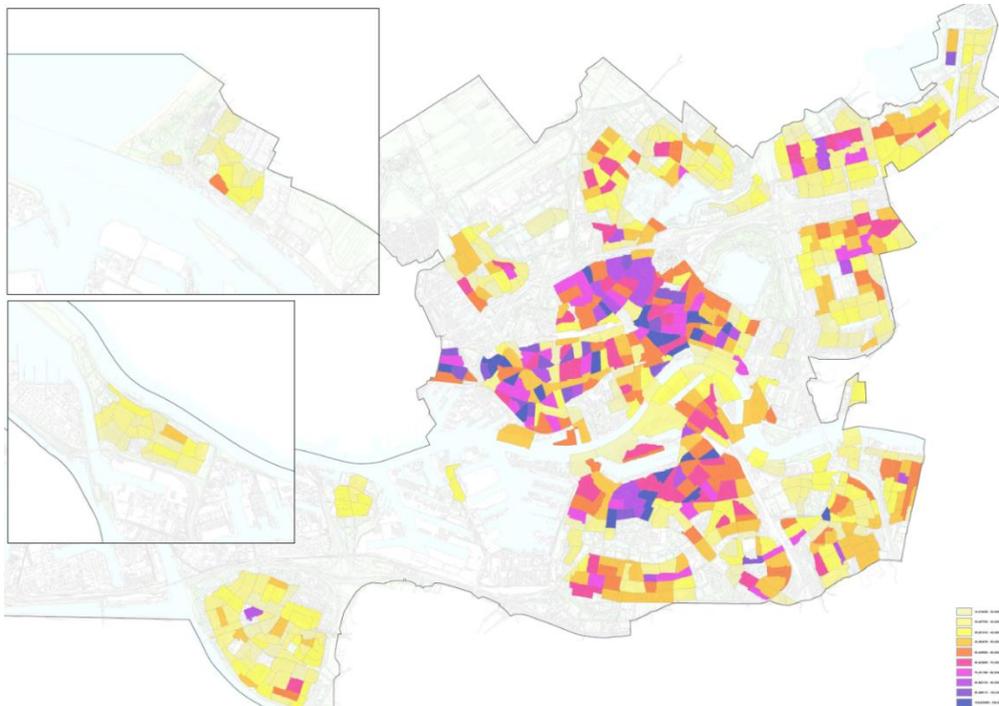


Figure 13: Density of houses per hectare in Rotterdam (Gemeente Rotterdam, 2017)

### Environmental-spatial dimension

The perspectives of the planners of the municipality and the PBL corresponded that building within the existing urban area, i.e. densification, is more sustainable since it preserves the open landscape and saves green spaces. In addition, it is argued that a compact city is a more energy-neutral city, because it can lead to less energy consumption for mobility.

*'High density leads to sustainability, all forms of sustainability'* (Planner, 2018)

The Traffic Agency stated that with the design of the public space through densification, it is possible to influence the behaviour of the public. This is acknowledged by the other interviewees. Higher densities lead to proximity of facilities which, in turn, lead to the limitation of mobility. People no longer need their car and are designated on cycling and walking, which is sustainable. In addition, higher densities make mixed-use development possible. With people living close to each other, the support for more facilities increases, which leads to mixed-use development. Mixed-use development is important for the limitation of mobility as well.

*'With facilities close by, people do not have to travel far'* (Transportation planner, 2018)

Moreover, according to the planners of the municipality, living and working should occur at the same location which could counter mono-functional areas. Especially the lack of liveliness in the mono-functional areas seems to be an issue. Mono-functional areas are nowadays regarded by the municipality as unacceptable. The area developer argued that higher densities and mixed-used development lead to a

more lively, varied and attractive living environment and more social safety. On the other hand, the PBL stated that places with existing mixed-use could be a reason for densification, because different facilities are already available. But, it is also argued that due to densification, more support will occur for facilities such as new public transportation connections. The transportation planner confirmed that densification of existing areas is important for the stimulation of public transportation and cycling as an alternative to car use.

*'Densification is important for the support of facilities'* (Area developer, 2018)

*'With high density, people are designated to walking, cycling and public transportation'* (Senior Traffic & Transport department, 2018)

In addition to these beneficial effects, the interviews also revealed several disadvantages and trade-offs of densification for the environment. Densification in existing urban areas could be a danger for the spatial quality of these areas. It is argued that the loss of urban green space through densification should be prevented. The Traffic Agency stated that densification should not lead to increased pressure on the public space. It is a challenge to preserve the (quality of the) green spaces in densification areas. Therefore, the urban planner stated that it is important that with densification the outdoor area and the existing quality of these areas are taken into account. Meaning that with densification, greening and improvement of the quality of life will be provided as well.

*'Sustainable densification is sustainable greening'* (Urban planner, 2018)

Other potential negative externalities of densification for the environment, highlighted by the interviewees, include noise issues, environmental legislation, air quality and safety issues. These externalities could increase with densification in the existing area. The fact that every place already has a function, even 'unused' green plots, could be another barrier for densification. A planner stated that this makes it challenging to realise the right function in the right place. Finally, another planner argued that a growing population in the existing urban area demands for more facilities, such as green, education, sport facilities and public transportation, which need space as well. In the Public Transportation Vision it is also stated that this can contribute to the capacity problems of the public transportation network.

*'The further you densify, the more other functions you need for this'* (Strategic planner, 2018)

### Social dimension

With densification, the municipality wants to build in the existing city (Gemeente Rotterdam, 2018). However, a planner of the municipality argued that not everyone wants to live in high densities, there is a need for green urban living environments as well. Densification could therefore lead to public resistance. The planner emphasised the importance of differentiated living environments. The PBL stated that the willingness of the citizens is an issue. 'Are they willing to pay for denser or less dense housing?' [...] Therefore, the Traffic Agency and planners argued that clear communication with the citizens in an early stage and an open planning process are required. A planner of the municipality stated that various interests are involved, citizens have their own interest and densification will not be favourable for everyone.

*'Densification will always hurt someone'* (Planner, 2018)

Finally, densification is by the planners seen as an opportunity for the realisation of housing differentiation. Different housing types attract different population groups which causes more differentiation of populations. The differentiation of populations leads to more support of (additional) facilities such as sport facilities.

#### 4.1.2 Sustainable Urban Mobility

##### Political-economical dimension

The municipality of Rotterdam is facing a major mobility challenge which is emphasised in the Urban Traffic Plan Rotterdam 2017-2030+. The Urban Traffic Plan has been developed from, among others, the City Vision. The changes, trends and developments in the city, as population growth, economic transition, accessibility task and mobility transition, require a clear mobility perspective which is future oriented (Gemeente Rotterdam, 2017). With the Urban Traffic Plan, this perspective has been set. The municipality of Rotterdam aims for accessibility and mobility at the service of a healthy, economically strong and attractive city. In other words, Rotterdam is aiming for a sustainable urban development. It is seen as important to consider how mobility can have a valuable contribution to the quality of life in Rotterdam of the future. The starting point reads that mobility is not an aim on itself, but it is an essential precondition for an attractive and economically strong city. According to the Urban Traffic Plan, mobility should connect people. The effects of changing mobility behaviour are most obvious in the inner city. The car use in the inner city of Rotterdam has been declining for years. One intended measure of the municipality of Rotterdam is to reduce the car use even further and to stimulate cycling and walking. In the longer term, the municipality is aiming for a car-free city centre (Gemeente Rotterdam, 2017). The mobility challenges have led to a long-term mobility strategy, the Rotterdam Mobility Strategy, for the accessibility of the city and region in order to shape the city of the future (Gemeente Rotterdam, 2017). The strategy is shown in figure 14.

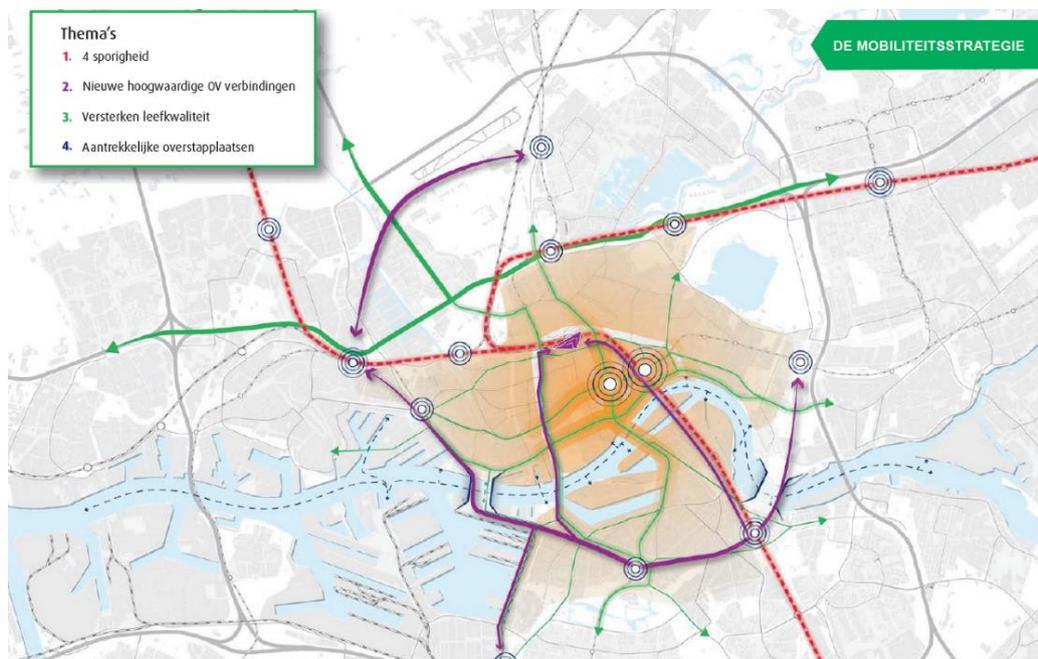


Figure 14: The mobility strategy (Gemeente Rotterdam, 2017)

In the mobility strategy, Rotterdam is looking for a balance in modalities (multimodal accessibility), i.e. a new balance between cyclists, pedestrians, cars and public transportation. The Rotterdam Mobility Strategy promotes public transportation and cycling as an alternative for car use (Gemeente Rotterdam, 2017). The city wants smart mobility in terms of stimulating cycling and public transportation. This means that densification within the urban area has given priority. A balance between

densification and spatial quality is important for the creation of a permanently attractive city. This importance of densification shows the connection with the Environmental Vision.

According to the municipality of Rotterdam (2018), in recent years, the mobility transition in the city has taken shape. The use of different modes of transport in Rotterdam is subject to change and in particular the use of bicycle and public transport has grown considerably in recent years. The transition to sustainable forms of mobility (pedestrian, bicycle, public transport and clean transport) will continue through the coming years.

*‘We are working on a better balance between the different modalities’* (Gemeente Rotterdam, 2018)

The Public Transportation Vision is an elaboration of the Urban Traffic Plan, which provides concrete elaboration for the public transportation on the mobility transition. It provides a development perspective for the period till 2040. In this vision as well, mobility is not a goal on itself, but a means to achieve integrated ambitions. This Vision focuses on the mobility transition with the aim of ‘mobility at the service of a healthy, economically strong and attractive city (Gemeente Rotterdam, 2018). Furthermore, the vision states that public transportation, with cycling, will function in the future as the carriers of the city. This is necessary to meet the growing demand for mobility in a sustainable way, to solve imminent bottlenecks and to provide more space to green, quality of public space, pedestrians and cyclists in the city. The vision is connected to the densification process in Rotterdam as well. The proposals in the vision make it possible that public transportation, together with cycling, can be structuring for the densification task. This will lead to less car kilometres within the city and cleaner car kilometres on the regional and urban network. Due to a growing population, the public transportation of Rotterdam faces major challenges. The vision proposes new public-transportation connections, including crossing the river, and is aiming for more high-quality public transportation alternatives, especially for short car trips within the ring of the city. It is required to ease the capacity bottlenecks, which are shown in figure 15 (Gemeente Rotterdam, 2018). A clear connection between accessibility by public transportation and the attractiveness of the housing market (in the inner city) is prevalent. It becomes clear that especially the connections in the inner city have the biggest capacity problems. Solving the capacity problems of the metro is an important agenda item of the Public Transportation Vision. The metro is an important ‘backbone’ of the public transportation in the region of Rotterdam.

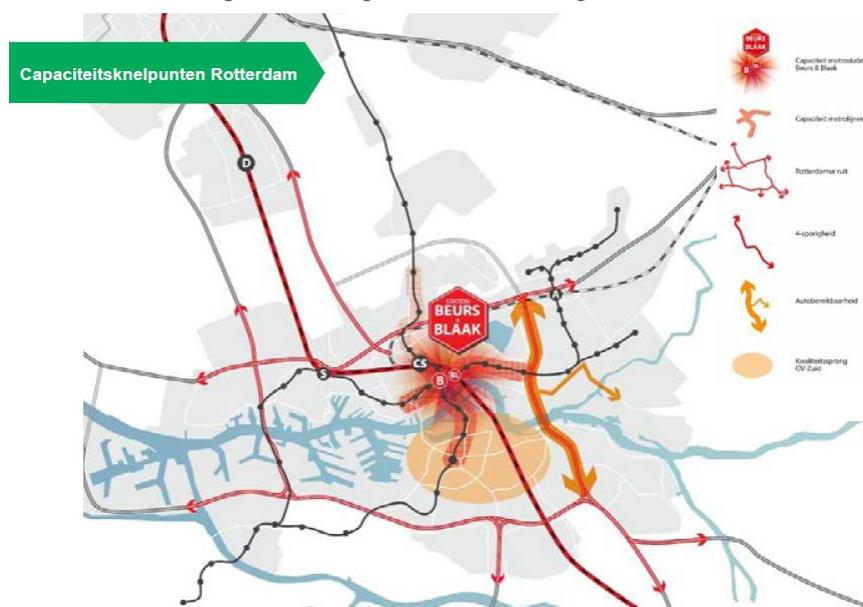


Figure 15: Capacity bottlenecks Rotterdam (Gemeente Rotterdam, 2018)

Based on the figure, it can be stated that no large capacity bottlenecks occur in the suburban neighbourhoods. However, the municipality is facing challenges in these suburban neighbourhoods as well concerning accessibility. This is further explained in part 4.2.

The interviews revealed that the interviewees considered the transition to sustainable forms of mobility as a positive and essential development. As emphasised in the Urban Traffic Plan as well, the interviewed planners of the municipality stated that (sustainable) mobility is not an end in itself, but it has to contribute to other tasks. This is also discussed in the Public Transportation Vision. 'It is a means to achieve a range of higher ambitions', including the urbanisation task (Gemeente Rotterdam, 2018). The RET argued that sustainable (urban) mobility enables urban development, including the process of densification, and it contributes to the attractiveness of the city.

*'The availability of public transportation makes it possible to densify'* (RET, 2018)

Despite the advantages of sustainable mobility, the interviewees recognised that the implementation of sustainable mobility is a challenge and faces several restrictions. Especially the necessary conditions for changing traditional forms of mobility form the restrictions. According to the transportation planner of the municipality, the inner city is more suitable for sustainability measures due to higher density which is beneficial for good public transportation and makes it possible to take more car discouraging measures. The strategic planner added that the current focus of the mobility transition is mainly on the inner city. The implementation of sustainable mobility in neighbourhoods outside the inner city is a bigger challenge. Furthermore, a shift in thinking within the organisation of the municipality and in politics seems to be required. Especially at the Traffic and Transport department of the municipality, according to the bicycle coordinator of the municipality, since this department is mainly a 'car department'. The area developer and the bicycle coordinator of the municipality both argued that Rotterdam has traditionally been designed for the car through which people are accustomed to the use of the car. This makes making choices in the urban area more complicated. Therefore, the PBL urged that support must be found and the urgency must be demonstrated, exemplified with the climate challenge. The RET confirmed this, 'people have to want to use sustainable mobility'. This is linked to the quality and attractiveness of the sustainable mobility forms. Yet, the PBL noticed that more support is already emerging in the region of the Southern Randstad, including from provinces and municipalities.

According to the RET, the financing of public transportation forms another restriction. The RET receives a fixed and limited budget which must be used as efficiently as possible. Therefore, it is argued that not everything is feasible. The transportation planner pointed out that transporting people is expensive.

*'Public transportation costs us (the municipality) money on balance'* (RET, 2018)

Furthermore, in order to achieve a mobility transition, the interviewees argued that several conditions are required. First of all, a policy is required in order to deal with this transition and the bicycle coordinator pointed out that it is necessary to appoint the main task of each area, i.e. taking area-specific measures.

*'There is a need for policy to ensure increasing sustainability, which facilitates changes and reinforces desired spatial developments'* (Transportation planner, 2018)

This started with the Urban Traffic Plan, but it only includes the broad outlines. Moreover, according to the strategic planner, the mobility transition will only establish successfully when a strong public transportation system at the regional level is available as well. Perspectives of several interviewees

agreed upon the fact that the mobility system is going to change, but that there is uncertainty about the speed of this change. The future of sustainable mobility is uncertain, because it can go in many different directions. Therefore, the PBL is working on different scenarios.

*'The speed is uncertain, but that the mobility system is going to change is for sure'* (Planner, 2018)

The perspectives of the interviewees revealed opportunities for the achievement of more sustainable mobility as well. First of all, the interviewees suggested that the mobility transition is an opportunity for more sustainable mobility. It is argued that the municipality is able to steer this transition. Introducing lower parking standards is by multiple interviewees seen as an important stimulation and steering tool of the municipality. This makes it as unattractive as possible to own a car. The senior of the Traffic & Transport department regarded the recent new recalibration of the parking norms as an opportunity when it comes to sustainable mobility. These new parking standards are elaborated in the 'Policy regulation parking standards for cars and bicycles in the municipality of Rotterdam 2018'. This policy states that urban development is only possible when the city remains sufficiently attractive. This means not only adequate and appropriate housing, but also an attractive public space, a cleaner vehicle fleet and fewer cars on the street. According to the municipality (2017), many new technologies will be helpful for this, such as digital information to combine car, bicycle and public transport in a smarter way in one journey. The valuable parking space in the city is also better utilised if drivers are guided directly to a free parking place. New technologies also stimulate the use and range of electric bikes, shared bikes (like the public transportation bicycle), and shared cars. New mobility services (Mobility as a Service) can quickly reinforce this trend. The city of Rotterdam has had parking standards for cars for decades. Parking standards set requirements for the parking capacity to be realised for construction developments. These standards are regularly adapted to the constantly changing mobility and ambitions in the area of urban quality. As an ambition from the Bicycle Plan Rotterdam 2016-2018, the parking standards for the bicycle have been included for the first time, because the growing use of the bicycle requires more and better facilities for bicycle parking. This policy regulation is the instrument for determining the number of car and bicycle parking places for new building developments and transformations.

The transportation planner argued that the municipality could introduce other measures in order to steer car use, for instance financial incentives which makes the use of car more expensive and less attractive. In addition, the municipality should provide charging facilities for electric cars which makes it a more attractive alternative. It is stated that, currently, there is a shortage of these facilities. Besides, charging facilities for electric busses in the future might be an upcoming challenge. According to the strategic planner, steering instruments are the 'push' factors, using a 'flanking policy'. Having attractive alternatives to (unsustainable) car use are considered as 'pull' factors, i.e. pulling people out of the car.

Based on the interviews, potential forms of sustainable mobility can be identified as well, which correspond to the forms as discussed in the Policy regulation parking standards above. The first identified form by the interviewees are the upcoming 'shared systems', such as shared cars and bicycles. The Traffic Agency argued that it could be interesting to connect this to the densification task. However, according to several other interviewees, these 'shared systems' face several challenges and it has not been successful yet. The area developer explains that people still want to own their own car and want to have freedom to travel. Furthermore, according to the bicycle coordinator, the current shared bicycles in Rotterdam (e.g. Obike, Mobike, Gobike) cause nuisance in the public space, it is not an organised system. This makes it politically sensitive.

*'How to organise 'shared systems'?'* (TNO, 2018)

According to the bicycle coordinator of the municipality, regulation is required in order to have a properly functioning shared bicycle system. Yet, the perspective of the senior of the Traffic & Transport department differs. He believes that the current shared bicycle system is a great success since it is literally on the map. It has created somewhat awareness that such a system is possible. In addition, the perspectives of the PBL and RET agreed upon the fact that the public transport bicycle ('OV fiets') does function well. In the end, all the interviewees shared the perspective that the shared bicycles has great potential and that it could be a valuable addition to sustainable mobility. At the same time, the interviewees also agreed that the system and its quality need to be improved and professionalised. According to the transportation planner, the shared bicycles offer an opportunity for the first and last mile transport. The interviewee of the RET confirmed this and stated that, in recent years, the RET has paid much attention to placing public transport bicycles at more metro stations in Rotterdam.

*'Such a shared bicycle system is really a complement for the last mile'* (RET, 2018)

Yet, the interviewees highlighted that first and last mile transport remains challenging. This challenge lies mainly in the last mile connections from station environments to destinations.

The bicycle coordinator argued that the bicycle is rising on the political agenda. The PBL believes that there is still much to achieve in the bicycle system, especially when it is linked to public transportation (e.g. train, metro). This is connected to another concept which has been emphasised by the interviewees, namely multimodal mobility. In the Urban Traffic Plan it is stated that multimodal nodes are important locations in the city with development potential. The openness of these locations should be increased to the environment and the spatial quality and identity must be strengthened in order to become a significant part of the city (Gemeente Rotterdam, 2017). The interviews revealed the importance of the multimodal mobility as well. Seamless connection of transportation facilities have positive effects and has great potential, especially the combination cycling and metro in Rotterdam.

*'It becomes more attractive for people to take the bike in combination with public transport'*  
(Bicycle coordinator, 2018)

According to the perspectives of the interviewees, this requires certain conditions. There is need for good and safe bicycle parking facilities at stations, there has to be a shared or public transport bicycle at every (metro) station, and it should be a safe and an easily accessible place. According to the Traffic Agency, Mobility as a Service (MaaS) is playing a crucial role in this. This is a new mobility service and a form of smart mobility with the essence that one becomes care-free (TNO, 2018). The Traffic Agency explained that the aim is to increase multimodal accessibility in a sustainable way, environmentally, socially, and economically. MaaS consists of being able to plan multimodal with one platform. MaaS relates to the main transport mode of a journey, but also to the first and last mile of a journey (Gemeente Rotterdam, 2018). The PBL believes that linking 'shared systems' and public transportation would be a very sustainable and ideal transport system. Figure 16 provides an overview of the digitalized elements included in the Mobility as a Service system.

## MOBILITY AS A SERVICE

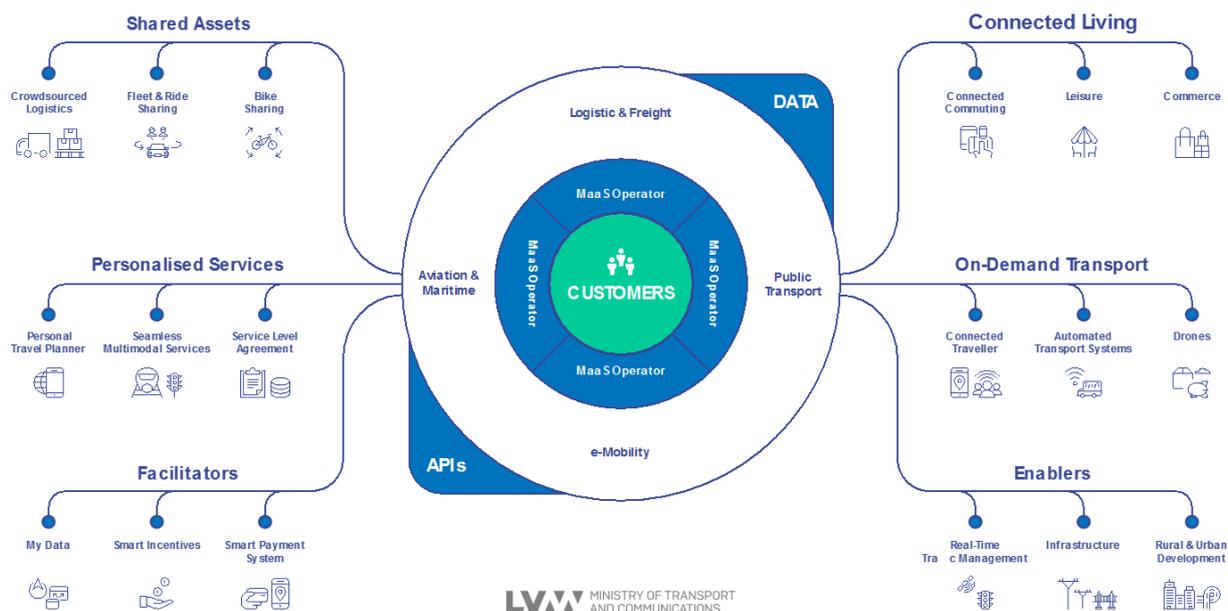


Figure 16: Mobility as a Service framework Sharp, 2017)

However, not all the interviewees are that enthusiastic about MaaS. Several perspectives of the interviewees revealed that still several restrictions and challenges are left in implementing MaaS. The impact of MaaS for instance on CO<sub>2</sub> reduction is uncertain, restrictions in access systems of data exist, and the way of communication to people is not clear yet. According to the Traffic Agency, a good public transport offer serves as ‘backbone’ of the MaaS system.

Although reducing car use seems necessary for a sustainable development, TNO argued that it is impossible to completely reduce car use. Therefore, car use has to be made more sustainable. According to the transportation planner, this requires incentives including coercive and financial incentives and the provision of charging stations for electric cars.

*‘The car does not necessarily have to go. That is not possible either’ (TNO, 2018)*

This refers to the last opportunity for more sustainable mobility, which emerged from the interviews, namely new sustainable transport technologies including electric cars, electric busses and automatic vehicles, i.e. the ‘clean vehicles’. Especially automatic vehicles is seen as ‘the future’ by the RET, for both private use and public transportation. According to the senior of the Traffic & Transport department, this can increase the frequency and capacity of the networks.

### Environmental-spatial dimension

The transportation planner of the municipality defined sustainable mobility as mobility that causes as little damage as possible to the environment. This concerns damage in the form of emissions of harmful substances, such as CO<sub>2</sub> and NO<sub>x</sub>. According to the transportation planner, noise and spatial footprint are an issue regarding mobility. ‘The less of it, the more sustainable it is’. The senior of the Traffic and Transport department of the municipality argued that walking, cycling, public transportation and clean vehicles are different forms of sustainable mobility, including new vehicle technologies. The PBL stated that walking and cycling are the most sustainable forms of mobility. However, the PBL and a planner

of the municipality argued that in order to achieve more use of sustainable mobility forms, these forms of mobility have to be strong and attractive alternatives to the car.

*'Make sure that the alternatives, as cycling and public transportation, are attractive'*  
(Transportation planner, 2018)

*'We want the car to become less dominant in certain areas'* (Verkeersonderneming, 2018)

The attractiveness of sustainable mobility forms is connected to the quality of these networks. The interviewees argued that the existing infrastructure should be better utilised instead of building new infrastructure, mobility flows must be bundled, existing routes should be improved and missing links should be realised. According to the bicycle coordinator, cycling networks must be attractive, safe, comfortable, coherent and direct. This also applies to walking routes. The interviewee of the RET acknowledged that the public transportation of Rotterdam has to be quick, easy and pleasant for the user in order to be an attractive alternative.

*'With good quality, good material, good services, and sufficient information you will attract customers'* (RET, 2018)

Considering public transportation, it is argued by the transportation planner of the municipality that this is also a proper sustainable mobility form since it takes up little space and it has no or hardly any emissions. The strategic planner and the RET shared the perspective that a larger part of the existing public transportation system should have the quality characteristics of the metro. According to the RET, the metro is the carrier of the network which is reflected in the number of travelers. About half of the total number of travelers uses the metro. This corresponds with the Public Transportation Vision which also stated that the metro is the 'backbone' of the public transportation network of Rotterdam.

*'The metro is the highest quality we have'* (RET, 2018)

Moreover, 'Mobility as a Service' is seen as promising for the environment. The Traffic Agency argued that MaaS could contribute to area developments, because it limits the disruption on the surrounding road network and space as much as possible. This is also connected to the use of a lower parking standard. However, it is still argued that a good alternative for people is needed which has to be better than their own car, it has to be faster, more comfortable and cheaper.

*'Mobility as a Service optimizes the entire transport chain'* (Verkeersonderneming, 2018)

Regarding opportunities for the future, the capacity needs to be increased and heavy mobility flows must be bundled for the provision of metro systems. Moreover, automatic driving metros and electric buses are seen as opportunities for the future as well. However, this requires charging facilities and the RET states that even though public transportation requires less space than individual traffic, different spatial claims still exist in urban areas between different people and interests. Therefore, according to TNO, cities have to make trade-offs. Finally, when looking at space and the stimulation of the use of sustainable mobility, the RET argued that capacity bottlenecks of the public transportation network could become an issue in the future.

## Social dimension

The interviewees agreed that sustainable mobility forms are not only beneficial for the environment, but contribute to social goals as well, such as safety, public health and social sustainability. It contributes to a liveable city. The TNO argued that sustainable mobility could be beneficial for the liveability of a city.

*'Sustainable mobility can contribute to a liveable city, where people want to live and companies want to be'* (TNO, 2018)

A social challenge in aiming for more sustainable mobility, is the understanding and acceptance by the people and their current behaviour and wishes. The acceptance of sustainable forms of mobility by the people is a challenge. The interviewees declared that the behaviour of people needs to change. Most people want to own a car by themselves, i.e. are car dependent, and want to drive whenever one wants. Sustainable behavioural change is important to achieve sustainable mobility.

*'A shift in thinking is required'* (Strategic planner, 2018)

*'Sustainable behavioural change is necessary'* (Verkeersonderneming, 2018)

The Traffic Agency and RET stated that the influence of urban design on the behaviour of the public is relevant. In order to make the car less dominant, it is possible to steer with the public space. Urban design can stimulate walking and cycling, which are seen as sustainable forms of mobility.

*'Certain choices in the public space might influence the behaviour of the public'* (Verkeersonderneming, 2018)

*'An attractive design of the environment is playing a role since it influences the experience of the journey'* (RET, 2018)

Furthermore, as discussed above, in order to stimulate people to use more sustainable mobility forms, these mobility forms have to be attractive alternatives to the car and the municipality could use incentives. The Traffic Agency and the bicycle coordinator considered it as important to stimulate cycling and walking with communication and to approach different target groups in different ways. The bicycle coordinator stated that cycling should be promoted, for instance at schools and events. This is connected to the term Mobility Management, proposed by the Traffic Agency. This means trying to make people choose a different modality instead of the car, trying to make people choose a different route, trying to entice people to travel at a different time, and lastly, trying to ensure that people do not have to move. This is divided into two approaches: the residents approach and the employers approach. Mobility Management aims at making people aware of their travel behaviour and stimulating people to use other mobility forms, for instance with the use of compensation measures. For Mobility Management, communication with residents is seen as important as well as participation in order to gain support. However, the Traffic Agency admitted that changing behaviour requires long-term effort. Furthermore, the Traffic Agency is aiming to contribute to people's happiness with mobility and developed a vision called 'Mobility Happiness'. According to the Traffic Agency, MaaS could provide insight into the connection needs of people and opportunities for new services, especially in the first and last mile transport. By contrast, as discussed above, the impact of MaaS is uncertain and the way of communication to the people is not clear. The PBL argued that a lot of people are attached to their own car which might be a challenge to change. Besides, the system of MaaS could also be complex to use by certain population groups, like elderly people.

Finally, according to the RET, in stimulating more sustainable mobility, safety becomes an issue. For instance, bicycle theft in the city but also increasing different bicycle speeds due to new

technologies, such as the electric bicycle. This highlights the lack of (and thereby the need of) good and safe bicycle parking and bicycle routes in the city. The interviewees concluded that, in order to stimulate cycling, it is important to have proper routes to public transport stations and to have good and safe bicycle parking facilities which is included in the policy regulation parking standards, discussed above. The transportation planner adds that the lack of charging facilities for electric cars can be demotivating for people to buy electric cars as well.

#### 4.1.3 Transit-oriented development

##### Political-economical dimension

In exploring the interviews, the concept of transit-oriented development was identified as well in terms of node development. The strategic planner viewed transit-oriented development as the use of proximity and argued that existing nodes should be better utilised since existing infrastructure is available. According to the PBL, nowadays it seems to be that support for node development has increased, including from politics.

*'Good coordination of urbanisation and infrastructure, i.e. node development, is very promising'* (PBL, 2018)

The publication 'Choose and share: Strategies for better coordination between urbanization and infrastructure' of the Planning Agency for the Living Environment discusses strategies for better coordination between urbanisation and infrastructure. According to the PBL (2014), it is important to coordinate urbanisation and infrastructure, because this will contribute to the achievement of policy goals. It is confirmed by the planners that integrated legislation and regulations is required, and densification and mobility has to be coordinated. This means developing an integrated system. The interviewees of the PBL admitted that this development of nodes needs time.

*'You have to view spatial developments and mobility issues integrally'* (Transportation planner, 2018)

*'It is a coherent whole'* (Urban planner, 2018)

According to the PBL (2014), node development can play an important role in connecting urbanisation and infrastructure. Node development can bring living, working, facilities, shopping and recreation within reach of more people, contribute to a better use of the existing infrastructure and can offer travellers a greater diversity of transport options. However, not every node is suitable for node development. The PBL (2014) argued that node development requires policy attention wherein spatial planning has a major role to play. The combination of node- and corridor development has received a lot of attention in recent years, especially under the name Transit-oriented development (TOD). According to the PBL (2014), TOD is one of the most frequently mentioned forms of coordination between urbanisation and infrastructure. The interviewees added that better coordination between densification and sustainable mobility requires a shift in thinking within the organisation of the municipality. The departments have to cooperate, have to achieve common projects and have to think more in-depth. Decisions on densification and sustainable mobility must go hand in hand. According to the planners, the challenge lies in combining both developments and combining different interests.

Another challenge of TOD, stated by the interviewees of the PBL and by the strategic planner, is that it is necessary to develop concrete plans for densification and sustainable mobility which are area-specific.

*'There is need for integrated plan development, which is area-specific'* (Strategic planner, 2018)

Despite the challenges of implementing TOD, the senior of the Traffic & Transport department believes that the new Environmental Vision might provide scope for reducing such problems

All the interviewees concluded that a synergy between densification and sustainable mobility emerges. The planners of the municipality acknowledged that public transportation and spatial planning interact, are interdependent and reinforce each other. Both processes function as a means for the other and both lead to a more attractive and varied living environment. Yet, the perspectives of the interviewees differed a little bit about which process is leading. About half of the interviewees stated that densification is a mean for sustainable mobility.

*'Densification leads to support for sustainable mobility (facilities)'* (Area developer, 2018)

*'The densification task is being used for sustainable mobility'* (Bicycle coordinator, 2018)

*'Mobility is following an economic strong city and an attractive residential city'* (Senior Traffic & Transport department, 2018)

*'The higher the density, the better public transportation is'* (Transportation planner, 2018)

*'Compact neighbourhoods offer opportunities for sustainable mobility'* (Urban planner, 2018)

The other half of the interviewees stated that sustainable mobility is a mean for densification.

*'The availability of public transportation makes urban development, including densification, possible'* (RET, 2018)

*'The existing infrastructure is the basis on which densification can be concentrated'* (Planner, 2018)

*'Sustainable mobility is conditionally for dense urban development'* (Urban planner, 2018)

*'Sustainable mobility is one of the means to make densification possible'* (Verkeersonderneming, 2018)

*'It is only possible to densify when the mobility transition is realised'* (Strategic planner, 2018)

Perspectives of interviewees which highlighted the synergy effect of the two processes also occurred.

*'I believe densification and sustainable mobility reinforce each other'* (Urban planner, 2018)

*'You have to view densification and sustainable mobility as a synergy'* (Transportation planner, 2018)

*'Densification and sustainable mobility are interdependent'* (Strategic planner, 2018)

These statements show that the existing coevolution between densification and sustainable mobility. The interdependence between urbanisation and public transportation is highlighted in the Urban Traffic Plan and Public Transportation Vision of Rotterdam as well. This is exemplified by the statement that 'further densification in the inner city contributes to capacity problems that already occur in the network' (Gemeente Rotterdam, 2018). This emphasises the downside of densification on mobility.

*'Choices for urbanisation and public transport development need to be made coherent'* (Gemeente Rotterdam, 2018)

The Institute for Transportation and Development Policy (ITDP) created a TOD Standard which could be a potential strategy for the municipality of Rotterdam. According to ITDP (2016), transit-oriented development (TOD) describes urban development that maximizes the benefits of public transportation and at the same time firmly emphasises the user and the human dimension (ITDP, 2016). TOD implies high area development, integrated planning-and-design of land use, buildings and mobility. For the

development of TOD areas, eight important principles exist: Walking; Cycling; Connect; Public Transportation; Mix; Densify; Compact; Change (ITDP, 2016). The TOD Standard describes a fundamental shift from the old paradigm of car-oriented development to a new paradigm in which urban form and design are closely integrated with efficient and sustainable urban mobility: walking, cycling and public transportation. TOD Standard is a score system and can be used for the evaluation of public transportation oriented characteristics of areas located around a public transportation station. It can also serve as a guideline for the preparation of plans, policies and regulations in order to improve walking and non-motorized mobility and to maximize the access to public transportation infrastructure. The TOD Standard provides criteria and measuring instruments (ITDP, 2016).

#### Environmental-spatial dimension

The perspectives of the interviewees emphasised different spatial advantages and opportunities of TOD. The RET argued that TOD contributes to the attractiveness of a city. According to the PBL, densification around nodes is favourable for keeping the city compact, it makes it possible to increase the frequency of the mobility system which makes it more attractive to use, and it leads to more support for facilities around these nodes which makes mixed-use development possible. In this way, a cleaner and more sustainable way of living can be stimulated. It is argued by both the RET and PBL, that the city of Rotterdam has a good metro system where TOD can be linked to. The urban planner of the municipality also recognised the opportunity of densification around the existing metro stations of Rotterdam. According to the urban planner, the new parking policy offers opportunities for node development, because it reduces car dependency. Moreover, the Traffic Agency stated that ‘shared systems’ and Mobility as a Service could also be linked to TOD in order to contribute to densification around station areas.

However, according to the senior of the Traffic & Transport department, the development plan of the area could be a barrier to TOD as well as the existing buildings in the station area. Different land ownerships exist. Furthermore, externalities also form a restriction, according to the urban planner and area developer. Especially noise and safety issue are seen as restrictions to the densification around stations areas. Finally, it is seen as important to upgrade existing infrastructure on time in order to be able to densify and to have facilities such as bicycle and car parking at the nodes.

#### Social dimension

A social challenge for TOD, according to the strategic planner, is the need for living environments which cannot be realised at public transportation nodes. A specific population group demands for green living environments. Finally, with regards to TOD, the Traffic Agency mentioned again the importance of the design of the public space, because this can influence the behaviour of the public.

### 4.2 Suburban neighbourhoods

This part focuses on densification and sustainable mobility in the suburban neighbourhoods of Rotterdam and the extent to which the municipality is focussing on these developments in the suburban neighbourhoods. In Rotterdam, most suburban neighbourhoods are post-war neighbourhoods which are characterised by low variety in housing types.

#### 4.2.1 Densification

##### Political-economical dimension

Up till now, the municipality of Rotterdam has only focused on densification in the inner city. In the Environmental Vision, the municipality of Rotterdam (2018) concluded that the choice of densification in the existing city, with the City Vision ten years ago, has visibly led to a more lively and attractive

inner city. This is in 4.1.1 confirmed by the interviewed planners of the municipality as well. The planners argued that the inner city has become much more attractive and lively through densification.

*'Without densification, that is almost unfeasible'* (Planner, 2018)

However, it is remarkable that the City Vision is not considering densification in the suburban neighbourhoods. Nevertheless, the City Vision Rotterdam argued that several (suburban) neighbourhoods need redevelopment, because of low valuation of the neighbourhoods or because they are likely to deteriorate. But still densification is not considered. The perspectives of the interviewees of the PBL confirmed that densification in suburban neighbourhoods seems to be 'an uncultivated terrain'.

Due to the growing housing need and the growing demand for (centre) urban living environments in the city of Rotterdam, there is an urgency of further densification. This has been translated into the ambition of building 50.000 houses till 2040 in the existing city. The PBL argued that a turning point is emerging with growing support for building in the existing urban areas. However, according to a planner, the densification process does not go fast enough and the inner city is getting very dense which eventually can lead to resistance. Therefore, in order to meet the growing task of the city, the strategic planner argued that all areas of the city have to be considered as potential densification areas, including the suburban neighbourhoods. The PBL argued as well that the centre urban area must be expanded. Finally, the area developer acknowledged that all available locations for densification must be used optimally. Within the Environmental Vision, the municipality strives to focus on a broader spectrum as well. It focuses on the entire territory of the municipality (Gemeente Rotterdam, 2018).

*'We have to look for additional plan stock in which we explore the different areas'* (Strategic planner, 2018)

The need to broaden the focus of densification towards the city as a whole is confirmed in the Urban Traffic Plan of the municipality. In this plan, the municipality of Rotterdam is admitting that all the neighbourhoods outside the inner city ring need to be addressed and redeveloped as well, including the suburban neighbourhoods (Gemeente Rotterdam, 2017).

However, according to the planners, one of the biggest challenges is how densification in the suburban neighbourhoods could contribute to other tasks and/or challenges in these neighbourhoods, such as the improvement of facilities and social challenges. This is linked to the statement in 4.1.1 that densification is not an end in itself, but it is a good opportunity to improve the city, which includes the suburban neighbourhoods. Another challenge, which has been highlighted in the interviews, is the existing housing stock in the suburban neighbourhoods. According to the transportation planner, when you want to densify in these neighbourhoods, existing houses have to be demolished and denser buildings have to be created. This also applies to existing offices and infrastructure. The strategic planner argued that this could make it very expensive and complicated. It is a consideration that must be made and must be adjusted to each area. The planner believes that the existing structures of these neighbourhoods makes it difficult to add new developments without changing the structure. Besides, each neighbourhood has other opportunities and challenges regarding densification. Connected to this challenge is the challenge of fragmented land ownership in the suburban neighbourhoods. According to the strategic planner, there are a lot of land owners in the existing situation, which makes it complicated to restructure and/or transform. It often only works when a housing corporation owns a large piece of land.

When looking at the current policy of the municipality, a planner argued that the municipality is little practiced in finding and exploring densification in post-war structures. The municipality is seen as responsible for determining the direction for the long term.

*'There is need for a kind of spatial vision of the municipality for these areas'* (Planner, 2018)

According to the PBL, broadening the regulation of densification is seen as an opportunity to make densification possible in suburban neighbourhoods. It could offer more possibilities to build a layer on top of another building. Yet, the PBL stated that this only occurs when there is building pressure. Moreover, the previously mentioned possibility of different forms of densification could also be a solution in suburban neighbourhoods since high-rise building is not very desirable in these neighbourhoods. The area developer and the PBL both acknowledged that densification does not always mean high-rise building, but that different types of densification exist, including compact low-rise. Besides, the PBL highlighted the slick effect of densification as an interesting strategy for densification in suburban neighbourhoods. 'It is not possible to just build a tower in the middle of the neighbourhood, but maybe at a part in the neighbourhood which already has some density or close to a station. From that point it is possible to expand the densification process'.

The map in figure 17 visualises that, compared to the inner city, most suburban neighbourhoods have a low density. Therefore, this map may raise questions about why certain areas in the suburban neighbourhoods have a low density. A planner stated that these areas in the suburban neighbourhoods require further research into the opportunities of densification.

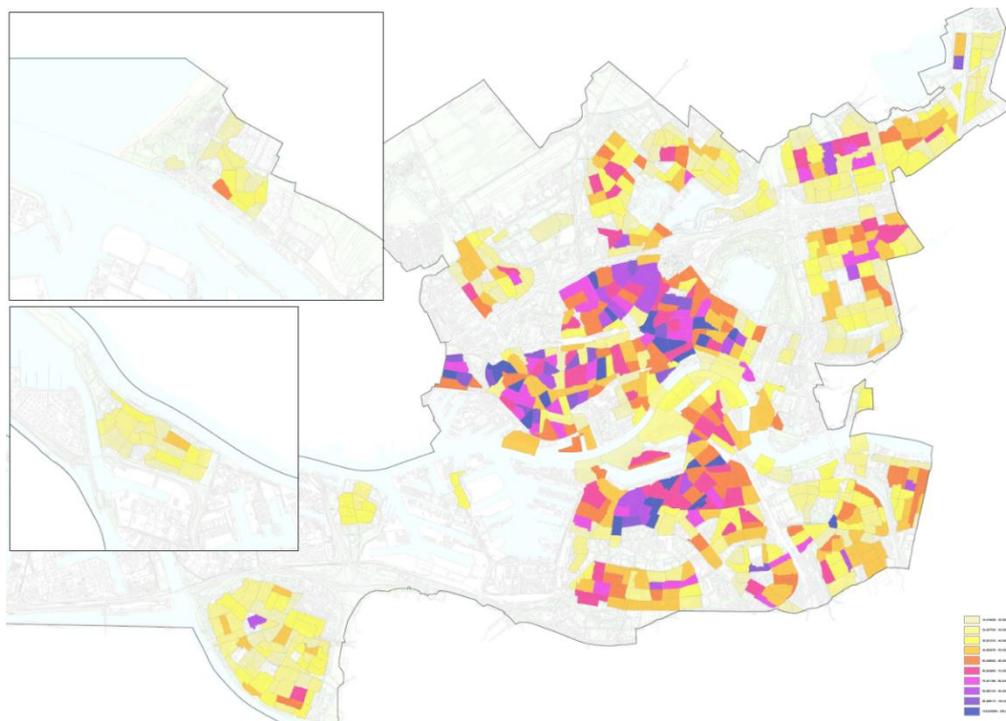


Figure 17: Density of houses per hectare in Rotterdam (Gemeente Rotterdam, 2017)

### Environmental-spatial dimension

Based on the perspectives of the interviewees, several opportunities for densification in the suburban neighbourhoods of Rotterdam can be identified. The perspectives of the interviewees agreed upon the fact that all opportunities for densification in suburban neighbourhoods must be utilised. For instance, centre areas of suburban neighbourhoods, i.e. (local) shopping areas, are potential locations for densification. According to the PBL, this occurs together with restructuring of these areas since it are usually built-up areas. The PBL and the planners of the municipality argued that densification could be an opportunity to make these centres more urban and attractive since densification can lead to mixed-use development, more attractive public space and the availability of facilities. Moreover, densification

in these neighbourhoods can also provide differentiation of housing and working. Both the planners and the PBL argued that most of the suburban neighbourhoods are designed functionally in the 60s and have the same type of housing. With densification, it is possible to create more differentiation in the type of housing which results in a more mixed environment. Because of different housing types, these neighbourhoods are becoming more interesting for other population groups.

*'With housing differentiation, it is possible to attract different population groups'* (Planner, 2018)

The urban planner argued that mixing of population groups is important for the support of additional facilities, such as sport facilities. Furthermore, according to the strategic planner, the differentiation of population groups and the differentiation of housing (including medium and higher housing) meet the housing need in Rotterdam and can have a positive contribution to these neighbourhoods. The image of certain suburban neighbourhoods can be improved through densification.

Other potential densification locations in suburban neighbourhoods, highlighted in the interviews, are mono-functional areas, which is also an opportunity for mixed-use development in these areas, and empty facilities complexes, such as old office buildings. According to the area developer, these old office buildings and other empty buildings can be transformed to housing or can be demolished allowing higher density buildings to return. Thus, intensifying the existing construction sites. Furthermore, areas around existing infrastructure are seen as potential densification locations. The urban planner argued that around these areas in suburban neighbourhoods, a lot of rest area exists. For Rotterdam specific, the areas around the highway zones A20 and A16 are seen as an opportunity, but also areas around larger roads within the neighbourhoods. However, it is emphasised in the interviews that it is dangerous to use the term rest areas. Most of these areas do fulfil a role. Yet, the strategic planner argued that especially in post-war neighbourhoods, relatively a lot of green is available which does not have a clear function or meaning.

*'Parts of green that do not function properly could be used for densification'* (Strategic planner, 2018)

On the other hand, densification is considered as a way to upgrade the existing green and give it more meaning. Finally, the planners of the municipality, the Traffic Agency and the PBL stated that development and densification around public transportation nodes, such as metro and train nodes, is promising in suburban neighbourhoods, including mixed-use development. This is further elaborated in 4.2.3.

*'At nodes you have to make relatively little investment to be able to realise a higher density'* (Planner, 2018)

However, the perspectives of all the interviewees revealed a major challenge when considering the environment, namely preserving the spatial qualities and existing character of the suburban neighbourhoods. This includes greenness, open space and quietness. Compared to the inner city, there suburban neighbourhoods have more open outdoor space. The PBL and the area developer stated that the existing qualities have to be taken into account. Furthermore, according to the urban planner, environmental and other spatial issues of the city play a role. Besides living, there is a demand for new business locations and new offices.

## Social dimension

As stated by the PBL and the area developer, the existing qualities of suburban neighbourhoods (green, open space, quietness) need to be taken into account. ‘Why do people like to live there?’ [...] People moved to suburban neighbourhoods for a single-family house with a private garden. Therefore, a good balance between green and building is required. This was an important outcome of the focus group as well. The planners argued that the spatial qualities of the suburban neighbourhoods need to be preserved. According to the transportation planner, it is important that different housing needs are taken into account. There is a need for green living environments as well which can be accommodated more in the suburban neighbourhoods.

*‘Densification should not be at the expense of the quality of the existing green structure’*  
(Strategic planner, 2018)

*‘Not everyone wants to live in high density’* (Transportation planner, 2018)

Citizens in suburban neighbourhoods often adopt a critical stance towards densification in their neighbourhoods. The area developer acknowledged that citizens of the inner city are more comprehensible for sustainability measures, such as densification, than citizens in suburban neighbourhoods. According to the urban planner, citizens in suburban neighbourhoods are often critical and often reason from their own interest. This increases the risk of resistance, which is a challenge for the implementation of densification in suburban neighbourhoods. The perspectives of the planners agreed that support from the residents for densification is necessary. This requires an open plan process from the beginning and benefits for the residents have to be highlighted. According to the planners, the way of storytelling plays a crucial role in this.

## 4.2.2 Sustainable Mobility

### Political-economical dimension

In 4.1.2, the Rotterdam Mobility Strategy from the Urban Traffic Plan was introduced. The mobility strategy promotes public transportation and cycling as an alternative for car use (Gemeente Rotterdam, 2017). An important part of the mobility strategy of Rotterdam is focused on the areas outside the ring, the suburban neighbourhoods. The municipality (2017) argues in the Urban Traffic Plan that these attractive residential areas outside the ring of Rotterdam are important places of residence. The different interconnections between these neighbourhoods and the connections from these neighbourhoods to the inner city are crucial for the functioning of these areas outside the ring. However, the municipality states that there are insufficient sustainable connections from and to the inner city and among the suburban neighbourhoods themselves. Obstacles concern accessibility and connectivity to the inner city and other suburban neighbourhoods of Rotterdam. Especially the highways A20, A16 and A13 are seen as barriers in the Urban Traffic Plan. Cycle connections under the highways exist, but the quality could improve. Figure 18 provides an overview of the crucial cycle (green) and public transportation (purple) connections within and between suburban neighbourhoods which need to be improved or implemented according to the municipality (Gemeente Rotterdam, 2017). It becomes clear that especially the cycle connections under the highways and the connections between the different suburban neighbourhoods of Rotterdam are crucial.

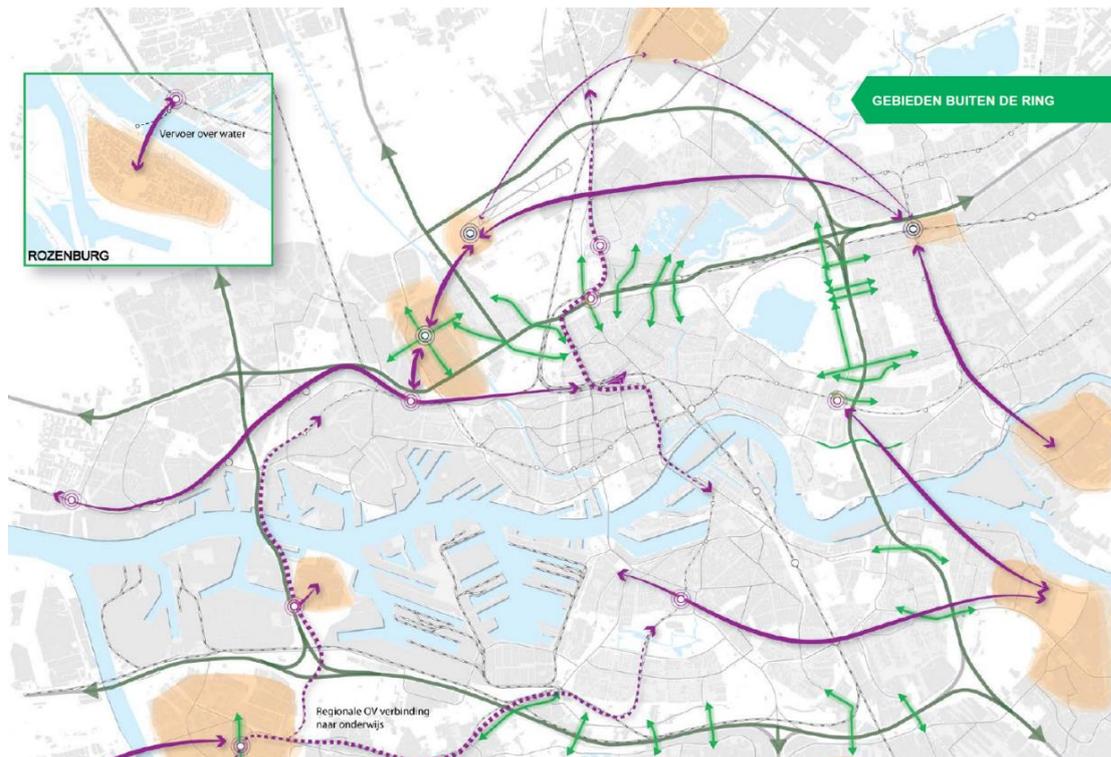


Figure 18: Crucial connections within and between suburban neighbourhoods (Gemeente Rotterdam, 2017)

In the Public Transportation Vision it is stated that from the public transportation perspective, the connection of the areas outside the ring in the A16 and A20 highway zone is the most complicated (Gemeente Rotterdam, 2018). These locations for housing are further away from the main network. The improvement of the accessibility quality of these neighbourhoods is a task for the longer term. The public transportation vision includes short (2018-2022), middle-long (2023-2029) and long term (2030-2040) goals. In the public transportation vision, the municipality states that for a number of surrounding areas, the bus remains essential to connect these areas. It concerns areas which cannot expect a new rail connection in the coming decennia.

It is remarkable that the perspectives of the interviewees differ on these barriers. The planners and the area developer concluded that the highways are not a barrier for the accessibility of the suburban neighbourhoods and the RET argued that the basis of the public transportation system is good.

*'There are enough possibilities to cross the highways'* (Area developer, 2018)

The urban planner adds that many spacious tunnels are available, both for cyclists and motorists. Yet, these interviewees acknowledged that the quality of these connections could improve, especially the bicycle connections. According to the area developer, several unsafe traffic situations exist and the PBL argued that suburban neighbourhoods often lack direct connections to the inner city and to other suburban neighbourhoods. This is emphasised by the municipality in the Urban Traffic Plan. The municipality (2017) stated that it is important to strengthen the cycle and public transportation connections between the suburban neighbourhoods. The main cycle routes share space with busy main roads which lead to unsafe traffic situations.

According to the transportation planner, in order to stimulate sustainable mobility in suburban neighbourhoods, a mix of measures is required. In exploring the interviews, several opportunities for the stimulation of sustainable mobility in suburban neighbourhoods were identified. As mentioned in

4.1.2, it is important to ensure that public transportation and cycling are attractive alternatives to car use and to make car use less attractive by means of incentives. According to the Traffic Agency, especially a wide range of good public transportation is important. The RET stated that the metro has the highest quality of the public transportation network of Rotterdam, even in several suburban neighbourhoods. Therefore, according to the RET, the characteristics of the quality of the metro should be adopted in other suburban neighbourhoods. This is exemplified by the RET's comment that trams might be able to drive faster. When looking at figure 15, no large capacity bottlenecks occur in the suburban neighbourhoods. The municipality (2018) states in the Public Transportation Vision that metro line E is the only 'suburban' line which has a capacity problem. Solving this capacity problem is an important task for Rotterdam (Gemeente Rotterdam, 2018). The other lines in the suburban neighbourhoods have capacity left, which corresponds to the perspectives of the area developer and RET.

Based on the interviews, the concept of multimodal mobility, as discussed in 4.1.2, also offers opportunities for more sustainable mobility in suburban neighbourhoods. The perspectives of the transportation planner and the strategic planner agreed that this requires a quick transfer to the metro or train system, stations should be easily accessible with cycling and walking, and safe bicycle parking facilities should be ensured. The Public Transportation Vision adds that tram and bus should be better connected to metro and train stations as well (Gemeente Rotterdam, 2018). According to the RET, the supply of public transportation bicycles or other shared bicycles is important as well, especially for the first and last mile transport. The Traffic Agency emphasised that all 'shared systems' might be an opportunity for suburban neighbourhoods. With this, based on the interviews, the concept Mobility as a Service becomes relevant. It is seen as an opportunity for the stimulation of sustainable mobility in the suburban neighbourhoods since it is supposed to make travelling with public transportation as easy as possible. Yet, as mentioned before, the impact is still uncertain. Furthermore, according to the TNO, when automatic vehicles will be used properly in the future, this could be an opportunity for suburban neighbourhoods since there is more space for automatic driving in these neighbourhoods. However, the TNO recognised several restrictions of automatic vehicles in suburban neighbourhoods as well, like the current infrastructure with mixed traffic and safety issues. In the Public Transportation Vision, these safety issues and interaction with the other traffic are acknowledged as well.

#### Environmental-spatial dimension

It is argued by the transportation planner and TNO that it should be accepted that the car use in suburban neighbourhoods is high and that it will never disappear completely.

*'You have to accept that car use in such neighbourhoods is relatively high'* (Transportation planner, 2018)

Therefore, TNO stated that cars should be made more sustainable in order to reduce the impact on the environment. The transportation planner adds that this should be stimulated by providing charging facilities and taking measures, especially at places where public transportation is not a good option. According to the RET and PBL, this also applies to cycling. There should be invested in cycling as alternative. Improving the quality of the cycle connections and facilities in suburban neighbourhoods could increase cycling. It appears from the interviews that good cycle connections are important, including accessibility and social safety. The bicycle coordinator of the municipality argued that the electric bicycle and upcoming 'quick bike routes' have potential for the suburban neighbourhoods, because it reduces the travel distance. Moreover, the RET believes that the quality of walking routes can make a real difference within suburban neighbourhoods. This is connected to the design of the environment and the attractiveness and safety of these routes. The PBL acknowledged in the interview that the experience of the route influences the distance one is prepared to walk.

According to the interviewed bicycle coordinator of the municipality, it might be more difficult to intervene in some neighbourhoods than in others. The strategic planner adds that the existing use and the existing 'DNA' of the neighbourhoods is the starting point which determines what can be changed in these neighbourhoods in the future. The perspective of the Traffic Agency confirms that it is important to know what is going on in an area. Based on the interviews, another restriction of more sustainable mobility in suburban neighbourhoods is the low density of these neighbourhoods. The perspectives of the TNO and the transportation planner agreed that with low density it is complicated to increase the frequency of public transportation, because of the lack of support. Therefore, no extensive public transportation network in the suburban neighbourhoods exists.

*'The fewer people per square meter, the less support for public transport'* (Transportation planner, 2018)

However, despite this low density in suburban neighbourhoods, the transportation planner still believes that a higher frequency of the public transportation in different directions would be an opportunity for suburban neighbourhoods. The perspective of the planner is that higher frequency offers quality. But this means that transport flows need to be bundled in order to be profitable.

The perspectives of the interviewees identified another challenge, namely high car ownership and dependency in suburban neighbourhoods. The suburban neighbourhoods are designed for car use, because these neighbourhoods have low-density structures and more space for using and parking a car, which makes the car best suited to use, argued by the Traffic Agency and PBL. The high density in the inner city leads to limited space, and makes it more attractive to use the public transportation.

### Social dimension

The perspectives of the interviews also agreed that the habits of the residents of the suburban neighbourhoods do play a significant role with regards to sustainable mobility. It is argued that most people in the residents want to own a car by themselves, causing a high car dependency. This car dependency can lead to resistance of residents, when aiming for more use of sustainable mobility. According to the strategic planner and the Traffic Agency, a change in thinking of these residents is required. Mobility Management seems to be a means for this, because it can stimulate people to use sustainable forms of mobility.

*'There is a need for sustainable behavioural change of these residents'* (Verkeersonderneming, 2018)

The transportation planner argued that residents of suburban neighbourhoods must have the willingness to use sustainable mobility forms instead of their car, also for the first and last mile. The RET stated that removing the first and last mile obstacles is a challenge as well. The bicycle coordinator acknowledged that alternatives have to be explained to residents in order to make them aware. But, the Traffic Agency stated that different population groups must be approached differently in order to reach the people effectively. As mentioned above, the quality and safety of cycling and walking routes plays an important role as well. The PBL argued that when the quality is high and the design is attractive, it becomes more attractive to use these cycling and walking routes.

*'By investing in bicycling, it becomes more attractive to use'* (PBL, 2018)

Another restriction for more sustainable mobility in suburban neighbourhoods could be transport poverty of certain population groups. Certain population groups do not have the (financial) means to

make use of sustainable mobility. On the other hand, it is argued that certain suburban neighbourhoods are not connected well to the public transportation network which lead to transport poverty as well. Finally, despite it is argued that all ‘shared systems’ and Mobility as a Service might be opportunities for the stimulation of sustainable mobility in suburban neighbourhoods, the impact of the systems and acceptability by the residents is still uncertain.

### 4.2.3 Transit-oriented Development

#### Political-economic dimension

The restriction of low density in suburban neighbourhoods for more sustainable mobility shows the connection between sustainable mobility and densification in these neighbourhoods as well. In the Public Transportation Vision it is stated that due to the increasing housing need, it is required to strengthen structurally the public transportation accessibility in the suburban neighbourhoods through a development strategy wherein public transportation and urbanisation occur simultaneously (Gemeente Rotterdam, 2018). Dense urbanisation contributes to the agglomeration force in the region and keeps the landscape open. Dense urbanisation is only possible through high-quality of public transportation, since this is the most effective means of transport in order to connect intensively built up urban areas quickly, with relatively little spatial footprint and negative external effects. Among the involved governments, there is support to focus in the first place on the concentration of housing in the proximity of public transportation stations (train, light rail, metro and tram) (Gemeente Rotterdam, 2018). This increased support for transit-oriented development is acknowledged by an interviewed planner and the PBL as well, partly due to the pressure on the housing market and the urgency of building in the existing city.

*‘It seems like there is now more support for TOD’ (PBL, 2018)*

Based on the interviews, several opportunities of transit-oriented development in suburban neighbourhoods can be identified. First of all, as discussed in 4.1.2, lower parking standards around these nodes are seen as an opportunity for more sustainable mobility, because it discourage car use. Besides, multimodal accessibility at these nodes is seen by the area developer as promising for transit-oriented development, because it can stimulate the use of public transportation. Moreover, according to the area developer and the PBL, current market initiatives offer opportunities as well for densification around nodes. The PBL stated that in the northern suburban neighbourhoods of Rotterdam more market initiatives exist than in the southern part, since the northern part has a more attractive position in the Randstad. Therefore, more opportunities for node development emerge in the northern suburban neighbourhoods of Rotterdam.

Despite the increased support for transit-oriented development, including in suburban neighbourhoods, an integrated development plan of the municipality is required. The municipality is seen as responsible for determining the direction for the long term. However, according to the PBL and strategic planner, this requires time, concrete and area-specific plans, and a proper coordination between urbanisation and infrastructure, which is discussed in part 4.1.3 as well. An important outcome of the focus group is that this requires scenario planning of the municipality per suburban neighbourhood. From the interviews, it can be concluded that basically all the political arguments stated in part 4.1.3 apply to TOD in suburban neighbourhoods as well.

#### Environmental-spatial dimension

The perspectives of the interviewees agreed that densification of existing public transportation nodes is the greatest opportunity for densification in suburban neighbourhoods. The PBL and the urban planner considered TOD as a promising way of densification in suburban neighbourhoods, because it makes it

possible to keep the areas compact and to increase the frequency of the mobility system. It is considered that a higher frequency will make public transportation more attractive. Furthermore, according to the urban planner, adding new stops to the existing metro or train track may also be an opportunity. But this would be more in the form of a metro, such as the new 'Hoekse Lijn' and 'Oude Lijn'. However, the urban planner emphasised that proper analysis of the spatial quality of the area is important and the desired identity of the public space needs to be considered.

#### Social dimension

The urban planner also argued that densification around these existing nodes could be attractive for people, because of the availability of public transportation. This in turn can lead to more support for facilities and mixed-use development around these nodes, according to the PBL. The urban planner stated that when this would be combined with a green living environment, it could lead to high quality. This also meets the desires of the citizens for more green.

### 4.3 Prins Alexander

As explained in the introduction, the research has a specific focus on the suburban neighbourhoods of the district Prins Alexander. The neighbourhoods of Prins Alexander are post-war neighbourhoods. According to the interviewed area developer of Prins Alexander, the district is originally developed as low-density area and has 45.000 houses of which 16.000 owner-occupied property and 27.000 rental property. The ratio varies per neighbourhood. In 2014, the municipality of Rotterdam established an Area Plan for the neighbourhoods of Prins Alexander for the period of 2014 till 2018. Within this plan, general priorities, priorities per neighbourhood, and several bottlenecks are formulated. The Area Plan of Prins Alexander has been established with input from many residents. Prins Alexander is by the municipality seen as a powerful magnet of Rotterdam which is able to attract and to bind people. Unlike other areas in Rotterdam, Prins Alexander offers peace and space, also for families and middle and higher incomes (p. 6). The ambition for Prins Alexander in 2030 is as follows: 'A good, accessible and safe living environment which is attractive for living, working and recreation. Due to the high level of facilities, the green and water-rich environment, people like to live and stay there. The area is attractive for middle groups, social climbers and entrepreneurs, also from outside Rotterdam'. However, in the Area Plan it is argued that in Alexander 'quality is vulnerable' (Gemeente Rotterdam, 2014). This means that, in addition to the opportunities, Prins Alexander is facing some major challenges which will be discussed in this part.

#### 4.3.1 Densification

##### Political-economical dimension

As mentioned before, the City Vision is not considering densification in the suburban neighbourhoods, but argues that several (suburban) neighbourhoods need redevelopment. However, the neighbourhoods of Prins Alexander are not included in those redevelopment plans. The City Vision states that Prins Alexander has in general a good quality and that the characteristics of the district do not need drastic changes (Gemeente Rotterdam, 2007). But, as indicated before, the City Vision is ten years old, which means a new vision is required. Nowadays, the neighbourhoods of Prins Alexander are facing bottlenecks and barriers which emphasises the need for redevelopment in these neighbourhoods (Gemeente Rotterdam, 2014). Considering the increasing housing need, densification in the suburban neighbourhoods of Prins Alexander might have potential, because of the low-density structure, shown in figure 16. Therefore, it is argued that the opportunities of densification in the neighbourhoods of Prins Alexander need to be examined.

In exploring the interviews, several opportunities for densification in the neighbourhoods of Prins Alexander can be identified. According to the area developer, it is important as a municipality to

take advantage of all the possibilities in Prins Alexander, which also applies to other suburban neighbourhoods.

*'All available locations for densification must be optimally utilised'* (Area developer, 2018)

According to the area developer and urban planner, the most important way of densification in Prins Alexander at this moment is the transformation of old office buildings to housing, including renewal as well as replacement of these buildings and building in higher density. So this means intensifying the existing construction sites. It is argued that, nowadays, a lot of market initiatives for restructuring are taken, especially in the neighbourhoods Lage Land and Prinsenland. These initiatives are made by housing corporations, project developers, property owners, and sometimes by chain stores. According to the area developer, the role to be taken by the municipality is a facilitating role and the municipality should establish frameworks for these initiatives.

*'We mainly facilitate initiatives that come to us, this is a big difference with the inner city where the municipality is more focused on certain programmes'* (Area developer, 2018)

Furthermore, the transformation of other empty facility buildings such as church and school buildings and/or buildings with a social function that are no longer needed due to the concentration of social functions are seen as opportunities for housing. This also applies to buying up scattered buildings that are no longer interesting for offices or companies. These buildings can be transformed to or replaced by housing. Because of these transformations, the area developer argued that, nowadays, many changes of function occur at locations in the neighbourhoods of Prins Alexander and occasionally additions of new buildings. Densification around sub (shopping) centres in Prins Alexander is also seen as an opportunity. According to the PBL, mono-functional areas in Prins Alexander offer also opportunities for densification, such as office or business areas, shown in figure 19. On the other hand, the area developer argued that it is also important to meet the demand for offices in Prins Alexander. Employment is seen as important by the municipality, therefore it stated that it is necessary to explicitly keep space for businesses and offices. Most companies are located at the industrial sites in the areas and the municipality wants to keep it that way.



Figure 19: Mono-functional office area Prins Alexander

Based on the interviews, a final important opportunity for densification in Prins Alexander can be identified. The planners argued that the areas around nodes are promising for densification, because of good public transportation connections. In Prins Alexander, this applies to the metro stations but also to the train station Prins Alexander ('Alexanderknoop'), see figure 20 and 21. This corresponds to a

statement in the Public Transportation Vision of the municipality that the existing transportation nodes in Prins Alexander are seen as opportunities for densification (Gemeente Rotterdam, 2018). According to the planners, the areas around the metro stations in Prins Alexander do not have a high density yet. The urban planner acknowledged that these areas should be examined well for densification opportunities, especially in Ommoord, Lage Land and Prinsenland.



Figure 20: NS-station Prins Alexander



Figure 21: Metro station Oosterflank

In addition to the opportunities for densification in Prins Alexander, the interviews revealed several challenges for densification as well. The senior of the Traffic and Transport department argued that in Prins Alexander, many different property situations exist. Different interests play a role which makes it complicated to densify. The PBL confirms that fragmented land ownership is a challenge for densification, as discussed before.

### Environmental-spatial dimension

When looking at the different neighbourhoods of Prins Alexander, densification is considered as most promising in Lage Land, Prinsenland and partly in Ommoord. In Lage Land and in the north of Prinsenland, many scattered and empty buildings exist, including offices, which are suited for transformation. The neighbourhoods Oosterflank and Zevenkamp do already have a relatively high density, according to the area developer, which makes further densification difficult in these areas. Ommoord has a high density as well due to many high-rise buildings. However, several opportunities for densification are left in this neighbourhood, such as the transformation of old offices or restructuring of the small shopping centres, called Binnenhof and Hesseplaats (figure 22). According to the area developer, some restructuring projects and improvements have already been facilitated, but both the urban planner as the area developer argued that there is more space for the combination of transformation and densification. Yet, at the same time, the area developer argued that Ommoord is a popular area because of its attractive greenness and open space, see figure 23. The other neighbourhoods characterised by green and open space as well. Densification should not lead to a loss of the (green) quality of these neighbourhoods. The perspective of the urban planner agreed that densification in such neighbourhoods could be a threat for the quality of these neighbourhoods. Preserving the greenness of the neighbourhoods is desired by the residents.



Figure 22: Sub centre Hesseplaats Ommoord



Figure 23: Greenness in Ommoord

*'The quality of this neighbourhood (Ommoord), green and open space, needs to be preserved'*  
(Area developer, 2018)

*'You have to be aware of the existing qualities and you should not change that'* (Urban planner, 2018)

Nesselande is the newest neighbourhood of Prins Alexander. The area developer explained that with the development of Nesselande, the addition of mixed living environments and different levels of density have been taken into account at the beginning of the planning process. Therefore, a mix of housing types already exists in Nesselande and the highest density is developed around the metro station and sub centre.

The interviews revealed another specific location which might be suitable for densification, the zone at the Kralingse Zoom. The perspectives of the planners agreed that adding houses in this area would be promising, also for the improvement of the (cycling) connection between the suburban neighbourhoods of Prins Alexander and the inner city of Rotterdam. It is stated that an opportunity for mixed-use development exists in this area, including living, working and recreation. However, currently several sports fields are located in this area. The urban planner argued that these are important facilities of the city which means that important decisions have to be made about how to implement or combine densification in this area

### Social dimension

According to the planners, it is important to add new types of houses in the neighbourhoods of Prins Alexander. This leads to differentiation of housing types and thereby a differentiation of population groups. The perspectives of the urban planner and area developer agreed that the focus should be on different target groups, including the existing population group and new population groups. This means offering owner-occupied properties, social housing, and apartments, also for elderly people. Especially the demand for medium-rent housing in Prins Alexander is high. Therefore, with transformation, especially medium-rent housing should return, according to the area developer. But also in the form of apartments, because of the ageing of the population in Prins Alexander. According to the urban planner and area developer, the existing elderly residents want throughput possibilities within Prins Alexander. By adding apartments, the housing stock can be widened which facilitates the housing need of these elderly. The current population group is given new possibilities in the neighbourhoods.

*'The current target group can make residential career'* (Head of planning department, 2018)

Besides, the urban planner stated that new young families have the possibility to enrol in the vacant single-family homes. This leads to more differentiation in the neighbourhoods.

The urban planner stated a social challenge in Prins Alexander as well. The residents of these neighbourhoods are often critical about densification. This is connected to the threat of densification to the quality of the neighbourhood and people seems to be afraid to lose their view. In order to prevent that densification will cause negative impacts for the neighbourhoods, a planner stated that a new vision of the municipality for the neighbourhoods is required about how to implement the densification process without being a threat for the existing quality and green structure.

Figure 24 shows the possible densification places in Prins Alexander based on the interviews. The figure shows a clear distribution of the densification possibilities within the neighbourhoods of Prins Alexander, except for the neighbourhood Nesselande in the north of Prins Alexander where, as mentioned above, already mixed living environments and different levels of density exist.

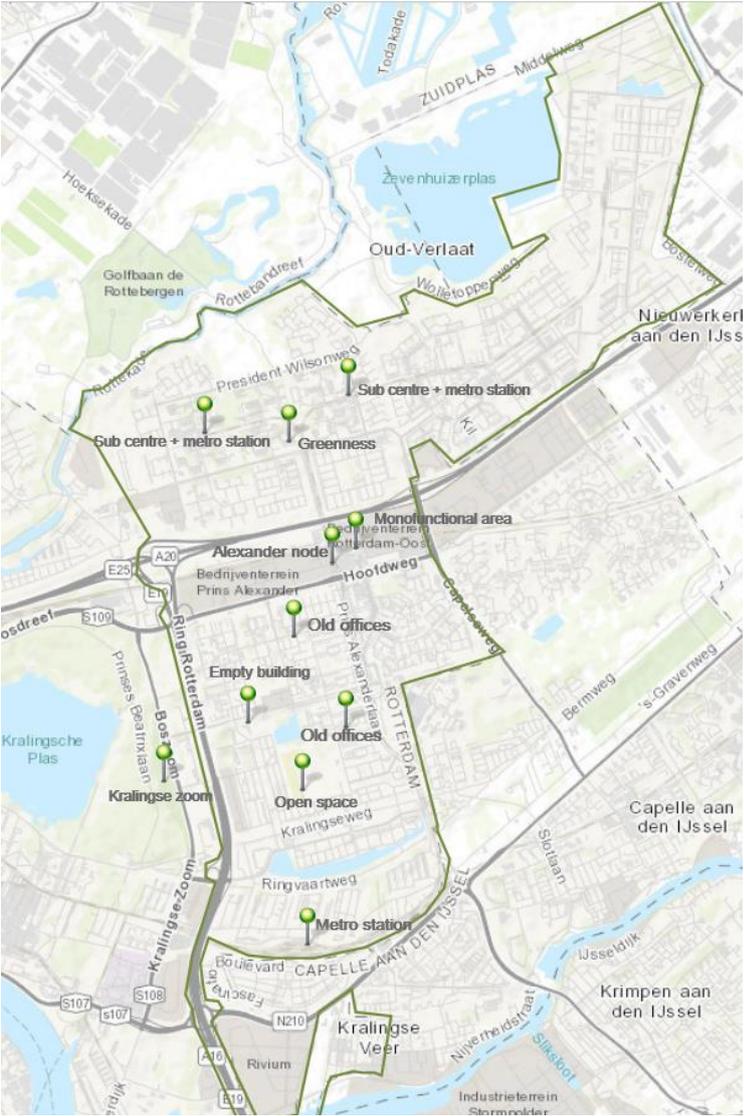


Figure 24: Densification possibilities in Prins Alexander (ArcGIS, 2018)

**4.3.2 Sustainable Mobility**

**Political-economical dimension**

The neighbourhoods of Prins Alexander are connected to the metro network of Rotterdam, have several bus lines, and Prins Alexander has a train station which is connected to the metro network as well.

Within the Public Transportation Vision, it is stated that especially the metro is the ‘backbone’ of the public transportation in Prins Alexander. Besides, it is argued that it is important to strengthen the strong bus lines in Prins Alexander. The current public transportation network of Prins Alexander is shown in figure 25. It is concluded by the interviewees as well that the metro is the carrier of the network in Prins Alexander and has a high quality. The transportation planner adds that because of the metro, Prins Alexander is well connected to the inner city. The urban planner argued that Prins Alexander is perfectly accessible because of the train and metro stations. Yet, the RET argued that the supply next to the metro does not have a high quality everywhere. First of all, Prins Alexander does not have a tram network. Secondly, the supply of buses is limited, because buses are not very profitable in these neighbourhoods. According to the RET, a bus line is only profitable when it serves a part which is located far from the metro.

*‘The bus only survives when it offers a connection that the metro does not offer’ (RET, 2018)*



Figure 25: Public transportation network Prins Alexander (RET, 2018)

As mentioned in 4.2.2, in the Urban Traffic Plan the municipality stated that there are insufficient sustainable connections between the suburban neighbourhoods and the inner city, and between and within the suburban neighbourhoods themselves. This also applies to Prins Alexander. The obstacles consists of accessibility and connectivity to the inner city from Prins Alexander. It is stated in the Urban Traffic Plan that the quality of the underpasses for cyclists at the highways A20 and A16 could improve. The unsafe traffic situations at these underpasses applies to Prins Alexander as well. Many underpasses are used by both car and bicycle traffic. Especially during rush hour this leads to unsafe traffic situations. Figure 26 shows such an underpass in Prins Alexander.



Figure 26: Underpass highway A16

*'New detached cycle connections of high quality are required to and from the inner city'*  
(Gemeente Rotterdam, 2017)

It is remarkable that the area developer and the transportation planner argued that the cycle connections within Prins Alexander and to the inner city are well organised and sufficient.

*'There is an extensive cycle path network in Prins Alexander'* (Area developer, 2018)

The highway is not seen as a barrier by the interviewees since enough underpasses are available. This is discussed in 4.2.2 as well. Even the social safety is regarded as proper. What is considered as a bicycle barrier, is the golf court on the other side of the highway A16 near the Kralingse Bos (small forest). Because of the golf court, people have to detour. According to the urban planner, the golf court is located at an unfortunate spot. In addition, a large empty area with some sport fields and allotment gardens is located south of the golf court. The planners argued that this is a mono-functional area with no identity which makes it unsafe to cycle through the area in the evening. Another restriction for the attractiveness of cycling in Prins Alexander is the lack of safe bicycle parking facilities. These should especially be available at the metro stations and easily accessible.

With exploring the interviews, several opportunities for more sustainable mobility in Prins Alexander can be identified. The urban planner stated that the introduction of parking fees in suburban neighbourhoods as Prins Alexander might be able to decrease the car dependency of the residents. Yet, Prins Alexander is not included in the new parking regulation of the municipality, because of the high car ownership, according to the urban planner. It seems to be a politically sensitive issue. Furthermore, electric buses are considered as an opportunity as well for Prins Alexander. According to the transportation planner, the municipality already has the ambition to switch to electric buses. However, electric buses require charging facilities. These facilities need to be organised by the municipality which is a challenge, according to the area developer. Yet, the area developer and transportation planner both argued that charging facilities could be arranged at the bus station of Prins Alexander. Finally, according to the interviewees, the car use could be controlled by the municipality by means of financial incentives and taking initiatives in order to change people's behaviour as explained in part 4.1 and 4.2.

### Environmental-spatial dimension

According to the transportation planner, when comparing with the inner city, Prins Alexander is a region of origin. Therefore, the public transportation in Prins Alexander is different than in a destination area such as the inner city. Despite the proper metro offer in Prins Alexander, the RET stated that still in certain areas, even close to the metro, the public transportation use is not as high as expected. The RET argued that 'we must learn from this'. The neighbourhood Kralingse Veer is the most complicated. This neighbourhood is, according to the area developer, quite isolated and has poor connections to the inner city. Moreover, the municipality argued in the Urban Traffic Plan of Rotterdam that the extension of the highway A16/A13 will improve the car accessibility of Prins Alexander greatly (Gemeente Rotterdam, 2017). This could be disadvantageous for the stimulation of sustainable mobility forms in Prins Alexander. However, the area developer and the transportation planner both argued that this extension of the highway is necessary in order to decrease the traffic congestion on the highway. The current congestion on the highway has negative impacts on the quality of life of the surrounding areas.

The interviews revealed several other opportunities for the stimulation of sustainable mobility. The transportation planner and the area developer argued that capacity is left in the current metro line. This capacity should be further utilised according to the area developer. Besides, the frequency of the metro could be increased, which corresponds with the Public Transportation Vision. The transportation planner stated that the municipality aims to increase the frequency. The accessibility of the public

transportation in Prins Alexander is also important for the stimulation of sustainable mobility and needs to be improved in Prins Alexander. This is related to the multimodal accessibility, as discussed before. Especially the combination bicycle metro forms the multimodality in Prins Alexander. According to the transportation planner, the idea in Prins Alexander is that everyone comes to the metro by bike or on foot. Therefore, safe and sufficient bicycle parking facilities and direct routes to the metro stations are required. There is a lack of proper bicycle parking facilities at metro station, see figure 27. In addition, the RET stated again that for Prins Alexander shared bicycles, including the public transportation bicycle, at metro stations are required as well as shown in figure 28. Within this, first and last mile transport has potential as well, according to the transportation planner.

*'Bicycle parking at metro stations is the most important way to guarantee multimodality'*  
(Transportation planner, 2018)



Figure 27: Lack of sufficient bicycle parking facilities at stations



Figure 28: Shared public transportation bicycles

The urban planner and the area developer proposed in the interviews a new cycle connections which crosses the golf court in order to remove this barrier for cyclists. Moreover, according to the planners, densification in the area south of the golf court could make cycling in this area more attractive and safe as well. Through densification in this area, a connection between the inner city and the suburban neighbourhoods of Prins Alexander will be developed.

### Social dimension

The social dimension of cycle connections is seen as important as well by the senior of the Traffic & Transport department of the municipality. A difference between the physical possibilities and what is physically comfortable exists. Comfort seems to play a crucial role for the stimulation of cycling.

*'A pleasant connection is a connection where you like to cycle'* (Senior Traffic & Transport department, 2018)

In the neighbourhoods of Prins Alexander, extra attention is required for the mobility of the elderly. They stay at home longer, which means that cycle and pedestrian routes require extra attention in terms of traffic safety and the accessibility of public transportation stops must be improved (Gemeente Rotterdam, 2017). The ageing of the population is confirmed by the interviewed area developer. The area developer emphasised that the ageing occurs especially in the neighbourhood Ommoord. In the Area Plan of Prins Alexander it is stated that the number of elderly in Ommoord is 31 percent (Gemeente

Rotterdam, 2014). The Traffic Agency acknowledged the ageing of the population and argued that it is a social challenge since this population group asks for specific facilities, also in terms of public transportation.

*'The mobility of this ageing group will decrease physically'* (Area developer, 2018)

The area developer argued that this emphasises the importance of taking demographic developments in the neighbourhoods into account. It reflects the needed facilities of the specific population group.

A social restriction for more sustainable mobility in Prins Alexander, which was again mentioned in the interviews, is the behaviour and habits of the residents. The residents want to own a car and are used to use their car for everything. According to the urban planner, the high car ownership in Prins Alexander causes a high parking pressure as shown in figure 29, which leads, in turn, to an increased pressure on the public space.



Figure 29: High car ownership in Prins Alexander

### 4.3.3 Transit-oriented Development

#### Political-economical dimension

One of the goals of the Area Plan 2014-2018 is the further development of the Alexander node, it is described as one of the bottlenecks (Gemeente Rotterdam, 2014). Better accessibility is required (public transportation, slow traffic, and cars), the node has to be connected to the surrounding neighbourhoods and a mix of reinforcing functions is needed. The Alexander node is an important work- and shopping area for the whole region. For better access of the Alexander node, the quality of the public transportation node Alexander needs to be improved dramatically, as stated by the municipality. Better connections between the (intercity) train station with the metro and buses are needed. Moreover, the parking places for bicycles need to be expanded. Investing in good facilities contributes to the liveability of the surrounding neighbourhoods. For the revitalisation of the shopping area Alexandrium, plans are made for extension and reinforcement in terms of mixed functions of the shopping area. Because of the regional attractive force, a wide range of facilities is possible. The direct environment can benefit from this even more when a good connection with the surrounding neighbourhoods is available. Better arrangement of the public area combined with good routes for slow traffic, such as cycling, should lead to this. The attractiveness of these neighbourhoods will improve through the expansion and improvement of mixed functions and the attractiveness of the public area (Gemeente Rotterdam, 2014). Furthermore, the municipality wants to invest in greenery, environment and the living environment.

The municipality (2018) has stated in the Public Transportation Vision that the Alexander node is a strong economic core area which makes it important to improve the accessibility of the node significantly. Alexander node is also an important supra-regional node. The existing node needs to be strengthened, like the other nodes of Rotterdam. The potential of the public transportation of the

Alexander node for the period until 2040 is visualised in figure 30. This shows that the Alexander node as well as the metro line in Prins Alexander has potential to grow in terms of passengers.

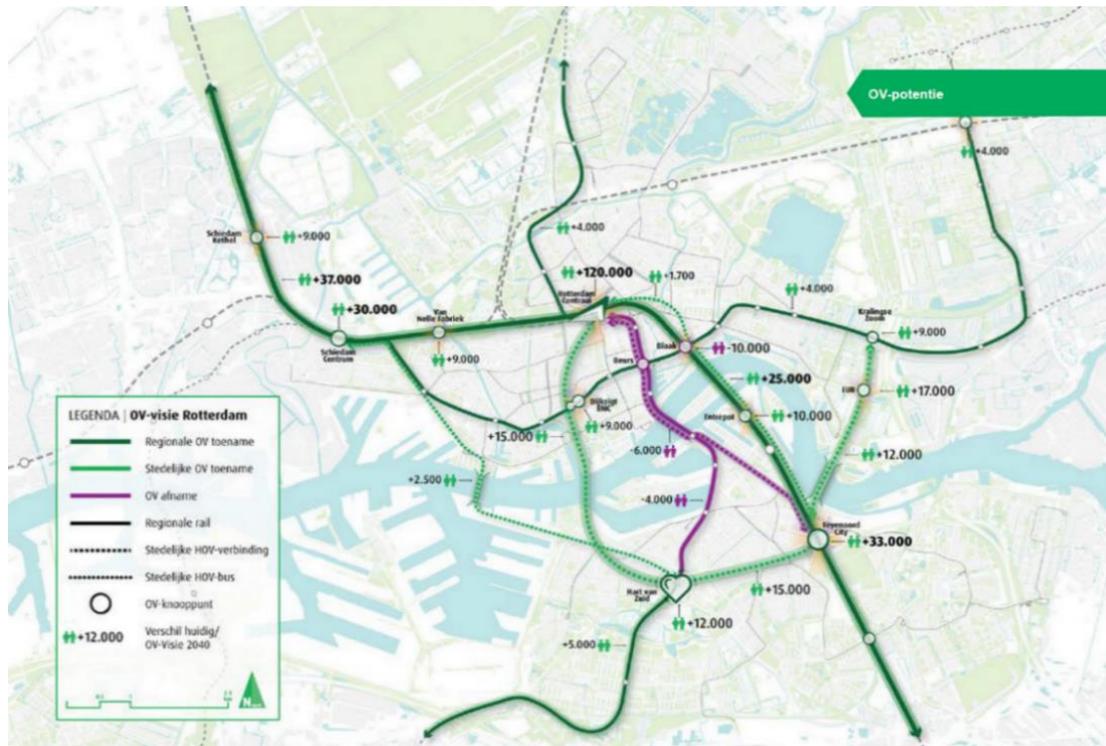


Figure 30: Public transportation potential (Gemeente Rotterdam, 2018)

Currently, redevelopment plans of the Alexander node are developed and the metamorphosis has already started in April 2018. The municipality admitted in the document ‘Alliance for station area Rotterdam Alexander’ the lack of spatial quality and social safety in the area, and that the public space in the station area needs to be renewed (Gemeente Rotterdam, 2017). The focus is on the accessibility, design, buildings and identity, which includes multimodal accessibility (train-metro), greening of the public space, more bicycle parking facilities, bicycle and walking routes, and place-making. Figure 31 shows an impression of the renewed NS-station Rotterdam Alexander.



Figure 31: Impression of the renewed NS-station Rotterdam Alexander (Algemeen Dagblad, 2018)

Yet, the urban planner urged that housing should be added at the Alexander node and this should be guaranteed, partly because of the housing task of the municipality and partly to increase the liveability of the area. Redevelopment of the Alexander node is by the interviewees seen as an opportunity for densification around the node. Furthermore, it is argued that the opportunities for densification around the metro stations in Prins Alexander should be examined as well. However, densification around these nodes faces different challenges,

First of all, it is argued that fragmented ownership situations at nodes have to be taken into account and can be a barrier to densification, because of different interests. This is especially true for the Alexander node. According to the area developer, in order to be able as a municipality to implement developments around a node, like the Alexander node as well as metro stations, the municipality needs land positions. This is also questionable around metro stations, since these areas are not greenfield sites.

*'Who is the developer? Which investors are behind it? Who has the interest?'* (Area developer, 2018)

Furthermore, the current land use plan must allow new developments as well. This plan determines whether new developments and new buildings are permitted or not. Moreover, negative externalities, such as safety and noise issues due to the highway and railway, do play a role as well, according to the area developer. It is argued that this requires additional measures to buildings with housing.

Because of the good car accessibility of the offices due to the highway, the area developer argued that the car accessibility should not be decreased in the area. But, with the new redevelopment plans, the public transportation accessibility should be increased. However, the perspectives of the planners agreed that the implementation of parking standards around the Alexander node could be an incentive to reduce car usage. Besides, as mentioned before, the Traffic Agency is pursuing initiatives in order to push people out of their car and stimulate more sustainable behaviour.

*'It (parking standards) is a specific management tool when it comes to new developments, through which areas automatically become more focused on public transportation'* (Urban planner, 2018)

### Environmental-spatial dimension

When exploring the interviews, criticism on the current state of the Alexander node can be identified, which corresponds to the above described issues described from the Area Plan. The perspectives of the urban and the transportation planner agreed that currently the area of the Alexander node is not attractive at all. It is an old area with few attractive functions and the design of the public space is bad, as shown in figure 32. It is argued that the public space does not have any quality. The area has been designed functionally and all the functions are separated. The mono-functionality of the area makes it a very anonymous area. This is reinforced by the dominance of the car, it is not attractive for pedestrians.

*'When you get there, you want to leave as soon as possible'* (Urban planner, 2018)



Figure 32: The public space of Alexander node

The planners concluded that at the Alexander node the same problem as in the inner city in the past is occurring, but on a more compact and smaller scale. The area has few housing and a lack of vitality and vibrancy, especially in the evening. However, the urban planner emphasised that the municipality started recently with a redevelopment project of the Alexander node, as explained above. The Alexander node is seen as promising, because of the good accessibility by public transportation (e.g. metro, train and bus) as well as by car, and it is considered as a prime location for offices. The interviews revealed that one of the most promising ways of densification in Prins Alexander is densification around the public transportation nodes, including the metro stations and the train station. Therefore, the redevelopment of the Alexander node is seen as a great opportunity for densification, partly because both train and metro facilities are available at this node.

*'At the Alexander node it is possible to add significant houses'* (Urban planner, 2018)

Based on the interviews, the densification of the Alexander node, as well around metro stations, can be seen as transit-oriented development. It is being examined how the existing Alexander node with its public transportation facilities can be better utilised, including with housing. The planners argued that housing should be added to the node in order to improve the vitality and vibrancy in the area, all day long. According to the urban planner, with the addition of housing, it becomes easier to improve the attractiveness of the public space as well and it leads to more support of facilities. Thus, adding houses could eventually lead to mixed-use development and a more attractive and interactive atmosphere. In addition, the planners stated that Alexander node should function more as a facility centre for the district Prins Alexander, which can be achieved with mixed-use development as well.

*'Being a heart for the whole area of Prins Alexander'* (Urban planner, 2018)

The urban planner acknowledged that the redevelopment of the Alexander node, including densification, requires a lot of interventions. In addition to adding housing, the entire design, furnishing and atmosphere of the station area needs to be improved, i.e. the quality of the area must be increased, including the quality of the facilities. Moreover, the routing to the area needs to be improved. This is seen as a major challenge and it is argued again that this requires a clear vision.

With densification around the Alexander node, the urban planner argued that it is possible to develop housing types which are less car dependent which is seen as beneficial. This could stimulate a

cleaner and more sustainable form of living. According to the PBL, the redevelopment and densification of the Alexander node could become an oil slick which could lead to a slick effect to the rest of Prins Alexander. This concept was discussed in 4.2.1 as a strategy for the realisation of densification in suburban neighbourhoods. The redevelopment of the Alexander node is by the transportation planner also considered as an opportunity to renovate the station on a large scale which can lead to a better transfer between train and metro. This refers to multimodal accessibility. Besides, it is required to expand the bicycle parking facilities and to refurbish the bus station.

### Social dimension

The interviewees agreed that with densification and subsequently mixed-use development at the Alexander node, the liveliness and attractiveness of this area increases. The strategic planner stated that densification is a way to improve such a place and make it more attractive which also benefits the existing residents.

However, the planners and area developer stated that for node development, the current habits and behaviour of the residents play a role as well. The high car dependency and ownership of the residents need to be countered to ensure this node development is efficiently. Besides, as discussed before, people always criticise new developments, especially densification. According to a planner, it is a challenge to organise the process well, including proper communication with residents and to involve them at an early stage. However, the planner also argued that criticism should not obstruct new developments completely and exemplified this before with the statement 'densification always hurts someone'. Therefore, it is argued by the strategic planner that a vision and area perspective is required which shows the benefits for (most of) the residents of redevelopment and densification as well.

## 5. Conclusion

After the theoretical and empirical research have been carried out, conclusions can be drawn from the analysis. This chapter is divided into three subparts. The first part 5.1 provides the discussion which includes a short summary of the research by testing the empirical results to the theoretical framework. By answering the subquestions, part 5.2 provides an answer on the research question: *'How could the municipality of Rotterdam mobilise synergies between suburban densification and sustainable mobility and thus contribute to smart suburban growth?'* In part 5.3, the recommendations are formulated, as well as for the policy of the municipality of Rotterdam as for further research. The last part 5.4 provides a reflection on the research process, including a methodological and theoretical reflection.

### 5.1 Discussion

In this part, the empirical results are tested to the theory. The reason for this is to examine interesting similarities as well as remarkable differences between the theory and empirical results, which makes it possible to draw conclusions and answer the research question in part 5.2.

#### 5.1.1 Densification

When testing the empirical results about densification to the theoretical debate on densification, it is possible to determine a number of similarities, but also a number of remarkable differences. First of all, it can be concluded that the perspectives from both data sources considered densification as relevant for a sustainable development of cities. Song (2005) argued that densification is a response to urban sprawl and low-density development. Because of ecological and economic objectives, most urbanists and planners favour dense and compact cities to counteract sprawl. When looking at the interviews, it can be concluded that the perspectives of the interviewees agreed that densification leads to sustainability, including in suburban neighbourhoods. A planner even emphasised that high density leads to all forms of sustainability. Densification is seen as sustainable, because it preserves the open landscape and saves green spaces. Besides, it is argued that higher densities lead to proximity of facilities which limits car use. People no longer need their car and are designated on cycling and walking. This leads to less energy consumption of mobility, which is beneficial for the environment. This corresponds with the theory. Charmes & Keil (2015) stated that lower-density environments lead to car dependency for even the shortest trips. This car dependency has negative impacts on the environment. Hoppenbrouwer & Louw (2005) acknowledged that the closeness of the different uses should reduce the need to travel, conserve energy and reduce pollution. Higher densities require much less land which is favourable for the environment and it does not have to lead to poorer public spaces (Lehmann, 2017). Lehmann (2017) added that the proximity of facilities is beneficial for the quality of life. The interviewees acknowledged this with exemplifying the positive impacts of densification on the quality of life in the inner city of Rotterdam. Sarkar et al. (2018) highlighted another positive impact of higher densities, namely on public health. Urban design could potentially influence individual behaviour and lifestyle. It could for instance stimulate walking and cycling. It is remarkable that the public health argument was not explicitly mentioned by the interviewees. However, the interviewee of the Traffic Agency stated that with the design of the public space through densification, it is possible to influence the behaviour of the public.

According to the interviewees, another consequence of densification is mixed-use development. Because of the fact that people live close together, support for more facilities increases which leads to mixed-use development. The area developer argued that higher densities and mixed-use development lead to a more lively, varied and attractive living environment and more social safety. Therefore, the interviewees agreed that densification would be an opportunity for the redevelopment and improvement of the suburban neighbourhoods. In the theory, it is stated that mixed-use forms part of a wider strategy for sustainable development (Lehmann, 2017). Hoppenbrouwer & Louw (2005) argued as well that

mixed-use development should contribute to urban diversity and vitality, which provides opportunities to improve the quality and attractiveness of the urban area.

Finally, densification is by the interviewed planners seen as an opportunity for the realisation of housing differentiation, especially in post-war suburban neighbourhoods which, in turn, causes differentiation of population groups. The differentiation of population leads to more support of (additional) facilities and can have positive impacts on the suburban neighbourhoods. This opportunity and advantage of densification is not discussed in the theory.

In addition to these positive perspectives on densification from both the theory and empirical data, downsides of densification are appointed as well. First of all, Neuman (2005) exemplified this with the Compact City paradox. For a city to be sustainable, it is being argued that functions and population must be concentrated at higher densities. But on the other hand, for a city to be liveable, functions and population must be dispersed at lower densities. The interviewees stated that densification in existing urban areas could be a danger for the spatial quality of these areas. It is seen as a challenge to preserve the (quality of the) green spaces in densification areas. This is especially true for suburban neighbourhoods, because these neighbourhoods are characterised by large green structures. Haalend & van den Bosch (2015) argued as well that higher density is a threat to the green space and thereby to the quality of life in the city. The danger of loss of green is acknowledged by Charmes & Keil (2015), low-density neighbourhoods are attractive for its greenness. Therefore, the Traffic Agency stated that densification should not lead to increased pressure on the public space. Moreover, the urban planner argued that it is important that with densification, greening and improvement of the quality of life have to be provided as well. The interviewees highlighted other potential negative externalities of densification, such as noise issues, environmental legislation, air quality and safety issues. Within the theory, this is not appointed explicitly. Yet, Lehmann (2017) argued that higher densities in cities can increase the risk of the 'urban heat island' effect, which would not be sustainable anymore. It is remarkable that the planners of the municipality did not discuss the 'urban heat island' effect even though Rotterdam is a big city and the city has to deal with increasing temperatures.

Furthermore, in the theory, Song (2005) concluded that higher-density areas are not always that favourable and limited evidence is available regarding the efficacy of densification policies. The implementation of higher-density areas is difficult, because of the lack of nontraditional aspects of planning for the encouragement of mixed land uses and to improve regional accessibility (Filion, 2009). The interviewees also acknowledged that the implementation is challenging. The interviewees argued that the fact that every space already has a function, even 'unused' green plots, could be a barrier for the implementation of densification. An interviewed planner of the municipality confirmed that this makes it challenging to realise the right function in the right place. Moreover, it is remarkable that the social component as a challenge to densification is much more highlighted in the interviews than in the theoretical debate. It was argued by the interviewees that not everyone wants to live in high densities and that there is a need for green urban living environments as well. This emphasised the importance of differentiated living environments. The residents have their own interest. Therefore, it is argued that densification could lead to public resistance. Song (2005) acknowledged the risk of resistance of citizens. When testing the empirical results to the theory, a clear similarity emerges. In both data sources, the need for active involvement of the public in order to make the process effective is emphasised. Communities need to provide some input into the process for public acceptance (Song, 2005; Banister, 2008). The Traffic Agency and planners of the municipality argued that clear communication with the citizens in an early stage and an open planning process are required.

The interviews have a more in-depth focus on the policy and the role of the municipality within the densification process than in the theory. The interviewees emphasised that densification is not an end in itself, but it should be used to achieve other goals. The perspectives of the interviewees also agreed that the municipality must take a facilitating role in the densification process and should make a

contribution to the realisation of densification. This includes adjusting laws and regulation. The PBL argued that the broadening of rules might be favourable for the implementation of densification in suburban neighbourhoods, because this can make it possible to use space more intensive, like adding storeys to existing buildings. Besides, the PBL stated that different forms of densification exist, which not always mean high-rise buildings since high-rise buildings are not favourable everywhere. Different forms of densification is acknowledged in the theory as well. According to Charmes & Keil (2015), every form of densification has different political and social meaning. Touati (2015) made the distinction between soft densification and hard densification.

Furthermore, it is remarkable that, as well as in the theory as in the interviews, the economic perspective of densification has barely been highlighted. In the theory, only Charmes & Keil (2015) mentioned an economic perspective of densification. Higher densities reduce sprawl and thereby reduce costs of infrastructure. The interviewees have not mentioned an economic perspective of densification at all which is an interesting finding. Only in the Urban Traffic Plan of the municipality the contribution of densification to the agglomeration force of a region has been emphasised.

When considering the city of Rotterdam, the focus of densification so far has been on the inner city. This corresponds with the theory. Charmes & Keil (2015) argued that the current compact city theories do not have an elaborated focus on the already existing suburban neighbourhoods. However, the municipality of Rotterdam and the interviewees have indicated that the scope of the densification process in the city of Rotterdam has to be broadened. All potential areas for densification have to be considered, including the suburban neighbourhoods. This is mainly due to the housing task the municipality is facing. Therefore, Rotterdam has chosen to build 50.000 houses before 2040 in the existing city. This refers to the concept of decentralised concentration which means the densification of already existing neighbourhoods and is based on sustainable development and urban form policies (Curtis, 2008; Holden & Norland, 2005). In the theory, Lehmann (2017) argued that densification of suburban neighbourhoods seems unavoidable. Higher density development is relevant to the entire city, not only for inner city areas. Lehmann (2017) even stated a strategy for densification in suburban neighbourhoods, namely suburban retrofitting ('sprawl repair'), which means 'making existing suburbs denser, more urban, more mixed-used and interconnected'.

### 5.1.2 Sustainable Mobility

When testing the empirical results about sustainable mobility to the theoretical debate on sustainable mobility, a number of similarities and differences can be identified as well. The most obvious similarity is that sustainable mobility is seen as essential for sustainable development of cities. Holden (2007) argued that sustainable mobility has a central role to play in the future of sustainable cities since mobility patterns have become unsustainable. According to Lam & Head (2012), the need for more sustainable forms of mobility are driven by three main factors: climate change; environment and health; and economy. The interviewees considered the transition to sustainable forms of mobility as a positive and essential development. The municipality wants the dominance of the car to decrease. Schuppan et al. (2014) argued as well that it is necessary to encourage the use of alternative mobility forms and to make car use and car ownership unattractive. Besides, the interviewees emphasised that mobility is not an end in itself, but it has to contribute to other tasks of the municipality. This also applies to densification as mentioned in 5.1.1. The perspectives of the interviewees on sustainable mobility correspond to the purpose of sustainable mobility stated in the theory. The transportation planner of the municipality defined sustainable mobility as mobility that causes as little damage as possible to the environment. A senior of the Traffic and Transport department of the municipality argued that walking, cycling, public transportation and clean vehicles are different forms of sustainable mobility, including new vehicle technologies. According to Lam & Head (2012), sustainable mobility is about easy and accessible travelling with minimal impact on the environment and others. Sustainable mobility requires that the

impacts of transport activities must not be a threat to long-term ecological sustainability (Holden, 2007). This shows that, in both the theory and interviews, the purpose of sustainable mobility is considered as having a minimal impact on the environment. Khreis et al. (2017) argued that more sustainable ways of mobility are not only beneficial for climate change impacts, but also for public health, because of less congestion. This corresponds to the interviews. The interviewees argued that sustainable mobility also contributes to social goals such as public health. It was argued that sustainable mobility can contribute to the liveability of a city.

Based on the interviews, a number of opportunities for more sustainable mobility in suburban neighbourhoods can be identified. These are new mobility systems such as Mobility as a Service, 'shared systems', last and first mile transport, and automatic vehicles. These new mobility systems should make the use of sustainable mobility more convenient and more attractive. Schuppan et al. (2014) argued that digitalisation and Information Systems (IS) solutions have enabled new and more sustainable alternatives. Besides, according to the TNO, car use will never completely disappear from the suburban neighbourhoods. This should be accepted and, therefore, car use have to be made more sustainable in order to have less impact on the environment. The theory does not proposed such specific opportunities for more sustainable mobility.

Moreover, multimodal mobility is by the interviewees considered as promising for suburban neighbourhoods, especially the combination bicycle and public transportation. Willing et al. (2017) defined multimodal behaviour as 'utilizing different transportation modes depending on one's momentary needs, as opposed to always travelling by personal car'. Schuppan et al. (2014) argued that the dominance of multimodal mobility is increasing and the role of private cars is declining in everyday mobility in dense urban areas. According to the bicycle coordinator, seamless connections of transportation facilities and quick transfer are important. But also the availability of safe bicycle parking facilities at metro stations and quick routes to and from the stations have to be ensured.

However, both in the theory as in the interviews, it is stated that the implementation of sustainable mobility is challenging. According to Holden (2007), achieving sustainable mobility requires high-quality implementation of innovative actions. According to the interviewees, a challenge for more sustainable mobility in suburban neighbourhoods is the low-density structure of these neighbourhoods. Lower density leads to less support for public transportation, because of less residents per square meter, which makes it challenging to increase the frequency of public transportation. This challenge is recognised in the literature as well. Touati (2015) argued that the shift of suburban neighbourhoods towards higher-density is a challenge. These large areas remained underexploited due to the low residential density development and densification raises a lot of resistance, especially from the residents (Touati, 2015). Another challenge, stated by the interviewees, lies in making the alternatives for car use, as cycling, walking and public transportation, more attractive which is connected to the quality and accessibility of these sustainable forms of mobility. Existing infrastructure needs to be improved and missing links have to be realised, within and between suburban neighbourhoods and to the inner city. Besides, urban design is playing an important role in this as well. Urban design is seen as an opportunity to influence the behaviour of the public, because it can stimulate walking and cycling. The argument of attractive alternatives is discussed in the theory. Schuppan et al. (2014) argued that it is crucial to keep alternative means of transport attractive and to take citizen's need into account. Lam & Head (2012) concluded that, among others, good urban design is important to achieve sustainable urban mobility. The urban built environment can influence travel behaviour (Zegras, 2005). In addition, Naess (2006) stated that individual behaviour and habits are related to mobility practices which are embedded in socio-technical and spatial arrangements. Another challenge for more sustainable mobility discussed in the theory, is the understanding and acceptance by the people and their habits (Banister, 2008). In order to change the dependence on personal vehicles, active involvement and action of the public is required through an interactive and participatory process. The interviewees acknowledged that

the understanding and acceptance by the people and their current behaviour are a challenge for achieving more sustainable mobility. It is stated that people in suburban neighbourhoods are highly car dependent. A high car ownership and a high car use are prevalent in suburban neighbourhoods. Therefore, the interviewees argued that a sustainable behavioural change among the residents is required. Lam & Head (2012) also argued that behaviour change is required in order to achieve sustainable urban mobility. Within this, according to the interviewees, it is important as a municipality to communicate properly with the residents in an open plan process and make them aware of the sustainable alternatives of mobility. Thus, the perspectives of both the theory and the interviews agreed that an open and active involvement of the public is required. This is connected to the term Mobility Management which is developed by the Traffic Agency. The aim of Mobility Management is making people aware of their travel behaviour and stimulating people to use other mobility forms (Verkeersonderneming, 2018). Schuppan et al. (2014) confirmed that travel demand management are targeting behaviour change. A final social challenge, highlighted in the interviews, is transport poverty of certain population groups, because of the lack of (financial) means or the lack of public transportation connections in the suburban neighbourhood. The suburban neighbourhoods of Prins Alexander are connected well to the public transportation network whereas other suburban neighbourhoods, for instance in the south of Rotterdam (e.g. IJsselmonde) are poorly connected to the network. This is not discussed in the theory.

It is argued by the interviewees that the municipality should use steering instruments in order to influence people's behaviour, such as introducing lower parking standards or other financial incentives which make car use more expensive. These steering instruments are defined by the strategic planner as 'push' factors. Having attractive alternatives to car use are defined as 'pull' factors. Within the theory, a distinction between 'push' and 'pull' factors is identified as well. Schuppan et al. (2014) argued that 'push measures' restrict or disable habitual behaviour. 'Pull-measures' attract a mode of shift by providing information and/or giving incentives (Schuppan et al., 2014). Lam & Head (2012) acknowledged that economic incentives are required as well. Besides, it is argued that leadership is required in order to achieve sustainable mobility. This corresponds with the argument of the interviewees that the municipality has an important role to play in stimulating sustainable mobility. Again, the interviewees go more in-depth on the policy and the role of the municipality within the sustainable mobility process. According to the interviewees, a policy is needed in order to deal with the mobility transition and it is necessary to take area-specific measures. In order to stimulate sustainable mobility in suburban neighbourhoods, a mix of measures is required. Besides, it is argued that a shift in thinking is needed within the organisation of the municipality and in politics. Banister (2008) emphasised that planning and regulations should be used to achieve sustainable mobility. This shows the importance of spatial planning and thereby the role of the municipality.

### 5.1.3 Transit-oriented Development

In the result chapter, the synergy between densification and sustainable mobility was emphasised. The interviewees stated that densification leads to more support for public transportation and that, on the other hand, public transportation makes it possible to densify, because of the existing infrastructure. This synergy is discussed in the theory as well. Theories on the influence of urban form on travel have concluded that dense and concentrated urban development is more conducive to sustainable mobility than low-density spatial expansion of the urban area (Naess et al., 2011). On the other hand, better accessibility to transit, pedestrian-friendly neighbourhoods and connectivity between neighbourhoods can enforce compact growth and discourage sprawling development (Song, 2005). However, Williams et al. (2000) are not convinced about the link between densification and reduced automobile trips. It depends on the type of auto trip. Short trips may decrease through densification, but longer travel distances can be independent of urban density. Charmes & Keil (2015) added that these long-distance trips are often ignored, whereas these trips increase with higher densities, due, among other things, to

the need for respite from the noise and stress of dense city centres. The risk of negative externalities due to densification, such as noise and air pollution, are emphasised by the interviewees as well.

In both the theory and in the interviews, the concept transit-oriented development was discussed. According to Suzuki et al. (2013), when combining sustainable mobility and densification, transit-oriented development (TOD) is an important development for sustainable urban futures. The goal of TOD is pursuing for a combination of stimulating transit and a more connected safe walking and cycling network (Curtis et al., 2016). According to Suzuki et al. (2013), transit and land-use integration is one of the most promising means of reversing the trend of automobile-dependent sprawl and developing cities in a sustainable way. The interviewees considered TOD as beneficial for the sustainable development of the city as well, including in suburban neighbourhoods. The PBL explained that good coordination of urbanisation and infrastructure, thus node development, is very promising. Densification around nodes is favourable for keeping the city compact, it can increase the frequency of the mobility systems, and it makes mixed-use development possible. Therefore, it is possible to stimulate a cleaner and more sustainable way of living. The strategic planner described transit-oriented development as the use of the proximity. It is argued that the existing infrastructure of public transportation makes it possible to densify, and, on the other hand, densification around public transportation could stimulate the use of sustainable mobility. Moreover, the interviewees considered TOD as a great opportunity for densification in suburban neighbourhoods. TOD could be linked to the metro systems in the suburban neighbourhoods. For Prins Alexander specific, it is seen as promising to link TOD to the train and metro station at the Alexander node. It is argued that this can improve the attractiveness and liveliness of the Alexander node. Densification around existing nodes in suburban neighbourhoods could be attractive for the people, because of the availability of public transportation which can lead to more support for facilities. Yet, it is seen as important to consider the spatial quality of these areas. Besides, not every suburban neighbourhood has a public transportation nodes.

Despite the fact that the perspectives on TOD from the theory and interviews are positive, challenges of TOD were identified as well. In the theory, Khan & Carville (2017) argued that the people who can afford to live in TOD areas are often those with high-paying jobs, who own higher-quality cars. This means that these groups of people are often least likely to use public transport for their daily travel, and the target groups are not reached. Changing the car dependency of these people is a major challenge (Khan & Carville, 2017). This corresponds with the perspectives of the interviewees. As mentioned before, changing the high car dependency of residents, and their habits, especially in suburban neighbourhoods, is seen as a challenge in aiming for more sustainable mobility. It is stated that a sustainable behavioural change of these residents is required.

It is remarkable that the interviewees highlighted even more challenges of TOD, which are not discussed in the theory. For instance, a social challenge stated by the interviewees is the need for living environments which cannot be realised at public transportation nodes, such as green living environments. Besides, the current residents around a node form a challenge. These residents are often very critical when it comes to new developments like densification. It is argued that it is necessary to involve these residents at an early stage in the planning process. Furthermore, the current development plan of an area and fragmented land ownerships could be barriers to TOD. According to the strategic planner and the PBL, it is necessary to develop integrated development plans for densification and sustainable mobility which are area-specific. It is argued that spatial developments and mobility are integrated and that the municipality has a key role in developing these plan. Banister (2008) stated as well that an integrated land-use development should be used to support shorter travel distances. Lam & Head (2012) added that integrated urban planning and design is required for sustainable urban mobility. Finally, Bishop (2015) acknowledged that municipalities have a relevant role to play in order to reach a sustainable and efficient city by using TOD.

## 5.2 Answering the Research Question

The research question *'how could the municipality of Rotterdam mobilise synergies between suburban densification and sustainable mobility and thus contribute to smart suburban growth?'* is characterised by two parts: the first part consists of the question which methods and policies the municipality of Rotterdam could apply to achieve smart urban growth (densification and sustainable mobility) in suburban neighbourhoods in order to contribute to the redevelopment of these neighbourhoods. The second part focuses on how the municipality could promote smart urban growth in the suburban neighbourhoods. Yet, the answer to the research question will be provided in one part since the answers on both parts of the research question are mainly integrated. The answer to the research question will be provided on the basis of the answers to the subquestions. At the end of this paragraph, a brief summary of the answer to the research question will be provided.

### 5.2.1 Benefits and Trade-offs, and Opportunities and Challenges of Densification in Suburbs

Densification is about building higher densities in the existing urban area. The most important benefits of densification are a limited impact on the scarce space and preserving the open and green landscape. In addition, densification leads to proximity of facilities and mixed-use development which limits mobility. This conserves energy and reduces pollution. Besides, densification is important for the support of facilities, including public transportation, and it can lead to a more attractive and liveable city. With urban design, it is possible to influence the behaviour of the public. Higher densities optimise walkability. Therefore, densification is seen as favourable for the quality of life and public health as well. Based on these arguments, it can be concluded that densification is seen as sustainable, in the theory as well as by the interviewees, and should be implemented in suburban neighbourhoods.

However, a number of trade-offs and challenges of densification in suburban neighbourhoods can be concluded as well. First of all, it seems to be challenging how densification in suburban neighbourhoods could contribute to other tasks and/or challenges in these neighbourhoods. It is stated that densification is not an end in itself, but it must be used to contribute to other goals the municipality is aiming for. Furthermore, densification could be a threat for the spatial quality of areas, such as greenness and open space. Densification should not be at the expense of these green spaces. This threat applies especially to the spatial qualities of suburban neighbourhoods, because these neighbourhoods are mainly characterised by green, open space, and quietness. This also applies to Prins Alexander which has a high level of greenness and a water-rich environment. When aiming for densification in suburban neighbourhoods, it is required to preserve the spatial qualities of these neighbourhoods. Other negative externalities can occur due to densification as well, such as noise and safety issues, air pollution, and environmental legislation. These externalities need to be taken into account when aiming for densification. Besides, higher densities require more other functions, such as green and sport facilities, but also more public transportation facilities. This can lead to conflicting spatial claims and increasing capacity problems of the public transportation network. Another trade-off of densification are the needs of the residents. Densification is not favourable everywhere, there is a need for differentiated living environments and not everyone wants to live in high densities. Densification could therefore lead to resistance of residents. Especially residents in suburban neighbourhoods are critical about densification developments, because they have usually consciously chosen for these spacious, green living environments which is connected to the spatial quality argument described above. Therefore, it is important that the municipality communicates openly with the residents at an early stage in the planning process. Participation and active involvement of the residents are required for an effective process. Besides, the benefits of densification for the residents have to be communicated clearly by the means of a spatial vision which is area-specific. Finally, the implementation of densification seems challenging due to fragmented land ownership and existing infrastructure and buildings. This can make it complicated and costly to densify, because of scarcity of space.

Despite these trade-offs and challenges of densification in suburban neighbourhoods, opportunities for densification in the suburban neighbourhoods can be identified as well. It is argued that all opportunities for densification in these neighbourhoods have to be utilised. These opportunities include, densification around sub (shopping) centres, in mono-functional areas, around metro and train stations, around existing infrastructure including highways, and the transformation of old (office) buildings to housing. It seems to be important that the municipality should take a facilitating role and establish frameworks for market initiatives. But, the municipality itself is also responsible for realising densification. Another opportunity of densification is the possibility for housing differentiation in the suburban neighbourhoods. This is especially beneficial for post-war neighbourhoods who have the same type of housing. Differentiation of housing can lead to a differentiation of population groups, which leads to more support for additional facilities and can have a positive contribution to the quality of the neighbourhoods. Moreover, it can be concluded that different forms of densification exists which not always include high-rise buildings. These different forms of densification are seen as an opportunity for densification in suburban neighbourhoods. In addition, broadening the regulation of densification is seen as an opportunity to make densification possible in suburban neighbourhoods. Finally, linking densification to sustainable mobility, mainly public transportation nodes, is seen as most promising in suburban neighbourhoods because of the existing infrastructure. This includes both metro and train stations.

### 5.2.2 Drivers and Restrictions of Sustainable Suburban Mobility

Sustainable mobility is about forms of mobility which causes as little damage as possible to the environment and to others. Forms of sustainable mobility are walking, cycling, public transportation and clean vehicles. It is seen as necessary to encourage the use of sustainable mobility forms and to make car use and car ownership unattractive. Sustainable mobility is not only beneficial for the environment, but also for public health, because of less air pollution. It can contribute to the quality of life in the city. Sustainable mobility is seen as essential for a sustainable development of cities, including in the suburban neighbourhoods.

However, a number of restrictions for more sustainable mobility in suburban neighbourhoods can be identified. Firstly, it can be concluded that the implementation of sustainable mobility is more challenging in suburban neighbourhoods than in inner cities. The inner city of Rotterdam is more suitable for sustainability measures due to higher density. The existing low-density structure of suburban neighbourhoods makes it challenging for more sustainable mobility in suburban neighbourhoods, because of less support for public transportation facilities. Furthermore, a shift in thinking within the organisation of the municipality seems to be required, because the focus should be more on sustainable forms of mobility. The city of Rotterdam is originally oriented on car use, which needs to change. The quality and availability of sustainable mobility forms plays an important role in order to be an attractive alternative for car use. The attractiveness of these alternatives includes quality, accessibility, safety, and comfort. Especially the availability of walking and biking routes have potential for suburban neighbourhoods and have to be made more attractive. This includes connections within and between suburban neighbourhoods, and connections to the inner city. Electric bicycles and 'quick bike routes' might be promising within this since it reduces travel time. Experience of the walking and cycling route is playing an important role. Therefore, urban design is seen as an opportunity to influence the behaviour of the public, it can stimulate walking and cycling. Another restriction of more sustainable mobility in the suburban neighbourhoods of Rotterdam is the financing of public transportation. It is expensive and only a limited budget is available. Therefore, not everything is feasible and smart choices have to be made.

A social challenge for more sustainable mobility in suburban neighbourhoods is transport poverty. Certain population groups do not have the (financial) means in order to make use of sustainable

mobility. Besides, certain suburban neighbourhoods are not connected well to the public transportation network which fosters transport poverty as well. Another social challenge are the habits and behaviour of the residents of suburban neighbourhoods. A high car dependency and car use is prevalent in these neighbourhoods. A sustainable behavioural change is needed. Within this, the municipality has a key role to play. It can be concluded again that communication with the residents is important, people have to be made aware of the alternatives. Mobility Management is seen as a means for this. Yet, different target groups have to be approached in different ways. In addition, the municipality could use steering instruments in order to make car use less attractive. For instance, introducing lower parking standards or other financial incentives which make car use more expensive. Besides, car use should be made more sustainable and this should be stimulated by the municipality, with for instance the provision of charging stations or taking measures. The car use in suburban neighbourhoods will never completely disappear and this should be accepted by the municipality. The provision of safe and good bicycle parking facilities around public transportation stations is also seen as important in order to stimulate the use of sustainable mobility. This is especially required around the metro stations of suburban neighbourhoods. Connected to this, are direct and good cycle (and walk) connections to and from these stations, i.e. first and last mile transport. This emphasises the importance and opportunities of multimodal mobility in suburban neighbourhoods. In order to guarantee multimodal mobility, quick transfer and bicycle parking facilities at metro stations are required.

Other opportunities for more sustainable mobility in suburban neighbourhoods can be identified as well. First of all, new mobility systems such as Mobility as a Service (MaaS), ‘shared systems’, last and first mile transport, and automatic vehicles are seen as opportunities. MaaS is about planning multimodal with one platform. ‘Shared systems’ as shared bicycles and shared cars are seen as opportunities in suburban neighbourhoods. Shared bicycles have also potential for the first and last mile transport in these neighbourhoods, especially at metro stations. These should be available at all metro and train stations. Automatic vehicles are seen as promising in suburban neighbourhoods since these neighbourhoods have a lot of space. Yet, safety issues and the current infrastructure are a challenge for automatic vehicles. These new mobility systems should make the use of sustainable mobility more convenient and more attractive. Besides, it is argued that these systems have to be linked to each other in order to reach an even more sustainable system. However, the impact of these new mobility systems is uncertain yet. The implementation remains challenging, and it is unclear how it should be organised and how it will be accepted by the public. Finally, the metro has the highest quality of the public transportation network of Rotterdam, which also applies to the suburban neighbourhoods of Prins Alexander. Therefore, it is stated that the characteristics of the quality of the metro should be adopted in other suburban neighbourhoods.

In order to reach more sustainable mobility in suburban neighbourhoods, it is stated that a mix of measures required. A policy and a spatial vision are required which are area-oriented as well. The main task of each area has to be appointed. Besides, mobility is also not an end in itself, but should be used for other tasks the municipality is facing.

### 5.2.3 Current Policy Rotterdam on Smart Suburban Growth

In Rotterdam, the focus of densification has traditionally been on the inner city, which started with the City Vision of Rotterdam. Densification of the inner city is seen as successful. The inner city has become more liveable and attractive. However, because of the growing housing challenge in Rotterdam and the demand for (centre) urban living environments, it can be concluded that densification in the suburban neighbourhoods is required and unavoidable. Potential densification locations in the suburban neighbourhoods have to be explored and must be used optimally. It is stated in the Environmental Vision as well that the scope needs to be broadened. When looking at the suburban neighbourhoods of Prins Alexander, nowadays, a lot of market initiatives can be facilitated by the municipality. However, this is

not enough for densification, the municipality has to contribute to the realisation of densification with programmes as well. Besides, the Urban Traffic Plan and the Public Transportation Vision are both focussing on sustainable mobility in the suburban neighbourhoods. However, it can be concluded that there is still much to achieve in terms of sustainable mobility and sustainable connections within and between the suburban neighbourhoods and to the inner city. The suburban neighbourhoods are often designed for car use and a high car dependency is prevalent among the residents. Thus, it can be stated that, for both densification and sustainable mobility, still many opportunities are left in suburban neighbourhoods in order to achieve a sustainable development of these neighbourhoods and the city. The municipality has a key role to play in this.

As mentioned above, linking densification to public transportation nodes is seen as most promising in achieving a sustainable development of suburban neighbourhoods. The existing infrastructure makes it possible to densify, and densification around public transportation could stimulate the use of sustainable mobility. The combination of densification and sustainable mobility is seen as transit-oriented development (TOD). In the city of Rotterdam, there seems to be increasing support for TOD from the government and politics, especially for in suburban neighbourhoods. TOD in suburban neighbourhoods makes it possible to keep it compact and to increase the frequency of the mobility system which makes it more attractive to use this mobility system. It can decrease the car dependency. Densification around these nodes could be attractive for people, because of the availability of public transportation. Besides, it can lead to support for facilities and mixed-use development. The current parking policy of the municipality could be an opportunity for densification around public transportation nodes with the introduction of lower parking standards. Furthermore, the municipality started recently with redevelopment of the Alexander node which can be seen as TOD. This makes it possible to improve the attractiveness of the public space of the station area. However, according to the planners, it is important to add housing to the node for more liveability. Even though there is more support for TOD in the suburban neighbourhoods of Rotterdam, the municipality has no specific policy which focusses on this development.

#### 5.2.4 Future Role Municipality for Smart Suburban Growth

The combination of densification and sustainable mobility, i.e. transit-oriented development, seems promising for sustainable development of suburban neighbourhoods. However, it can be concluded that a more integrated approach for densification and sustainable mobility of the municipality is necessary. The opportunities for densification and sustainable mobility in suburban neighbourhoods are still insufficiently utilised. Densification and sustainable mobility have to be considered integrally and have to contribute to other tasks the municipality is facing. Therefore, more integrated urban planning is required. It can be concluded that this requires a shift in thinking within the organisation of the municipality, from sectoral to integrated thinking, which requires sustained effort. The Environmental Vision is just a start of shifting to integrated thinking, but is still too abstract. Besides, it can be concluded that a long-term perspective for each suburban neighbourhood is missing. The municipality is seen as responsible for determining the direction for the long term. There is need for a spatial vision of each specific suburban neighbourhood. It can be concluded that area-based approaches are important. It is necessary that the municipality makes trade-offs and 'smart' decisions per suburban neighbourhood. The current situation and spatial qualities of each suburban neighbourhood have to be analysed well. This also applies to the needs and habits of the residents in these areas. Participation is important and a good balance between green and building should be achieved. Besides, the opportunities for densification and sustainable mobility differ per suburban neighbourhood. These arguments show the need for concrete area-oriented visions. This could be helpful to explore opportunities, to overcome challenges and to convince the existing residents that the development is necessary and beneficial for them. In addition, the future of both densification and sustainable mobility is uncertain. Therefore, the

municipality should work with scenario studies in the suburban neighbourhoods. This was an important outcome of the focus group as well.

Moreover, it is argued that establishing visions and policy is not enough. The municipality itself has to contribute to the realisation of densification and sustainable mobility in suburban neighbourhoods as well. This can be achieved by adapting law and regulations and by the use of steering instruments which makes it possible to influence as a municipality.

After answering the subquestions, the following brief summary will provide an answer to the research question as a whole: *'How could the municipality of Rotterdam mobilise synergies between suburban densification and sustainable mobility and thus contribute to smart suburban growth?'*

Based on the research, it can be concluded that when densification and sustainable mobility are integrated in concrete spatial visions for suburban neighbourhoods, smart urban growth can contribute to a sustainable development of these neighbourhoods and the city as a whole. This conclusion of the research confirms the first hypothesis that, within the municipal organisation, an integrated urban planning for sustainable redevelopment of suburban neighbourhoods is needed, which is stated in part 2.6. However, it is seen as important that these spatial visions are area-based. It is required to explore the opportunities and challenges of densification and sustainable mobility per suburban neighbourhood. Within this, it is necessary to analyse the spatial qualities and needs of the residents of each suburban neighbourhood properly. Such aspects are challenging with regard to densification and makes participation important. Besides, it can be concluded that the municipality has to stimulate the attractiveness of the sustainable alternatives to car use and sustainable behavioural change among the residents. The recognition of these challenges confirms the second hypothesis that social and environmental aspects form a challenge for densification. Transit-oriented development, i.e. node development, is seen as most promising for smart urban growth in suburban neighbourhoods, which confirms the third hypothesis. Finally, the municipality is seen as responsible for establishing a long-term perspective for the suburban neighbourhoods which includes the opportunities and benefits in order to promote smart growth in the future in the suburban neighbourhoods of Rotterdam.

### 5.3 Recommendations

After answering the research question, it is possible to formulate specific recommendations for the policy of the municipality of Rotterdam. These recommendations are completely based on the empirical results and the literature study of this research. The recommendations are interrelated, shown in figure 33, since they all apply to the urban planning of the municipality of Rotterdam. After the recommendations for the municipality of Rotterdam, recommendations for further research are provided as well.

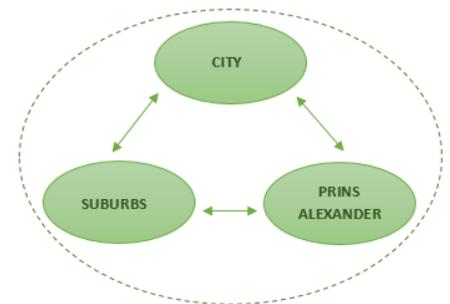


Figure 33: Interrelated recommendations

#### 5.3.1 Policy

- *Provide more integrated urban planning which requires a shift in thinking within the organisation of the municipality.*

Densification and sustainable mobility are interdependent and should be implemented together. Besides, densification and sustainable mobility should be used to achieve other tasks the municipality is facing. When densification and sustainable mobility are integrated in concrete plans, this can contribute to sustainable redevelopment of the suburban neighbourhoods. Better communication between urban planning and mobility planning is required. Therefore, a shift in thinking is needed within the organisation of the municipality, namely from sectoral to integrated thinking. The different departments of the municipality have to cooperate and tasks must be tackled together. The municipality is aware of this necessary shift towards integrated

thinking. The Environmental Vision is a small start of this shift. However, this vision is still too abstract. The intentions of integrated thinking have to be translated into practice. This requires a long breath from the municipal organisation.

- *Provide area-based spatial visions per suburban neighbourhood with a long-term perspective.*  
For each suburban neighbourhood, a spatial vision should be developed since each neighbourhood has different opportunities and challenges. It is questionable if it is desirable to densify in every suburban neighbourhood. It might be the case that one suburban neighbourhood might be more suitable for densification and sustainable mobility measures than the other. For instance, it is not in every suburban neighbourhood possible to densify around public transportation nodes or sub centres, because these facilities are not available in every neighbourhood. Furthermore, the preservation of green living environments could be more important in a certain suburban neighbourhood than in another suburban neighbourhood. Therefore, the opportunities and challenges of each suburban neighbourhood need to be analysed and the municipality has to make considerations per neighbourhood. Linked to this is the need for a long-term perspective for each suburban neighbourhood. The municipality is seen as responsible for determining the direction for the long term. Long-term perspectives of the suburban neighbourhoods are missing.
  
- *Create scenario studies of the suburban neighbourhoods.*  
The future and speed of both densification and sustainable mobility are uncertain. Therefore, the municipality should make use of scenario studies per suburban neighbourhood.

### 5.3.2 Suburban Neighbourhoods

- *Analyse the spatial qualities of the suburban neighbourhoods.*  
The spatial qualities such as green, open space and quietness need to be preserved in suburban neighbourhoods when aiming for densification.
  
- *Utilise all the possible densification locations.*  
Opportunities for densification in suburban neighbourhoods are: around sub centres, in mono-functional areas, transforming old empty buildings to housing, around metro and train stations, and around existing infrastructure. It is important to note that the opportunities for densification differ per suburban neighbourhood. Therefore, the opportunities for densification in suburban neighbourhoods have to be explored separately. This is connected to the need for area-based spatial visions.
  
- *Analyse the needs of the residents of the suburban neighbourhoods.*  
There is need for green urban living environments. Not everyone wants to live in high densities. Within this, participation in the planning process is important. It is recommendable to analyse this social dimension more in-depth since this research is mainly focused on the policy dimension.
  
- *Connect densification to the current public transportation system in the suburban neighbourhoods (Transit-oriented development).*  
Node development is seen as most promising for densification in suburban neighbourhoods. This includes densification around metro and train stations. Alexander node is a good example of node development. The rest of the neighbourhoods in Prins Alexander are well connected to the metro system. This means that many opportunities for densification exist around public

transportation nodes in Prins Alexander. However, it has to be taken into account that certain other suburban neighbourhoods in Rotterdam are not well connected to the public transportation network of Rotterdam, like certain suburban neighbourhoods in the south of Rotterdam as IJsselmonde. This makes it impossible to densify around public transportation nodes. Therefore, it is recommendable that the focus of densification in these neighbourhoods should be on other opportunities. Furthermore, it is recommendable to analyse the opportunities for connecting these neighbourhoods to the public transportation network. The lack of public transportation leads to transport poverty of certain population groups. Finally, a specific vision for TOD should be established by the municipality.

- *Stimulate sustainable behavioural change of the residents.*  
In suburban neighbourhoods, a high car dependency is prevalent. The behaviour and habits of these residents need to change in order to achieve more sustainable mobility. Communication with residents and steering instruments are seen as important means for this wherein the municipality has a key role to play.
- *Make sure the alternatives as cycling, walking and public transportation are attractive.*  
Quality and attractiveness of cycling and walking routes and public transportation can make them attractive alternatives for car use. But the facilitation of good and safe bicycle parking (at stations) and charging stations for electric cars are required as well.
- *Take advantage of the opportunities of multimodal mobility.*  
Especially the combination bicycle and metro is seen as promising in the suburban neighbourhoods. This requires quick transfer to metro or train, good and safe bicycle parking facilities at metro and train stations, and direct and easy routes to and from these stations. However, not all suburban neighbourhoods have a metro system. Therefore, other options of multimodal mobility in these suburban neighbourhoods have to be explored, such as multimodal mobility with trams or buses.
- *Explore the impact of new mobility systems.*  
This includes Mobility as a Service, 'shared systems', first and last mile transport, and automatic vehicles. These systems are supposed to make travelling with public transportation as easy as possible. However, these systems are dealing with challenges and the future of these systems remains uncertain. How sustainable are they? How do these systems have to be organised? How will these systems be accepted and adopted by the public? This should be investigated.

### 5.3.3 Prins Alexander

- *Facilitate market initiatives.*  
These include the transformation of old office buildings or other empty buildings to housing. It is important that the municipality fulfils a facilitating role.
- *Densify around metro and train stations.*  
This is seen as very promising. Especially Alexander node is seen as promising, because of the combination of metro and train station. Densification around this node makes it possible to improve the attractiveness and liveability of the station area. Besides, the areas around all the other metro stations in Prins Alexander have potential for densification as well.

- *Densify around existing infrastructure, including the highways A20/A16*  
Around the infrastructure, space is left, especially the areas around the main roads within Prins Alexander and around the highways A20/A16 are seen as promising locations for densification. However, negative externalities, such as air and noise pollution, have to be taken into account.
- *Densify in mono-functional areas.*  
This is an opportunity for the mono-functional office area of the Alexander node. It can lead to mixed-use development which can lead to a more liveable and attractive public space. Another specific mono-functional area which needs to be densified is the zone at Kralingse Zoom. Mixed-use development is required, because this can improve the liveability and safety of the area, including for cyclists from Prins Alexander to the inner city.
- *Densify around sub centres in the neighbourhoods.*  
This has to occur together with redevelopment of these sub centres, because these areas are built-up areas. Specific potential sub centres for densification are the sub centres in Lage Land and Prinsenland, and in Ommoord such as Binnenhof and Hesseplaats which have a metro station as well. With the development of Nesselande, densification around the sub centre and metro station has already been implemented.
- *Preserve the green spatial qualities of the neighbourhoods.*  
The suburban neighbourhoods of Prins Alexander are characterised by open space and greenness. Especially the neighbourhood Ommoord is characterised and appreciated by its greenness. Densification should not be at the expense of these qualities.
- *Use densification for housing and population differentiation.*  
The municipality should retain the current population groups, which are especially elderly, and attract new population groups through different types of housing. There is especially a demand for medium-housing in Prins Alexander, including in the form of apartments for the elderly. Population differentiation could improve the quality and identity of a neighbourhood.
- *Increase the capacity and frequency of the metro.*  
The metro is the carrier of the network in Prins Alexander. Capacity is left and it is possible to increase the frequency of the metro which can make it more attractive to use the metro.
- *Take advantage of the opportunities of multimodal mobility (bicycle-metro).*  
Especially the combination bicycle and metro is promising in Prins Alexander since Prins Alexander has a good metro system. In order to stimulate this, direct and easy routes to and from the metro stations have to be realised as well as good and safe bicycle parking facilities at every metro station.
- *Analyse opportunities for first and last mile connections.*  
The first and last mile connections remain challenging in Prins Alexander. This is connected to multimodal mobility. Shared bicycles might be an opportunity, especially for the last mile, but this systems needs to be professionalised. The municipality has to explore how to organise the system.

- *Enable direct and sustainable bicycle routes to the inner city.*

Remove barriers, such as the golf court at the other side of the A16 and the mono-functional area located beneath the golf court. However, due to the existing functions in the area, considerations in these areas have to be made by the municipality.

#### 5.3.4 Further Research

In addition to recommendations for the policy of the municipality of Rotterdam, recommendations for further (academic) research can be made as well. The timeframe of this research did not allow to pay in-depth attention to all the relevant aspects of the research topic. Since this research focused generally on the suburban neighbourhoods of Rotterdam and only specifically on the suburban neighbourhoods of Prins Alexander, it is not possible to give specific recommendations for the other suburban neighbourhoods of Rotterdam. Therefore, it is recommendable to do further research into the specific opportunities and challenges for densification and sustainable mobility in the other suburban neighbourhoods of Rotterdam as well. This can lead to more area-based approaches and/or visions which are required as concluded in the research. Furthermore, it is recommendable to analyse the social dimension of densification and sustainable mobility in suburban neighbourhoods more in-depth since this research is mainly focused on the policy dimension. As a result, a clear idea about the specific needs and desires of the public is missing. Further research also applies to the economic dimension, because in both the theory as in the empirical results hardly any attention has been paid to this perspective. Moreover, suburban neighbourhoods of other cities which have the similar situation as the suburban neighbourhoods of Rotterdam could be explored and compared to the situation in Rotterdam. It might be possible to learn from these examples. For the 'academic world', it is recommendable to do further research on the social dimension of densification and sustainable mobility in suburban neighbourhoods since there is barely a focus on this social dimension in the academic literature. The research shows that this is an important aspect when aiming for densification and sustainable mobility in suburban neighbourhoods. In addition, it is recommendable to explore how densification could be implemented in suburban neighbourhoods without being a threat for the spatial and green qualities of these suburban neighbourhoods. Finally, the opportunities for the combination of densification and sustainable mobility (transit-oriented development) in suburban neighbourhoods should be further explored as well, because the research shows that this combination can be seen as promising for the suburban neighbourhoods.

### 5.4 Reflection

This part is a brief review of the research methods and process, including restrictions of the research. By the means of a methodological and theoretical reflection, the way in which this research can be added value is examined.

#### 5.4.1 Methodological Reflection

For the research qualitative research methods have been used, namely expert interviews and the study of policy documents. The use of qualitative research methods was an appropriate method for this research since it provided in-depth information and a reliable research. A quantitative research method would not have been a better alternative for a more reliable research. The reason for this is that a quantitative research method would have been too objective and would not have provided in-depth information.

This research is mainly based on the ten expert interviews which have been conducted. With the ten interviews, twelve experts have been interviewed. This has led to saturation of the data. With interviews, it is important as a researcher to be as objective and open as possible. Interviewees should not be steered with the interview questions. In addition, the choice for semi-structured interviews was a good choice since this has led to an 'open' interview with other questions emerging during the interview.

Yet, the topic list, which has been made for the interviews, was very useful since this provided a certain structure and guidance for the interview. This guidance kept the focus to the research topic and aim. However, a limitation of the research was that in some cases it was still difficult to stick to the interview topics. Certain interviewees were very willing to talk, also about things which were not related well to the research. Furthermore, still some degree of subjectivity among the interviewees occurred, but with the checklist and asking mainly the same questions to the interviewees, it has been tried to limit this problem.

The hardest part of conducting the interviews was making appointments with the experts. Some experts did not reply or it took a long time before they answered. Fortunately, approaching the experts has started on time, thus no time pressure arose. Eventually, every expert who was intended to interview, has been interviewed. However, these interviewed experts are just a part of the relevant actors of this research. Due to the limited time period of this research, it was not possible to interview all the relevant actors. Interviewing more and other relevant actors about the research topic can provide a more complete picture of how people think about densification and sustainable mobility in suburban neighbourhoods. Additional interviewees could be other experts, but also citizens or entrepreneurs.

Furthermore, conclusions and recommendations have been drawn based on the interview results and partly on the policy documents. However, a more comprehensive policy analysis of the municipality of Rotterdam would have been useful for more concrete and focused recommendations. A more comprehensive policy analysis could provide more insight into the actual laws and rules that play in Rotterdam regarding densification and sustainable mobility. Moreover, these recommendations only apply to the municipality of Rotterdam. The recommendations might be valuable for suburban neighbourhoods of other cities, but this is not sure and not examined. The focus of this research has been on the city of Rotterdam. Therefore, it is not possible to do generalised conclusions for all suburban neighbourhoods in the Netherlands. This shows that generalisability remained an issue for this research.

Another issue is validity. When reflecting at the conclusions, it is important to have a look at the validity of the research. 'Do I know what I wanted to know?' After collecting the data and the empirical analysis this has been achieved, the research question has been answered and the hypotheses have been confirmed. However, it is not possible yet to do specific recommendations for each suburban neighbourhood of Rotterdam. This could be examined with further research.

Reliability of the research is also important. Are the results of the research stable? When the research would be repeated, would the same results occur? It is possible that a deviation in the results will occur, when other experts, both from inside and outside the municipality, will be interviewed. Other experts could have a different opinion about densification and sustainable mobility in suburban neighbourhoods. Moreover, when the research would be done in another city of the Netherlands, the results could deviate as well. Suburban neighbourhoods of other cities are often in a different situation. Therefore, it might be possible that the opportunities and challenges for densification and sustainable mobility in the suburban neighbourhoods of another city will be completely different than those in Rotterdam. Besides, the policy of each city and/or municipality differs. Therefore, the view on densification and sustainable mobility in suburban neighbourhoods of experts of another city could differ as well.

Finally, ethical research is important as well. The privacy of the respondents have to be respected. Therefore, the rights of the respondents during and after the interview have been explained at the beginning of the interview, including their right of anonymity. Besides, it has been proposed to the respondents to send this research when it is finished in order to increase the transparency of the research.

When regarding the focus group, the attendance of the invited experts was disappointing. Around ten experts of the municipality were invited, but only three experts were able to attend. Even though the focus group was planned well on time and the agendas of the experts were checked, many experts had to cancel unfortunately. Therefore, no additional remarkable outcomes have been identified.

The focus group could have been a more valuable addition to the research when the attendance of experts would have been higher. A higher number of people in a focus group could lead to more interesting discussions and outcomes. Despite the expectation of the focus group was not met, it was not the most important data source for the research. It was just an addition to the other used research methods. Therefore, the results of the research are still reliable.

#### 5.4.2 Theoretical Reflection

The aim of the research was to examine how the municipality of Rotterdam can achieve a more sustainable redevelopment of suburban neighbourhoods by mobilising synergies between densification and sustainable urban mobility. This research examined whether and how both concepts of sustainable mobility and densification could reinforce each other. The interviews have been based on a large amount of academic literature. The literature study has been a sufficient base for the interviews. The concepts and findings in the theory provided a structure for the interviews and have been discussed in these interviews. A lot of similarities between the theory and empirical results could be identified regarding the concepts. However, several deviations between the theory and empirical results could be identified as well, as discussed in 5.1. Therefore, it can be stated that the literature study did not cover all the perspectives on the research topic. Besides, academic literature about the research topic in other cities or countries would have been valuable as well, because this makes it possible to compare.

Furthermore, based on the theory, it was concluded that the combination of densification and sustainable mobility leads to transit-oriented development. Because of this finding, transit-oriented development has been added as discussion point in the interviews as well. It seems to be that this was an interesting topic for the interviewees.

This research is scientifically relevant since the research has examined the opportunities and challenges of densification and sustainable mobility in suburban neighbourhoods. So far, the literature lacks a specific focus on these two processes in suburban neighbourhoods. However, the social relevance also appears to be very large, because the research resulted in a set of concrete recommendations for the municipality of Rotterdam.

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### Figures:

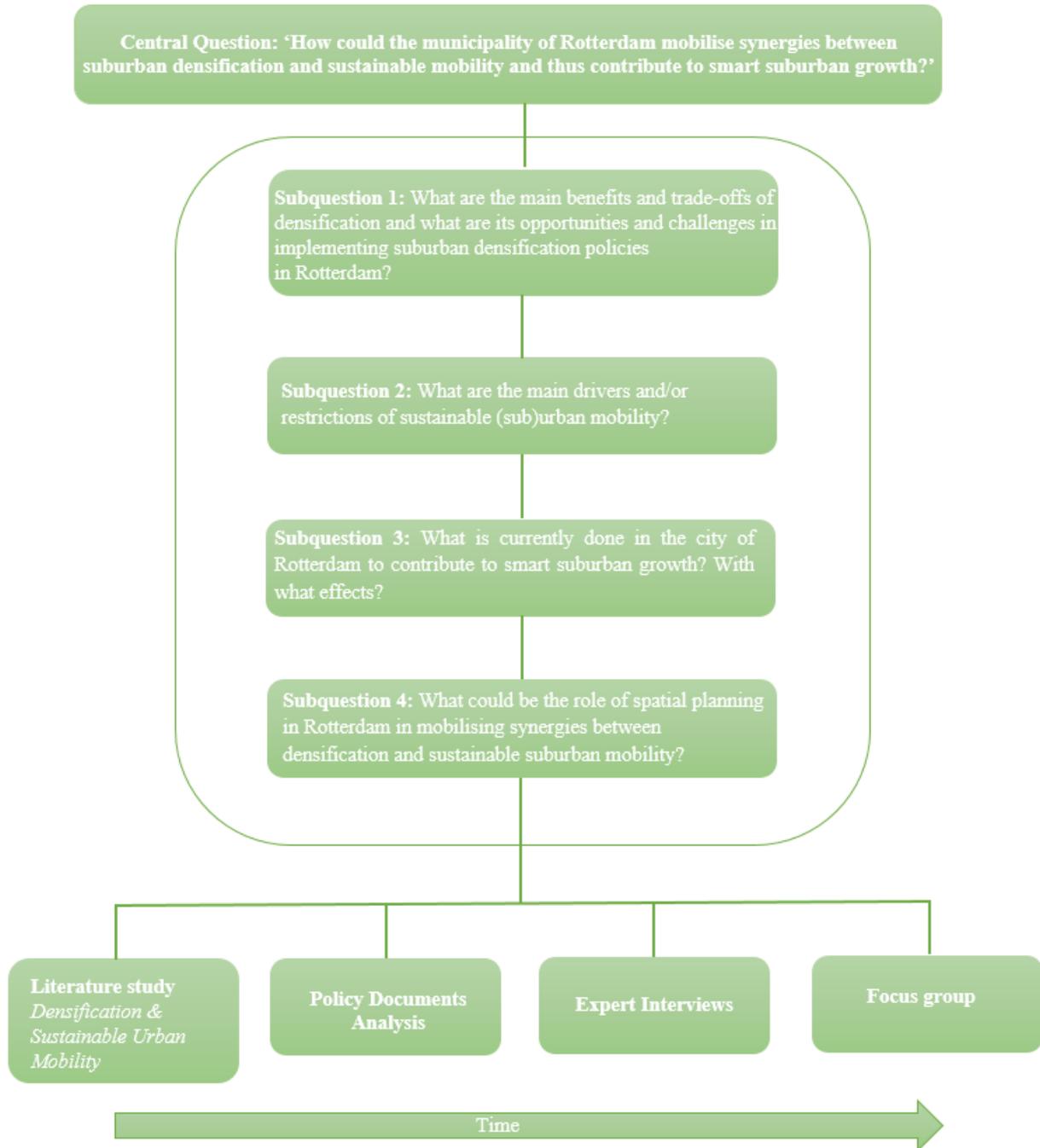
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All other figures, images and tables consist of own material.

## 7. Appendices

### 7.1 Research Structure



## 7.2 Topic List Interviews

<b>Densification</b>	<b>Sustainable Mobility</b>	<b>Transit-oriented development</b>
Perspective	Perspective	Perspective
Benefits - Trade-offs	Drivers - Restrictions	Benefits - Trade-offs
Opportunities - Challenges	Opportunities - Challenges	Opportunities - Challenges
Current policy municipality	Current policy municipality	Current policy municipality
Different scale levels	Different scale levels	Different scale levels
<i>The City of Rotterdam</i>	<i>The City of Rotterdam</i>	<i>The City of Rotterdam</i>
<i>Suburban neighbourhoods</i>	<i>Suburban neighbourhoods</i>	<i>Suburban neighbourhoods</i>
<i>Prins Alexander</i>	<i>Prins Alexander</i>	<i>Prins Alexander</i>
Mixed-use development	Multimodal mobility	Combination densification and sustainable mobility
Compactness	Urban design	Utilisation of public transportation
Greenness	Behaviour of the public	
Restructuring	Mobility barriers	
	<i>Inner city – suburbs</i>	
	<i>Between suburbs</i>	
	<i>Within suburbs</i>	
Perspective on future	Perspective on future	Perspective on future

### Interview guides

The different interview guides of the interviews are available by contacting the author:

E-Mail: [m.bakker11@students.uu.nl](mailto:m.bakker11@students.uu.nl)

## 7.3 Codebooks

### 7.3.1 Densification

<b>Benefits:</b>	
Ruimte, groen:	<ul style="list-style-type: none"> <li>- Ruimte en groen besparend</li> <li>- Bestaande ruimte verbeteren</li> <li>- Gebruiken voor betere buitenruimte</li> <li>- Aantrekkelijkere stad, wonen en leef kwaliteit</li> <li>- Duurzaam</li> </ul>
Mobiliteit:	<ul style="list-style-type: none"> <li>- Beperking mobiliteit = duurzaam</li> <li>- Aangewezen op fietsen en lopen</li> <li>- Minder energie verbruik (door voertuigen)</li> <li>- Energietransitie (en mobiliteitstransitie)</li> </ul>
Functiemenging:	<ul style="list-style-type: none"> <li>- Draagvlak voorzieningen → <i>maakt functiemenging mogelijk</i> <ul style="list-style-type: none"> <li>o Maatschappelijke voorzieningen</li> <li>o OV voorzieningen</li> <li>o Winkelvoorzieningen</li> </ul> </li> <li>- Mensen dichtbij activiteiten, nabijheid</li> <li>- Door functiemenging: <ul style="list-style-type: none"> <li>o Aantrekkelijker</li> <li>o Meer levendigheid, leef kwaliteit</li> <li>o Sociale veiligheid</li> </ul> </li> <li>- Functiemenging kan ook aanleiding zijn voor verdichting</li> <li>- Monofunctionele gebieden tegen gaan</li> </ul>
Sociaal:	<ul style="list-style-type: none"> <li>- Sociale duurzaamheid</li> <li>- Inrichting ruimte invloed gedrag burgers (<i>meer gebruik fietsen en lopen</i>)</li> <li>- Maakt mixen van groepen mogelijk, <b>differentiatie</b> (=belangrijk)</li> </ul>
Woningopgave:	<ul style="list-style-type: none"> <li>- Voorzien in woningopgave</li> <li>- Voorzien in vraag (centrum) stedelijke woonmilieus</li> <li>- Kans voor woningdifferentiatie</li> </ul>

<b>Trade-offs:</b>	
Ruimte, groen:	<ul style="list-style-type: none"> <li>- Gevaar voor ruimtelijke kwaliteit</li> <li>- Vraag naar groen stedelijke milieus</li> <li>- Elke plek heeft al een functie</li> <li>- Kans op extra druk op openbare ruimte</li> <li>- Toevoegen van meer woningen → meer auto's?</li> </ul>
Grondexploitatie:	<ul style="list-style-type: none"> <li>- Versnipperd grondbezit</li> <li>- Kostbaar</li> </ul>
Externe condities:	<ul style="list-style-type: none"> <li>- Geluidsaspecten, belemmeringen</li> <li>- Luchtkwaliteit</li> <li>- Milieuwetgeving</li> <li>- Veiligheidsaspecten</li> </ul>
Sociaal (sociale opgave)	<ul style="list-style-type: none"> <li>- Bereidheid burgers</li> <li>- Verschillende belangen:</li> </ul>

	<ul style="list-style-type: none"> <li>o Eigen belang bewoners</li> <li>- Meer behoefte aan overige functies</li> </ul>
Termijn	- Overgangperiode kan schuren

<b>Opportunities suburbs:</b>	
Alle kansen benutten:	<ul style="list-style-type: none"> <li>- Alle kansen benutten</li> <li>- Naar alle buitenwijken kijken</li> <li>- Verkenning in buitenwijken</li> <li>- Verdichting koppelen aan andere opgaven <i>'Verdichting is geen doel op zich'</i></li> <li>- Centrum stedelijk gebied uitbreiden (binnenstad raakt vol)</li> <li>- Voorzien in vraag centrum stedelijke woonmilieus</li> <li>- Goed voor oprijvende woningmarkt</li> </ul>
Waar liggen de kansen?/Gebieden met ruimte:	<ul style="list-style-type: none"> <li>- Rondom ov stations (trein en metro) → knooppuntontwikkeling</li> <li>- Rondom infrastructuur</li> <li>- Rondom snelweg zones (A16, A20)</li> <li>- Rondom subcentra (centrumgebieden van buitenwijken)</li> <li>- Stukjes groen zonder functie, betekenis</li> <li>- Lege voorzieningencomplexen</li> <li>- Monofunctionele gebieden → functie, voorzieningen menging</li> <li>- Rotterdam Zuid <ul style="list-style-type: none"> <li>o Nu verdunning</li> <li>o Oprijvende woningmarkt</li> <li>o Kan buitenwijken opliften!!!</li> </ul> </li> <li>- Merwevierhavens</li> <li>- Olievlekwerking V</li> </ul>
Wat biedt het voor de buitenwijken:	<ul style="list-style-type: none"> <li>- Kans voor woningdifferentiatie</li> <li>- Kans voor differentiatie groepen</li> <li>- Kans voor functiemenging</li> <li>- Kans om wijken op te liften/positieve impuls (op drijvende woningmarkt)</li> <li>- Bestaande groen meer opwaarderen</li> <li>- Duurzaam (verdichting staat gelijk aan duurzaamheid) (<i>zie voordelen den general</i>)</li> </ul>
Verschillende typen verdichting:	<ul style="list-style-type: none"> <li>- Containerbegrip</li> <li>- Niet alleen hoogbouw</li> <li>- Tussenschaal verdichten</li> </ul>
Sociaal:	<ul style="list-style-type: none"> <li>- Manier van verhaal brengen</li> <li>- Open plan proces vanaf begin</li> <li>- Mixen van groepen, differentiatie (=belangrijk)</li> <li>- Thuiswerken</li> </ul>
Wet- en regelgeving:	- Regelgeving verruimen om verdichting mogelijk te maken

<b>Challenges suburbs:</b>	
Ruimte:	<ul style="list-style-type: none"> <li>- Behoud ruimtelijke kwaliteit en karakter buitenwijken (Groen, rust en ruimte)</li> <li>- Differentiatie woonmilieus behouden</li> </ul>

	<ul style="list-style-type: none"> <li>○ Vraag naar groen stedelijke woonmilieus</li> <li>- Milieu en andere ruimtevragen in stad</li> <li>- Bestaande woningvoorraad</li> </ul>
Grondexploitatie:	<ul style="list-style-type: none"> <li>- Versnipperd grondbezit</li> <li>- Kostbaar</li> </ul>
Sociaal:	<ul style="list-style-type: none"> <li>- Kritische bewoners</li> <li>- Woningbehoefte</li> <li>- Weerstand</li> </ul>
Beleid:	<ul style="list-style-type: none"> <li>- Overgangperiode kan schuren</li> <li>- Maatwerk per gebied of wijk kijken</li> <li>- Weinig geoefend verkenning naorlogse structuren (= veel buitenwijken)</li> <li>- Afwegingen maken (zie node toekomst; grootste opgave buitenwijken)</li> </ul>

### 7.3.2 Sustainable Mobility

<b>Drivers:</b>	
Duurzaam:	<ul style="list-style-type: none"> <li>- Lopen en fietsen meest duurzaam (<i>Fietsvisie</i>)</li> <li>- Metro is makkelijk in gebruik (<i>OV-visie</i>)</li> <li>- Metro is drager van het netwerk</li> </ul>
Omgeving, ruimte:	<ul style="list-style-type: none"> <li>- Beperkt schade aan omgeving</li> <li>- Draagt bij aan leefbare stad</li> </ul>
Verdichting:	<ul style="list-style-type: none"> <li>- Maakt verdichting mogelijk</li> </ul>
Maatschappelijk:	<ul style="list-style-type: none"> <li>- Draagt bij aan maatschappelijke doelen</li> </ul>
Mobiliteitstransitie	-
Voertuigtechnologie:	<ul style="list-style-type: none"> <li>- Nieuwe vervoersconcepten</li> </ul>

<b>Opportunities general:</b>	
Mobiliteitstransitie:	<ul style="list-style-type: none"> <li>- Auto minder dominant <ul style="list-style-type: none"> <li>○ Inrichting ruimte</li> <li>○ (lagere) parkeernorm</li> </ul> </li> <li>- Autogebruik verduurzamen <ul style="list-style-type: none"> <li>○ Financiële prikkels</li> <li>○ Laadpalen faciliteren</li> <li>○ Stimuleringsmaatregelen, dwang</li> </ul> </li> <li>- OV en fiets als aantrekkelijk alternatief → Fietsen, lopen en ov als drager van mobiliteit in de stad</li> <li>- Alle systemen meer metro kwaliteit</li> <li>- Deelsystemen <ul style="list-style-type: none"> <li>○ Deelauto's</li> <li>○ Deelfietsen</li> <li>○ Koppeling verdichtingsopgave</li> <li>○ Acceptatie?</li> </ul> </li> <li>- Mobility as a Service (Smart Mobility) <ul style="list-style-type: none"> <li>○ Bijdrage ontwikkeling stad</li> <li>○ Deelsystemen</li> </ul> </li> </ul>

	<ul style="list-style-type: none"> <li>○ Multimodaliteit</li> <li>○ Uitdagingen</li> </ul>
Fiets en lopen:	<ul style="list-style-type: none"> <li>- Aantrekkelijkheid</li> <li>- Veiligheid</li> <li>- Comfort</li> <li>- Samenhang</li> <li>- Directheid</li> <li>- Kwaliteit infrastructuur, routes</li> <li>- Deelfietsen</li> <li>- Stimuleren, communicatie</li> <li>- Sociale gedeelte</li> <li>- Beleving</li> <li>- Goede en veilige fietsenstallingen</li> <li>- Per gebied belangrijkste opgave</li> </ul>
Openbaar vervoer:	<ul style="list-style-type: none"> <li>- Capaciteit vergroten</li> <li>- Zware stromen bundelen</li> <li>- Elektrische bussen</li> <li>- Oplaadvoorzieningen bussen</li> <li>- Automatisch rijden metro's</li> <li>- Parkeernormen, sturingsinstrument</li> </ul>
Technologische ontwikkelingen:	<ul style="list-style-type: none"> <li>- Automatische voertuigen (duurzamer)</li> <li>- Zelfrijdende auto's (duurzamer)</li> <li>- Deelsystemen</li> </ul>
Multimodale ontsluiting:	<ul style="list-style-type: none"> <li>- Gigantische potentie</li> <li>- Fietsen en ov</li> <li>- Fietsenstalling is vereiste</li> <li>- OV en/of deelfiets bij elk metrostation</li> <li>- Herkomst en aankomst station</li> <li>- Naadloze aansluiting ov</li> <li>- Veilige plek is vereiste</li> <li>- Snel op locatie kunnen komen, fietsroutes</li> <li>- First &amp; last mile vervoer (<i>MaaS speelt belangrijke rol</i>) <ul style="list-style-type: none"> <li>○ Fiets, ov/deelfiets</li> </ul> </li> </ul>
Infrastructuur:	<ul style="list-style-type: none"> <li>- Bestaande infrastructuur beter benutten <ul style="list-style-type: none"> <li>○ Gedrag</li> <li>○ Mobiliteitsdiensten</li> </ul> </li> <li>- Bundeling mobiliteitsstromen (<i>uitdaging first &amp; last mile vervoer</i>)</li> </ul>
Sociaal:	<ul style="list-style-type: none"> <li>- Wensen burgers</li> <li>- Gedrag burgers</li> <li>- Mensen op verschillende manieren benaderen</li> <li>- Mobiliteitsgeluk</li> <li>- Mobiliteitsmanagement (stimulans) <ul style="list-style-type: none"> <li>○ Bewoners aanpak</li> <li>○ Werkgevers aanpak</li> </ul> </li> <li>- Werkgevers <ul style="list-style-type: none"> <li>○ Marktplaats voor Mobiliteit</li> </ul> </li> <li>- Ontwikkelaars stimuleren, kortingen</li> <li>- Diversiteit <ul style="list-style-type: none"> <li>○ Op verschillende groepen richten (Verkeersonderneming)</li> </ul> </li> </ul>
	<ul style="list-style-type: none"> <li>- Goede, veilige fietsenstallingen <ul style="list-style-type: none"> <li>○ Fietsendiefstal</li> </ul> </li> </ul>

Oplaadvoorzieningen bussen

<b>Restrictions general:</b>	
Ruimte:	<ul style="list-style-type: none"> <li>- Verschillende ruimteclaims                             <ul style="list-style-type: none"> <li>o Langere reistijd ov</li> </ul> </li> <li>- Capaciteitsknelpunten</li> </ul>
Voorzieningen:	<ul style="list-style-type: none"> <li>- Goede, veilige fietsenstallingen                             <ul style="list-style-type: none"> <li>o Fietsendiefstal</li> </ul> </li> <li>- Oplaadvoorzieningen bussen</li> </ul>
Financiering:	<ul style="list-style-type: none"> <li>- Vervoeren is duur</li> <li>- Beperkt budget (RET)</li> </ul>
Veiligheidsissues:	<ul style="list-style-type: none"> <li>- Verschillende (fiets)snelheden</li> </ul>
Sociaal:	<ul style="list-style-type: none"> <li>- Draagvlak vinden, urgentie tonen klimaatopgave</li> <li>- (duurzame) Gedragsverandering</li> <li>- Mensen moeten het willen</li> </ul>
Toekomst:	<ul style="list-style-type: none"> <li>- Onzekere toekomst duurzame mobiliteit</li> <li>- First &amp; last mile                             <ul style="list-style-type: none"> <li>o Moet je dit organiseren of niet?</li> </ul> </li> <li>- Voor mobiliteitstransitie is beleid nodig</li> <li>- En snelheid mobiliteitstransitie is onzeker</li> </ul>
	<ul style="list-style-type: none"> <li>- Rotterdam van oorsprong autostad</li> </ul>

<b>Opportunities/drivers suburbs:</b>	
Mobiliteitstransitie:	<ul style="list-style-type: none"> <li>- OV en fiets als aantrekkelijk alternatief</li> <li>- Auto onaantrekkelijker maken                             <ul style="list-style-type: none"> <li>o Inrichting openbare ruimte</li> <li>o Lagere parkeernorm</li> <li>o (politiek gevoelig)</li> </ul> </li> <li>- Autogebruik verduurzamen                             <ul style="list-style-type: none"> <li>o Faciliteer elektrische auto</li> <li>o Financiële prikkels</li> </ul> </li> <li>- Deelsystemen</li> <li>- First and last mile vervoer</li> <li>- Ruimte voor automatisch rijden</li> <li>- Mobility as a Service</li> <li>- Mobiliteitshubs icm MaaS</li> <li>- Multimodale ontsluiting (ook voor first en last mile)</li> </ul>
Openbaar vervoer:	<ul style="list-style-type: none"> <li>- Kenmerken kwaliteit metro in andere wijken</li> <li>- Goed ov aanbod nodig                             <ul style="list-style-type: none"> <li>o Nu goede ov basis</li> </ul> </li> <li>- Hoog frequent ov nodig, alle richtingen</li> </ul>
Fietsen en lopen	<ul style="list-style-type: none"> <li>- Kwaliteit looproutes                             <ul style="list-style-type: none"> <li>o Ontwerp/design omgeving</li> <li>o Beleving speelt rol</li> </ul> </li> <li>- Kwaliteit fietsroutes                             <ul style="list-style-type: none"> <li>o Betere verbindingen</li> <li>o Sociaal veilig</li> <li>o Fietsbereikbaarheid</li> <li>o Snelfietsroutes</li> </ul> </li> </ul>

	- Elektrische fiets, speed pedallics
Sociaal:	- Mensen op verschillende manieren benaderen - Alternatief uitleggen aan mensen

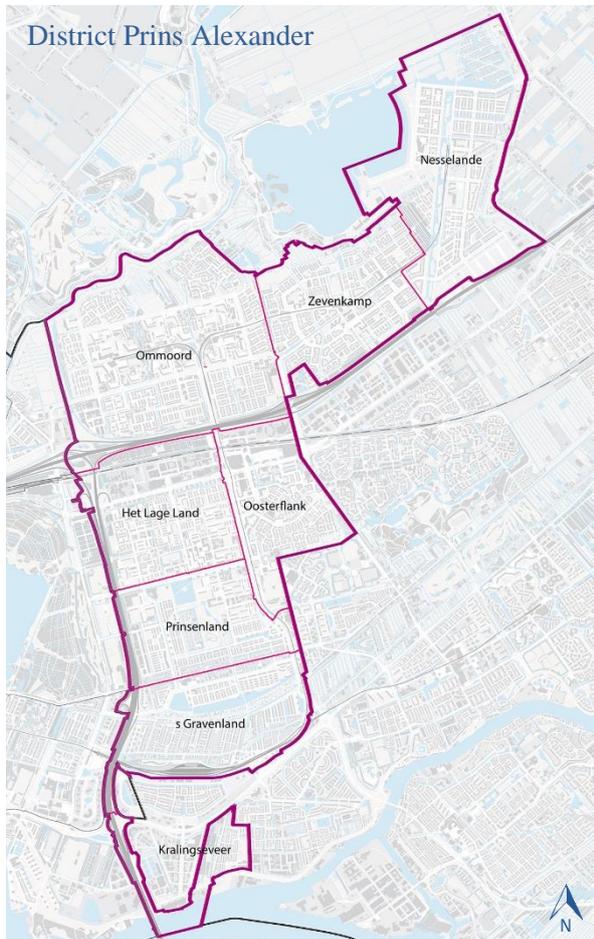
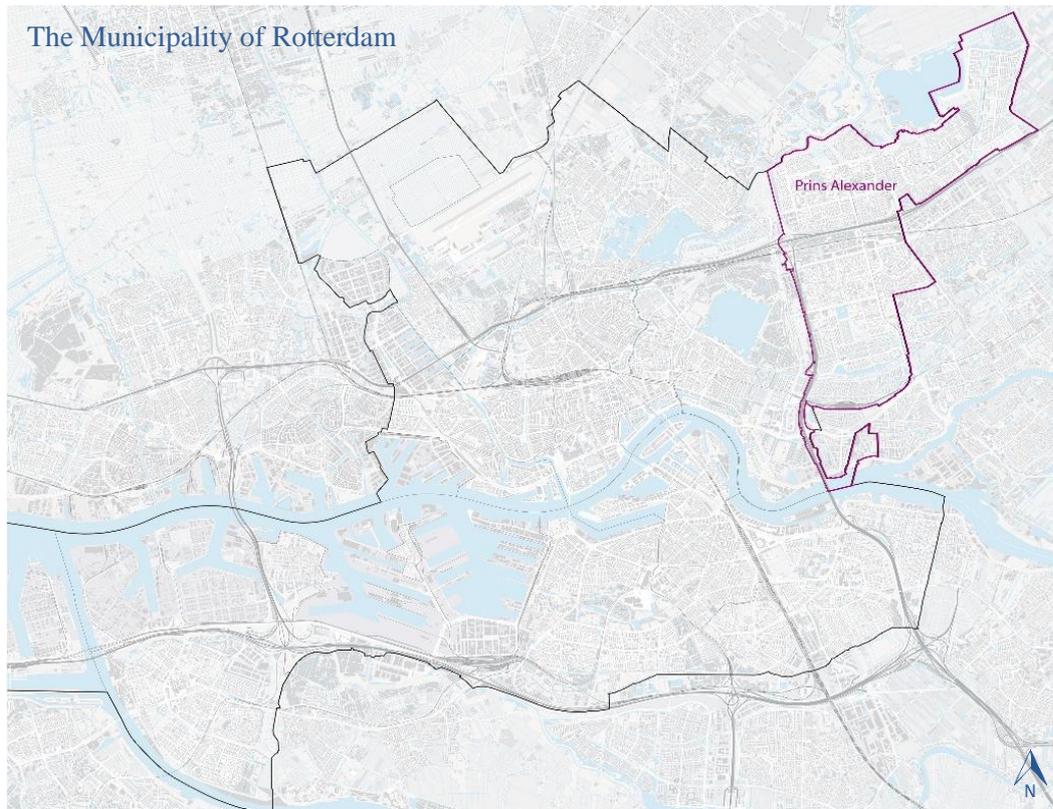
<b>Restrictions suburbs:</b>	
Ruimte:	- Bestaand DNA gebied is uitgangspunt - Lage dichtheid, minder draagvlak ov
Sociaal:	- Autoafhankelijkheid - Hoog auto bezit en gebruik - Weerstand bewoners - Gedragsverandering, omslag in denken nodig - Zit men op MaaS te wachten?
Vervoer	- OV barrières - Fiets barrières <ul style="list-style-type: none"> <li>o Lagere dichtheid in buitenwijken</li> <li>o Onveiligheid</li> <li>o Geen directe verbindingen</li> <li>o Vervoersarmoede</li> <li>o Gedrag, bereidheid</li> </ul> - Hindernis first & last mile - Knelpunten bij automatische voertuigen
	- Verschillen per wijk

### **Transcripts of the interviews**

The transcripts of the conducted interviews are available by contacting the author:

E-Mail: [m.bakker11@students.uu.nl](mailto:m.bakker11@students.uu.nl)

## 7.4 GIS maps



## 7.5 Time Table

<b>Date</b>	<b>What</b>	<b>Remarks</b>
07-02-2018	Return Day Master Thesis	13.00-17.00
12-02-2018	Start Internship Municipality of Rotterdam	
End of February	<b>Deadline Research Proposal +</b> Theoretical framework	
07-03-2017	Meeting with supervisor UU	Discussing research proposal + How to make expert interviews
March/April	Literature study Examination of policy documents Making appointments interviews Constructing interviews	
04-04-2018	Meeting with supervisor UU	Constructing expert interviews
18-04-2018	Second Return Day Master Thesis	09.00-17.00
25-04-2018	Meeting with supervisor	Analysis of interviews
April/May	Conducting expert interviews Literature study Examination of policy documents	
May	Analysis of interviews Results, Conclusion etc.	
28-05-2018	Focus group @ municipality	
June	Conclusion, Discussion, Reflection Recommendations	
08-06-2018	Meeting with supervisor UU (skype)	Results, conclusion
18-06-2018	Presentation research at municipality	
Mid-July	<b>Deadline Draft Version Thesis</b>	
29-06-2018	Third Return Day Master Thesis	13.00-17.00
29-06-2018	Completing/finishing Internship	
02-07-2018	Meeting meeting with supervisor UU	
End-July/Begin-August	<b>Finishing Master Thesis</b>	
08-10-2018	<b>Handing in Master Thesis</b>	

## 7.6 Overview of the Interviews

<b>Date</b>	<b>Time</b>	<b>Who</b>	<b>Function</b>	<b>Organisation</b>
11-04-2018	13.00-14.00	M. ten Kate	Head of planning department	Municipality of Rotterdam, <i>Urban Development</i>
		R. Rodrigo	Planner	<i>Cluster Space &amp; Living</i>
12-04-2018	9.30-10.30	J. de Bok	Urban planner	Municipality of Rotterdam <i>Urban Development</i>
13-04-2018	9.00-10.30	K. Nabielek	Researcher urban developments	Planbureau voor de Leefomgeving (PBL)
		A. Harbers	Researcher, urban planner	(Planning Agency for the Living Environment)
16-04-2018	13.30-14.30	J. van den Berg	Area developer	Municipality of Rotterdam <i>Urban Development</i>
16-04-2018	16.30-17.30	B. Christiaens	Bicycle coordinator	Municipality of Rotterdam <i>Urban Development</i> <i>Cluster Traffic &amp; Transport</i>
17-04-2018	13.30-14.15	S. Bekx	Policy adviser, Strategic planner	Municipality of Rotterdam <i>Urban Development</i> <i>Cluster Space and Living</i>
23-04-2018	14.00-15.00	A. Kamphuis	Senior traffic & transport department	Municipality of Rotterdam <i>Urban Development</i> <i>Cluster Traffic &amp; Transport</i>
26-04-2018	9.00-10.00	M. Balk	Transportation planner	Municipality of Rotterdam <i>Urban Development</i> <i>Cluster Traffic &amp; Transport</i>
01-05-2018	9.45-10.45	M. van de Leur		Verkeersonderneming (Traffic agency)
09-05-2018	14.00-14.45	E. Pelle		RET (Rotterdamse Elektrische Tram)
15-05-2018	16.00-16.30	I. Wilmink		TNO (Dutch organisation for applied-scientific research) (Call-conversation)

## 7.7 Policy Documents

<b>Policy Document</b>	<b>Organisation</b>	<b>Place</b>	<b>Period</b>
City Vision Rotterdam <i>Stadsvisie Rotterdam</i>	Municipality of Rotterdam	Rotterdam	2007-2030
Environmental Vision Rotterdam <i>Omgevingsvisie Rotterdam</i>	Municipality of Rotterdam	Rotterdam	2018+
Urban Traffic Plan Rotterdam <i>Stedelijk Verkeersplan Rotterdam</i>	Municipality of Rotterdam	Rotterdam	2017-2030+
Public Transportation Vision Rotterdam <i>OV-visie Rotterdam</i>	Municipality of Rotterdam	Rotterdam	2018-2040
Policy regulation parking standards for cars and bicycles in the municipality of Rotterdam <i>Parkeerbeleid Gemeente Rotterdam</i>	Municipality of Rotterdam	Rotterdam	2018
Bicycle Plan Rotterdam <i>Fietsplan Rotterdam</i>	Municipality of Rotterdam	Rotterdam	2016-2018
Area Plan Prins Alexander <i>Gebiedsplan Prins Alexander</i>	Municipality of Rotterdam	Rotterdam	2014-2018
Choose and share: Strategies for better coordination between urbanization and infrastructure <i>Kiezen en delen: Strategieën voor betere afstemmingtussen verstedelijking en infrastructuur</i>	Planning Agency for the Living Environment	The Hague	-